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DEVELOPMENT ECONOMICS – I

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SYLLABI-BOOK MAPPING TABLE
PAPER NO: MAECO501
DEVELOPMENT ECONOMICS

SYLLABI	**Mapping in Book**

Unit – I :CONCEPT OF ECONOMIC DEVELOPMENT

Economic Growth and Economic Development - Economic Development - Measurement of economic development problems - Obstacles to Economic Development – Technology - Kuzets' characteristics of Modern Economic Grash.

Unit – II : THEORIES OF UNDERDEVELOPMENT

Dualism and Backward Bending Supply Curve - Vicious Circle of Poverty - Nelson's Low Level Equilibrium Trap - Critical Minimum Effort - Paul Baran's Theory of Underdevelopment - Myrdal's Theory of Cumulative Causation.

UNIT- III : CLASSICAL, SCHUMPETERIAN AND MARXIAN THEORIES OF GROWTH

Adam Smith's theory of Growth - Multhus Theory of Growth - Ricardo's Theory of Growth - Schumpeter's Theory of Growth - Marxian theory of Reproduction.

UNIT-IV : NEO-CLASSICAL AND CAMBRIDGE MODELS OF ECONOMIC GROWTH

Harrods Model of Growth – Domars Mode of Growth - Solow Growth Model - Cambridge Model of growth (Joan Robinson)

UNIT – V : TECHNICAL CHANGE

Hicksian and Harrodian Versions of Neutral Technical Progress - Labour and capital Augmenting Technical progress (Harrod and Solow versions) - Disembodied and embodied Technical Progress - Overview of Endogenous growth theory - Growth under vintage capital model.

CONTENTS

UNIT-IV: NEO-CLASSICAL AND CAMBRIDGE MODELS OF ECONOMICGROWTH

UNIT – V: TECHNICAL CHANGE

INTRODUCTION OF THE BOOK

The economic development refers to the problems and challenges faced by the economics at the labour strata of development hierarchy. Right from Adam Smith to Karl Mark and Keynes the study of economic development has engrossed the attention of economists. Although before the 20th century the economists were mainly interested to understand the problems of Western European nations. It was only after the Second World War, the economists were shown their concern for the less developed countries and thereby formulate the theories and models of economic development and growth.

This book would examine the problems of economic development of underdeveloped countries. To understand the problems of economic development of LDCs countries the book is divided into ten units-

In the very first unit, the book has elaborately discussed the concept of economic development, problems and measures, obstacles and a model. In the second unit, we have discussed the factors responsible for the economic underdevelopment of underdeveloped countries and also suggested the policies to stimulate the pace of development.

In the third unit, the readers are expected to learn some theories put forward by the Classical Economists. In this chapter, we have discussed about growth theories of three famous classical economists i.e., Adam Smith, David Ricardo and Malthus. In this unit, we have also discussed Schumpeter's theory of innovation andthe Marxian theory of development.

In the forth unit the learners may acquaint themselves about Neo-Classical and Cambridge Models of Economic Growth. The Harrods Model of Growth, Domars Mode of Growth, Solow Growth Model and Cambridge Model of growth has elaborately conversed in the unit.

Indeed the technical progress is important for economic growth. In the fifth unit, we have discussed the importance of technical changes inthe economic development of underdeveloped countries.

The important theories and approached for the economic development of underdeveloped countries have been discussed in the sixth unit. We have broadly discussed Rodan's Theory of big push, Nurkse's Model of Balanced Growth, Unbalanced Growth, Hirschman's Strategy and Ranis –Fei Model.

In unit seventh, we have discussed the importance of human capital formation, the role of the market, the role of government and community in economic development.

The vicious circle of economic underdevelopment requires that scarce resources are allocated properly and efficiently. Pertinent to the vicious circle of economic underdevelopment in underdeveloped countries, unit eight discusses the need for Investment Criteria in Developing Countries, Rate of Turnover Criterion, Social Marginal Productivity Criterion, Marginal Per Capita Re-investment Criterion, Time Series Criterion and Little-Mirrlees Cost-Benefit analysis of Projects.

Proper planning is utmost necessary in underdeveloped countries to take the path of economic development. As such, the unit ninth minutely discussed the importance of proper planning in LDCs countries.

The last unit deals with the trade strategies of development. It also discusses the model of rent-seeking society and the impact of the institution on economic development. In the last few decades, there were rapid growths of foreign investment in various countries. So, the role of foreign investment and foreign aid in economic development is also discussed in this unit.

It is hoped that the students will find the book useful for learning.

UNIT-I

CONCEPT OF ECONOMIC DEVELOPMENT

Structure

1.0 Objectives

In this unit students are expected to know and learn about the concepts relating to various dimensions of economic growth and development.

- Economic growth and economic development
- Measurement of economic development:
- Problems in measures of development,
- human development index
- Obstacles to economic development: weak Property rights,
- low ability to create and adopt new technology,
- low levels of human and physical capital
- Kuznets' characteristics of modem economic growth.

1.1 Economic Growth and Economic Development

Economic growth is the sustained growth of per capita real income over a long period of time. Unlike macro-economic which deal with the short-cum behavior of the economy, the focus of Development Economics is the long run. Trade cycles are a common phenomenon in any growing economy. Income may increase over a number of years and then it may even fall for a few years. The figures a, b and c show the behavior of income per head (yp) over the different phases of the trade cycle.

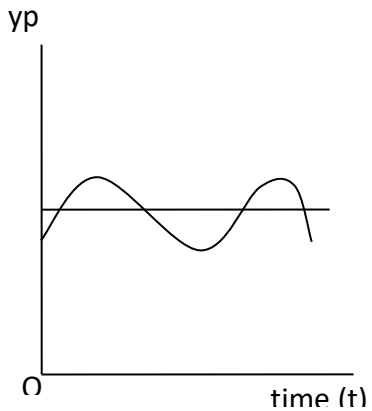

Figure 1(a)

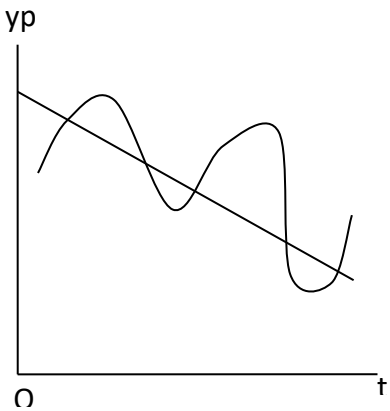

Figure 1(b)

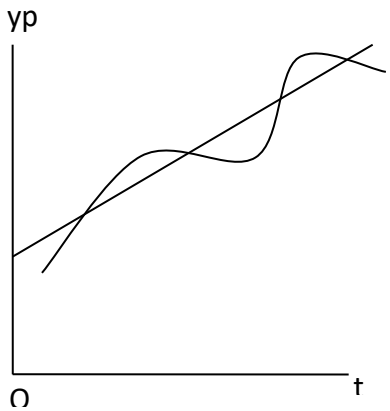

Figure 1 (c)

All the three figures shows the fluctuate nature of income. In figure (a) yp fluctuates about a flat trend line. This means the economy is not growing over the years. If our focus is only the short-cum, then we would find the economy either expanding or contracting. But a trend line only gives the picture relevant to the study of economic growth.

Figure (b) shows an economy whose per capita income fluctuates about a line which is downward sloping. This line represents the economic growth that is negative. The long run per capita income displayed in figure c is increasing. In the short run there are fluctuations, income rises in the upward place of the trade cycle and then it falls in the downward phase. However, the fluctuation of income per head occurs around a trend line which is upward-rising. This upward-rising trend line covering phases of trade cycle is indicative of economic growth.

The growth of per capita income is sustained in the long-run by the interplay of a number of factors of which the most crucial one is technological progress. The line of technological progress has especially been in the initial stage of development, the industrial sector. The growing industries absorb more and more workers from the low productive traditional sectors. So the concomitants development of industrialization is urbanization and

the expansion of various term-serving activities. Another characteristic of economic growth is sustained growth in population. It is the growing population that meets the growing demand for man power.

The relationship between the growth of income per head and growth of population (gp) is:

gyp = gy –gp, where gyp is the rate of growth of income per head and gy is the growth of income. One basic characteristic of economic growth is that in a growing economy population growth is usually positive and gy>gp, the relation paving the way for the growth of income per head.

1.2 Economic Development

When economic growth continues long and brings about deeper changes not only in the economy but also in the society. There is economic development. The changes occur in the social realm slowly. Mere economic growth cannot bring much social changes. It is the spread of education, urbanization and industrialization that tends to reduce the relative importance of ascribed status and enhance that of the achieved status of an individual in the social hierarchy. In the pre industrial society a person inherits the social status of her parents. There is what is called social reproduction. This is shown below:

Period I	Period II
Social category	Social category
I	I
II	II
III	III

In the traditional society the children of the people belonging to the first category occupy the first category by virtue of their birth. The status is a birth right. This situation is social reproduction, common in pre-industrial or rural society. With the industrialization, urbanization, and spread of modern education especially scientific and technical education there is what is called social transformation or development. This occurs through the decay of ascribed status in society and rising importance of ‘achieved’ status. People belonging to the lowest category can through merit rise to the highest category. In such a situation status depends on the individual’s own capability, not the status of his caste, class or any other ascribed status attribute. In short sustained economic growth occupied with social change or

transformation is what is called economic development, a long term process experiences, to date, only by a very few centuries of Asia such as Japan, Singapore, etc.

1.3 Measurement of economic development problems

Economic development is a complex process involving the changes in a large number of variables, a few of which are quantitative and most of them are qualitative. In general, qualitative variables have different dimension and so they cannot be added together. A part from this, the qualitative variables cannot be added to the quantitative variables. These problems stand in the way of finding a singular measure of economic development.

Because of its encompassing other quantitative and qualitative variables, to date it has not been possible to find out a singular measure of economic development. Some economists, belonging mainly to neoclassical school tend to accept the centrality of income as the measure. Centrality does not mean singularity; the role of non-income factors cannot be neglected. Moreover, income is not an object which is intrinsically valuable. It carries largely instrumental value it is the means by which the intrinsically valuable objects can be made available.

The absence of a proper measure of economic development led to the search for a measure with more acceptability that the hitherto formulated ones. This led to the formulation of the paradigm of human development and its quantitative measure called Human Development Index (HDI). The focus is on the determination of ultimate goals of development an identification of the instruments and made of their operation to achieve the specific targets. The relation between goals and the instruments to achieve then is illustrated in Note.

The ultimate goal of all human endeavors is the enhancement of their welfare. The challenge is to identify ways and means to achieve maximum possible human welfare. Human Development Paradigm was formulated to determine the basic goals of development and the means of their achievement. There is no absolute measure of human development, there is only relative measure. This measure called Human Development Index (HDI).

Human Development has three components: health, education and income, all of them carrying the same relative weight; namely $\frac{1}{3}$. Health is measured by life expectancy at birth. The maximum and minimum values of life expectancy at birth are taken into consideration in order to find out the dimension index of health. This is done by the formula;

Dimension index of health = $\frac{L^0o(a)\_L^0o(me)}{L^0o(ma)\_L^0o(me)}$

Where $L^0_o(a)$ is the actual life expectancy at birth of the country being studied
$L^0_o(me)$ is the minimum life expectancy at birth observed in the world.
$L^0_o(ma)$ is the maximum life expectancy at birth observed in any country of the world.

Dimension index of health varies from 0 to 1. In calculating education index mean years of schooling and expected years of schooling are taken into consideration. In income index calculation per capital income in purchasing power parity in dollar (PPP$) is taken. Lastly HDI is the geometric mean of health, education and income indices.

Human Development Paradigm is also concerned with the different types of inequality and poverty. In order to estimate the magnitude of inequality in different indicators, an inequality adjusted Human Development Index is constructed. It is based on inequality-adjusted life expectancy index, inequality adjusted education index and inequality adjusted income index.

Gender inequality is a problem found not only in poor countries but also in an attenuated form, in developed countries. However, the inequality is an acute problem in many developing counties including India. The components of Gender Inequality Index show the magnitude of inequality in Health, empowerment and labor market. Lastly, Multidimensional Poverty Index is constructed by incorporating status of nutrition, child mortality, schooling and the standard of living.

Position of India in Human Development Index in 2011 among 187 countries is 134. India belongs to the group of countries having a medium range of human development. India's position in 2006 was 135. So even a period of five years India's position among all the countries of the world improved by one rank. India's condition in human development still remains far from satisfactory.

1.4 Obstacles to Economic Development

A poor country faces a number of obstacles to its path of economic development. All the poor countries do not encounter the same problems. However, there are some obstacles common to all the developing countries. These are :

1. Low rate of savings: In general poor countries have a low level of income. So the ability of these countries to save a significant part of their income for accumulation of capital is low. Ragnar Nurkse (1953) used the low rate of savings to develop his theory of vicious circle of poverty. This circle is vicious because it behaves like a trap from which a poor country finds it very difficult to come out. The argument is very simple. A low level of income leads to a low ability to save. A low level of saving means a low level of investment. When the level of income is very low, a poor country can at least save. The amount which is only enough to make the investment to compensate the depreciation of existing capital stock. Inability to make any new net investment leads to the stagnation of income. This completes the vicious circle.

It is necessary to make an appraisal of the vicious circle of poverty. In the first place if low income is responsible for continuation of low income through vicious circle of low saving and investment then a good number of countries which are once poor could not now become rich. Secondly the hypothesis of vicious circle is based on the restrictive assumption of market imperfections especially the capital market. A poor country has, by definition, a low income and investible surplus. Moreover, the capital endowment of a poor country is low. A low level of capital means its high marginal productivity. On the other hand many developing countries including India have abundant labour. So it means a poor country has a low marginal productivity of labour and hence a low wage rate and a high marginal productivity of capital. So, in general capital would have a tendency to flow towards the poor areas from the rich areas. The opposite would happen in case of labour.

This point can be further illustrated by the internal flow of capital in India. It is a vast country with some of its areas having a strong industrial and modern service that is IT sector. One can mention rational capital region, Mumbai-Pun belt, Bangalure, Hyderabad, Chennai and Ahmedabad, Vadodara region. If these areas are compared with Northern and East India, largely Bihar, West Bengal and North India, one can see contrast. Wage rate in these poor areas is low. The rate of industrialization is also low. Capital is not flowing to their capital-scarce area from the capital-rich parts of the country. Rather the circulating capital has a tendency to move towards the capital-rich areas from the poorer parts of the country.

This compels us to look into the more basic issues of under development the true obstacles to economic development. These obstacles are called institutional factors which are inseparably related to the cultural mores and ethos of the people and

therefore these obstacles cannot be removed by external factors. An only internal need of the society, more properly the operational necessity, tends to change the factors, called the institutions conditioning the economic behavior.

A very important institutional obstacle comes from weak property rights. In all developed countries the property rights are strong and in many poor countries the property rights are weak. Even in the same country the strength of property rights may vary from region to region. Invariably the urban property rights in a poor country are stronger than the rural property rights.

An inseparable part, more appropriately, the vital part of property rights is rule of law and effective contract-enforcement mechanism. In the developed countries the contract enforcement mechanism is very strong. It, of course depends on the strength of the legal personality of the people. A formal promise made by a legal person must be observed by him/her. If the promise is not kept by him/her, he/she is liable to punishment.

A fundamental problem in the developing countries is the weakness in the administration of justice and ultimately it is this weakness that stands in the way of investible resources flowing to the poor areas. The problem of low investment cannot be removed without strengthening the property rights regime of the poor countries.

1.5 Technology

Economic development is a creative process. The creative element is not revealed in what Schumpeter called invention-innovation and diffusion of new technology. UK was the threaten of first industrial revolution. This small county composed of Islands was empowered by the new technology so much that it established the empire covering parts of all continents except one, Australia, which was entirely under British control. The new technology gives new energy and power that propels a country to a higher level of development. So the force of development flows from the creative energy of the people who tend to improve the technique of their production.

Many developing societies can create neither new technology nor adopt new technology. They are so much engrossed in their own old technology that they find it very difficult to adopt new technology. Two factors are responsible for this. One is low level of human capital and the other is deficiency of physical capital of these two, human capital is more important than physical capital.

In the whole spectrum of development, the human capital plays the more crucial role. But human capital alone is not enough. For its better performance it requires the physical capital. In fact the productivity of human capital depends on the level of physical capital. When the amount of physical capital is high, the productivity of human capital is also high. So this complementary relationship demands emphasis on investment in both physical and human capital.

1.6 Kuznets' characteristics of Modern Economic Growth

Modern economic growth has some fundamental characteristics. Professor Kuznets has isolated six of these characteristics. These six characteristics are common to all the developed countries:

1. **Growth of per capita output and population**: Modern economic growth has been accompanied the growth of population. Before industrial revolution in UK, the population growth was not high in that country. In India the year 1921 is called the demographic great divide. Before 1921 the population of India was growing with fluctuation. For example, the decade 1911-1921 witnessed the decrease of Indian population. Only after 1921 the population of India has been increasing without any fall. Like the growth of population, modern economic growth is characterized by the positive growth of per capita income.
2. **Growth of total factor productivity**: Economic growth is not limited to the growth of only labour productivity. It is also associated with the growth of total factor productivity which means the rise in overall efficiency in production.
3. **Structural transformation**: The journey of modern economic growth began in steam powered ship – it was the steam engine which caused the first industrial revolution. This revolution made UK the 'workshop' of the world. Industrial sector became the most important sector of the economy, employing a significant segment of the labour force. In course of time industrial sector gave way to the tertiary sector shaped by inventive activities and different kinds of service activities.
4. **Social and ideological transformation**: Industrialization paved the way for urbanization. Urban society became radically different from the rural society which kept align at least some vestiges of traditional cultural practices. Urban society traced a new path unseen and unknown before. Urban society is considered western compared with the rural society. Ideological landscape of the urban industrial society is also different from that of the rural society.

5. International economic outreach Industrialization is accompanied with expanded relationship. This relationship is shaped by the need of industrial inputs and the sale of finished products. The large-scale industrial production facilities ensure a low cost of production; it demands expanded relationship in the international domain.
6. **Limited spread of economic growth**: Modern economic growth did not spread widely. Initially it was confined to Western Europe, North America, Japan, Australia and New Zealand. The vast areas of the world remained outside the net of modern economic growth and development. In recent years economic growth has been high in China, South Korea, Singapore, Eastern Europe and in oil rich West Asian countries. In spite of the recent spread, modern economic growth has not equally benefitted all countries.

APPENDIX

Note

1. The simplest way to illustrate the instruments-targets relation, we can consider the simple simultaneous equation. We started with one variable and one equation:

   $2x - 10 = 0$

   Here $x = 5$

   If we are to determine the values of 2 Unknowns, we need 2 equations which must be (i) independent and (ii) consistent. To illustrate this we take examples. If we are given

   $2x-y = 4$ --- (1)

   $x+2y = 6$ --- (e)

   We see that these two equations are independent and also consistent. Their solution : $x= 14/5$, $y=8/5$.

   If we are given

   $3x-y =4$ --- (3)

   $6x-2y = 8$ – (4)

   We see that equations (3) and (4) are not independent.

   By multiplying equation (3) by 2 we get equation (4).

   The next case shows the inconsistency between the given equation:

   $2x+y = 4$ --- (5)

   $2x-y = 4$ --- (6)

   Equation (6) is inconsistent with equation (5).

1.7 Questions

1. Distinguish between economic growth and economic development.
2. Discuss the various measures of human development and the problems relating to its measures.
3. Illustrate and explain Kuznet's characterization of economic development.

1.8 Key Word

Human Development Index : a measure to index human development

Property Right's : right over private property on the basis of excludability and contract enforcement

Measure : to quantify or rank according to a predefined scale

1.9 Suggested Reading

Thirwal, A.P., *Growth and Development*, Macmillan, London, 1999.

Meier, G, *Leading Issues in Economic Development*, Oxford University Press, New Delhi, 1990.

Higgins, B., *Economic Development*, W.W. Norton, New York, 1959.

Todaro, M.P., *Economic Development*, Longman, London, 1996.

UNIT-II

THEORIES OF UNDERDEVELOPMENT

Structure

2.0 Introduction

More than 150 member countries of United Nations constitute the developing and underdeveloped nations. However, there are diversities among those countries regarding the level of development. The nature and structure of their economies are also not homogeneous. The common characteristic of those countries is that their per capita income is low and they are unable to generate adequate economic surplus to sustain the development process. Economists and policy makers have been trying to analyse the factors responsible for their underdevelopment. They also try to give policies for development of such countries. This chapter discusses some of those theories.

2.1 Objective

In this unit the learners is expected to know and understand the various theories of underdevelopment. The unit deals ;

- Dualism and backward bending supply curve
- Vicious circle of poverty
- Nelson's low level equilibrium trap
- Leibenstein's critical minimum effort
- Paul Baran's theory of underdevelopment
- Myrdal's theory of cumulative causation.

2.2 Dualism and Backward Bending Supply Curve

J.K. Boeke was one of the pioneers of the distinctive theories that were applicable only to the underdeveloped countries. According to Boeke's theory of social dualism, in the developing countries two socio-economic systems exist. And these two systems could be easily distinguished from each other. In a dual society, one of the two social systems is more advanced imported, and has gained existence in the new environment. But the imported and advanced social system could not drive out the indigenous (that prevailed in the society before importing the advanced system) social system entirely. This results that neither of the two systems becomes general for the society as a whole. Thus, both the systems co-exists and hence termed as dual social system. Boeke termed the advanced imported social system as "Western System" and the indigenous system as "Eastern System". The west penetrates into the east, but it has not been able to absorb the east culturally and socially. Both the East and the West have their definite culture and a definite philosophy of life. Thus, Boeke defines social dualism as "clashing of an imported social system with an indigenous social system".

2.2.1 Characteristics of Dualistic Society

a) Overriding importance of social needs

The indigenous societies are influence more by social rather than economic needs. The eastern society gives greater importance social needs compared to western society. Due to the comparative primitive character of eastern society, there is overriding importance social needs. The more dependence of the society on social needs, lesser the societies' economic needs. In the eastern society the value of goods depends on its prestige value not on its value-in –use.

b) Limited needs

In the eastern society needs are limited compared to western societies. It is because the eastern societies are contended on what they produce for themselves. Economic motivation to produce more does not exist in eastern society or is very weak, because of the limited needs. Thus the developing countries have a backward sloping supply curve of labour.

c**) Accent of self-sufficiency**

In the developing countries, the indigenous sector does not have the motive to produce for profit. They produce for self-consumption. However, the modern sector in those economies produces for profit only.

d) Western theories are not applicable in eastern societies:

It is because the latter is a pre capitalist society and the former is a capitalist society. What is beneficial for western society are not applicable in the eastern society. Boeke therefore warns that "we shall not try to transplant the tender, delicate hothouse plants of western theories to tropical soil, where an early death awaits them."

e) Agriculture system

Mental changes in farmers are necessary for introduction of the western agriculture technologies. If not, an increase in wealth will result in growth of population. If western technology fails, the result will be huge indebtedness of the farm households.

2.2.2 Concept of Backward Bending Supply Curve

The eastern societies are characterized by a backward sloping supply curve. It is because of the limited human needs in the eastern societies. The ability to satisfy their limited wants increases as their wage increase since their demand for money is limited. It leads to a situation where a rise in wage induces workers to work less. This result in backward bending supply curve as shown in figure 2.1:

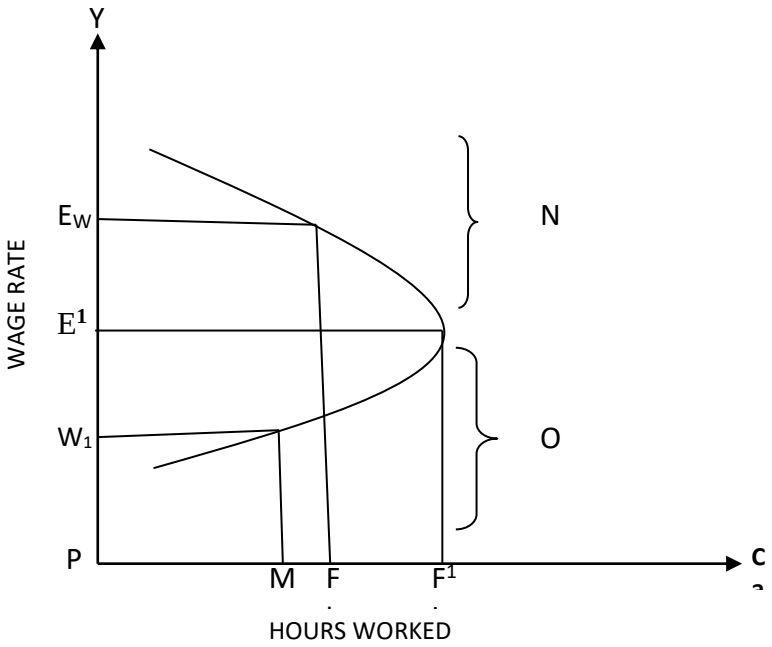

Figure 2.1: Backward sloping supply curve of labor

In Figure 2.1, X axis shows the hours worked and Y axis shows the wage rate. If wage rate increase from OW_1 to OW_2, the workers are willing to increase working hours from OL_1 to OL_2. But if the real wage further rise from OW_2 to OW_3, the number of hours offered for work would fall from OL_2 to OL_3. The utility to be gained from one extra hours of unpaid time is now greater than the utility to be gained from extra income that would be earned by working extra hour.

2.2.3 Policy Implication of Social Dualism

Boeke believes that western interference can only lead to impoverishment of the traditional eastern society rather than progress. Boeke was of the view that the best thing that the western society can do is to leave the underdeveloped countries alone. The western interference can worsen the underdeveloped countries in all activities viz. agriculture, industries, international trade etc. As discussed earlier, developing eastern pre-capitalist

agriculture through western technology may prove harmful. Boeke feels that the eastern societies are perfectly adapted to their environment. The highly capitalist forms of organization are very different from the eastern societies. This capitalist form of organization cannot be developed in eastern societies because the latter lacks the 'Intermediate' or 'The Middle Class'. If the eastern producers continue to imitate western methods, production cost will increase, making the eastern societies loss towards the highly capitalized and other western enterprises. Due to limited needs of the eastern societies, business motive of produce does not exist.

Thus, Boeke leads to a pessimist conclusion that the intervention of developed society has an adverse effect on the primitive society. Boeke concluded that the developed countries should leave the underdeveloped countries alone.

2.2.4 Criticism of Boeke's Theory of Social Dualism

However, Boeke's theory of social dualism has certain limitations. These are:

a) **Wants are not limited:** Wants of the people are not limited. Wants of the villagers are also so varied and expensive. An increase in income leads to a substantial expansion of homemade and imported luxury and semi-luxury consumer goods.

b) **Casual labor not unorganized**: According to Boeke eastern casual labour are unorganized, passive, silent and casual. It may be unorganized in traditional agriculture sector, but in tea, coffee and rubber plantation the trade union is the strongest.

c) **Labour not immobile**: Labour is mobile even in the developing countries. They move from village to village, and village to cities. Urban life offers many social and economic opportunities and attracts villagers. This results in huge number of migration from village to cities leading to congestion, unemployment, inadequate community facilities in the urban life.

d) **Dualism not a problem of eastern society alone**: Higgins argues that dualism exists not only in eastern societies but highly advance countries like Italy, Canada and the USA also have the characteristic of dualistic economy.

2.3 Vicious Circle of Poverty

The concept of 'Vicious Circle of Poverty' was developed by prof. Ragnar Nurkse. His book, "Problem of Capital Formation in underdeveloped Country", analysis the reason for underdevelopment of the countries. According to Nurkse, vicious circle refers to a circular constellation of force tending to act and react one another in such a way as to keep a

poor country in a state of poverty. According to doctrine of vicious circle in under developed countries level of income is low; which leads to low level of saving and investment. Low level of saving and investment leads to low productivity which again results in low income.

2.3.1 Causes of Vicious Circle

Economists have given many causes for the vicious circle of poverty. According to Nurkse, lack of capital formation is cause of vicious circle of poverty. According to Kindleberger, vicious circle is caused by the small size of market. The causes for vicious circle has been classified into three groups

a) Supply side of vicious circle

It shows that in underdeveloped countries productivity is so low that it is not enough for capital formation. The supply side of vicious circle is illustrated in figure 2.2

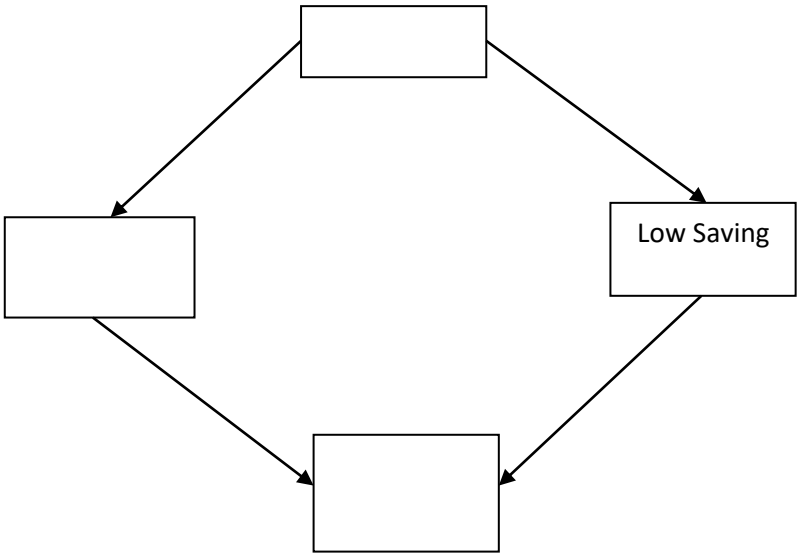

Figure 2.2: Supply Side Vicious Circle

The figure reflects why the underdeveloped countries are poor. Here countries poverty refers to low real income. Production is low due to low level of capital formation, and capital formation is low due low level of savings and investment. Again the reason for the low level of saving is the low level of income.

A man can save only when his real income exceeds consumption. In UDCs, society is divided into two groups viz. Rich and Poor. Majority of the farmers are poor. Their income is very low because they are engaged in subsistence farming. The productivity is low because of unskilled labour, disguised unemployment and immobility of labour. Under this situation a huge chunk of national product is spent on consumption purpose resulting in lack of saving,

investment and capital formation. The rich people may be in position to save but they spent their saving on luxury products and import goods. Thus, their demand does not enlarge size of the domestic market.

b) Demand Side of Vicious Poverty

According to Nurkse, on the demand side, the inducement of investment is low because of the small purchasing power of the people, which is due to low productivity. The level of productivity however, is the result of lower level of capital used in production. The extent of capital formation is low because of lower inducement to invest. The demand side vicious circle is illustrated in diagram 2.3

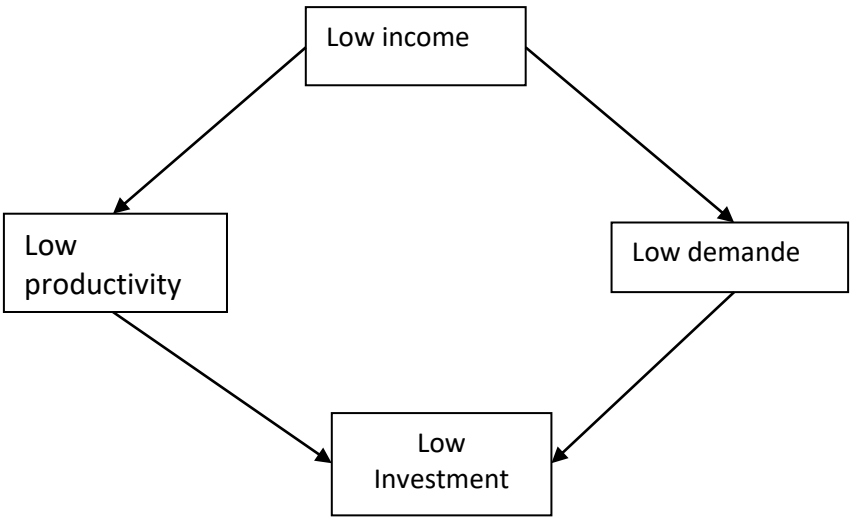

Figure 2.3: Demand Circle Vicious Poverty

In demand side of vicious circle, the main reason for poverty is the low level of demand. This consequently leads to a small market size which becomes as an obstacle in the path of induced investment. Thus, the investors do not establish industries on large scale. The productivity remains low and so the income.

c) Vicious Circle of Market Imperfections

The existence of market imperfection prevents optimum utilization and allocation of resources. This leads to underdevelopment which paves to economic backwardness. Human capital plays an important role in the development of natural resources. But in underdeveloped countries, because of lower level of knowledge and skills the resources remain underdeveloped and underutilized. Thus, the vicious circle of poverty is a result of

both sides i.e. supply of and demand for capital. As a result, capital formation remains low, leading to low productivity and low income. The economy is caught in a vicious circle of poverty which is mutually aggravating and it is very difficult to break it.

2.3.2 Solution for Vicious Circle of Poverty

I. Solution for supply side vicious circle

a) **Increase in saving**: Effort should be made to increase saving so as to increase investment for productive purpose. Expenditures on social ceremonies like marriage, funerals etc. should be curtailed to increase saving. Expenditures on luxury goods should be limited and government interventions is necessary to encourage saving.
b) **Increase in investment**: Only increase in savings will not break the vicious circle of poverty. The next is to mobilize the saving into productive channels through investment. Thus, coordination of both short run and long run investment is necessary.

II. Solution to demand side vicious circle

To solve demand side vicious circle, Prof. Nurkse advocated the doctrine of balanced growth i.e. investment should be done in every sphere of the economy. So, that one sector can fulfill the demand of another sector. This will broaden the market and induce investment. But, some economists like Hirschman, Singer etc. have advocated unbalance growth for breaking demand side vicious circle.

III. Other solution to vicious circle

Backwardness of human power is the main obstacle in economic growth of underdeveloped countries. To increase human power, emphasis on education, technical knowledge, administrative training, health facilities etc. should be enhanced. This will increase the efficiency of the workers. Transportation and communication facilities should also be enhanced and developed.

2.4 Nelson's Low Level Equilibrium Trap

Low level equilibrium trap model was given by Richard R. Nelson in year 1956, in his article entitled "A Theory of the Low Level Equilibrium Trap". Nelson's theory is based on Malthusian population theory. That is, with increase in per capita income above the minimum subsistence level, population also tends to increase rapidly. After the population

growth rate reach an upper physical limit it starts declining with increase in per capita income. According to Nelson the malady of underdeveloped countries can be diagnosed as a stable equilibrium level of per capita income at or close to subsistence requirements. Both saving and investment are low at the stable equilibrium level. If per capita income increases, it encourages the population growth. The population growth in return pushes down the per capita income to the minimum subsistence level. This situation is called as low level equilibrium trap.

Nelson has pointed out four conditions that may bring about the trap:-

a) A high correlation between the level of per capita income and the rate of population growth.
b) A low propensity to direct additional per capita income to saving and investment.
c) Scarcity of uncultivated durable lands.
d) Inefficient production methods.

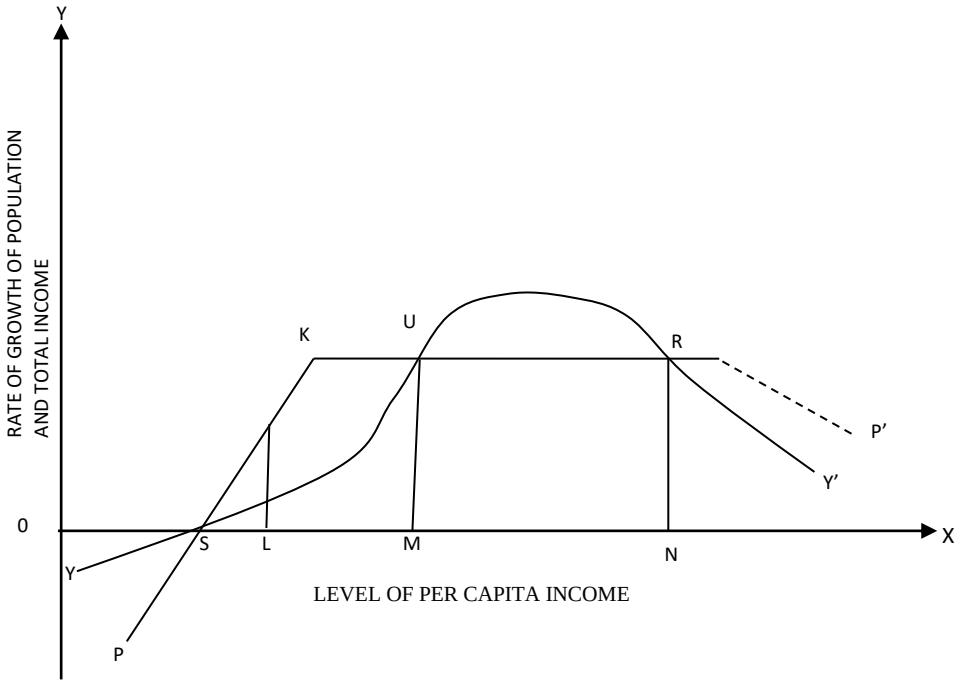

Figure 2.4

In the figure 2.4, x axis represent per capita income and y axis represents rate of growth of population and total income. The point S in the figure denotes the 'low level equilibrium trap' because at this point the population growth curve denoted by PP' and the income growth curve denoted by YY' intersect each other at the zero rate of growth. An increase in per capita income say from point S to L, the rate of growth of population will be higher than the total income growth rate. This will result in per capita moving back to initial equilibrium point i.e. point S. This will happen at all point to the left of Point M.

It is only when the per capita income level increased by a discontinuous jump of more than SM (see fig 2.4) then only the country can hope to get out from low level equilibrium trap. At the right side of point M, the total income growth rate is higher than the rate of growth of population. The possibility to escape from the low level equilibrium trap is either by increasing the rate of growth of income or by lowering the rate of growth of population or by both. Further, no action of government should be undertaken until a high level of per capita income is reached.

Factors that avoid Trap

1. Socio-economic environment should be favorable in a country.
2. Entrepreneurships must be given greater emphasis. Incentives must be given to produce more and also to limit the size of the family.
3. Equal distribution of income and measures must be adopted to enable accumulation of wealth by investors.
4. Income and capital should be increased through funds from abroad.
5. There must be government investment programme.
6. Better and improved production techniques must be adopted for efficient utilization of existing resources.

Criticism of Nelson's low level Equilibrium Trap

Nelson's theory is criticized especially on two grounds:

Firstly, the functional relation between level of per capita income, growth rate of population, and rate of growth in total income is not always rigid. The main cause of population growth in underdeveloped countries in recent years have been the reduction in death rate due to better public health care facilities and control of epidemics and endemics, and not to the prior rise of per capita income.

Secondly, the time element in Nelson's theory brings some complications. According to Myint, Nelson's theory illustrates a set of timeless functional relationship rather than time series of growth in income and population. The theory has failed to indicate the length of period for which a country must sustain high per cent growth rate before it can be sure of breaking the population barrier

2.5 Critical Minimum Effort

The theory of critical minimum effort was propounded by Harvey Leibenstein. This theory has been formulated in the wake of vicious circle of poverty that keeps underdeveloped countries around a low per capita income equilibrium state. To break this vicious circle "critical minimum effort" is need in order to raise the per capita income level so that a sustained development could be maintained. According to Leibenstein, in order to transform the economy from the state of backwardness to a more developed state, it is necessity but not always sufficient condition that economy needs a stimulus to growth which much be greater than a certain critical minimum size.

The basis of critical growth minimum effort is the relationship between three factors namely, population growth, investment and per capita income. Leibenstein referred population as income depressing factor. Whereas regarded investment as an income generating factor or stimulant. The main rationale of Leibenstein's theory is that the economic growth in underdeveloped and overpopulated countries is not possible unless a certain minimum level of investment is injected into the system. Critical minimum effort is the minimum level of investment that can pulls the economy out of vicious poverty. Leibenstein's theory can be explained with the help of Figure 2.5:

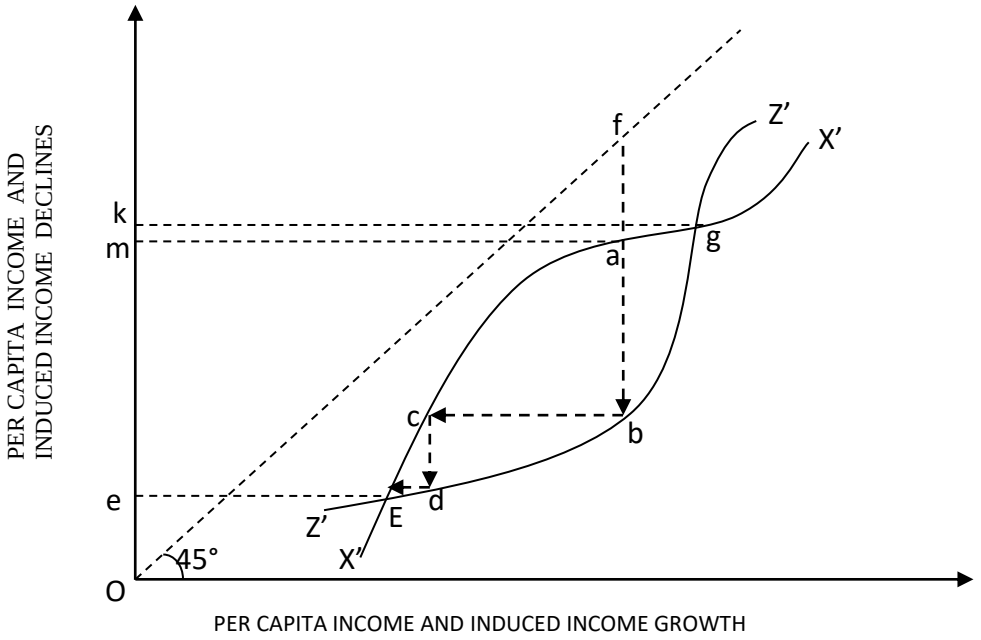

Figure 2.5: Leibenstein's Critical Minimum Effort

In figure 2.5, X axis represent per capita income and induced income growth. Y axis indicates per capita income and induced income decline. The 45^0 line shows increase and decrease in induced income. X'X' curve shows stimulant and Z'Z' represent shocks or depressing factors. At point E, X'X' curve and Z'Z' curve intersect each other. This indicates that there is equality between growth rate of population and income growth. Thus, the income is caught in vicious circle of poverty. If the income level is raised from 'Oe' to 'Om', the increased income is neutralized by the rising population. This brings the income level back to point 'E' again (subsistence level).

Rise in the level of national income where stimulants are stronger than the shocks is the solution of the problem. Then, the growth of income in the underdeveloped countries becomes self-sustaining. If the per capita income rises beyond point 'Ok' then the economy can break out from the vicious circle of poverty. The growth in income becomes self-sustaining. It is therefore necessary that the underdeveloped countries undertake a level of investment that pushes up per capita income above 'Ok'. The possibility of growth in the economy is when the income generating factors turn out to be more powerful than the income depressing force. A small additional investment may produce a small income but thus will again bring back to initial equilibrium level. An initial substantially large volume of investment is necessary to create condition that outweighs the growth of population. According to Leibenstein, it is necessary to make a critical minimum effort in a single stroke.

Determinants of the need for a 'Minimum Effort'

Leibenstein has given four factors that determine the need for a minimum effort:

1. **Internal economies**: It is important to undertake investment above a minimum size because of indivisibilities in factors of production.
2. **External economies**: According to Leibenstein, interdependence of industries mainly causes external economies. Industries depend on each other. So, if one industry has to exist, the another industry has to exist. If there were no indivisibilities, with any level of investment balanced growth could be achieved.
3. To overcome income depressing factors, investment above certain minimum size is necessary.
4. The cultural and institutional attitudes that exist in the in the backward countries are the attitudes that inhibit growth. It is necessary to have an outlook in which success is seen by market performance which is determined by rational rather than traditional or conventional consideration. Thus, to break away from the traditional and conventional attitudes and inculcate new attitudes, a large minimum effort should be undertaken.

2.6 Paul Baran's Theory of Underdevelopment

Paul Baran pioneered the theory of underdevelopment in his work "The Political Economy of Growth" in year 1973. Baran in his theory explains the problem of backwardness. He argues that underdevelopment of the backward countries is a result of the fact that the richer nation exercise dominance and imperialist assertion over the less developed or backward countries.

Barans views on Underdevelopment

The capitalist or the develop nation due to it's inherit characteristic exploits the backward nation. It is the capitalist opinion and interest to keep the third world countries as an indispensable hinterland. The third world countries were the producers and source of raw materials for the rich nations. And therefore the third world countries extract economic surplus for the capitalist. According to Baran the colonizers were, "rapidly determine to extract the largest possible gains from the host countries and to take their loot". Being a promoter of Marxist approach, Baran argues that the economic stand off between the rich and the poor can be narrowed through socialist economic system. He was of the view that the social class system of the backward countries was responsible for their dependent situation. Thus, the backward countries were stuck between feudalism and capitalism. And the third

world countries suffered from worst aspect of both systems. Baran has given four factors that raise the preconditions for raising capitalism in the Western Europe; viz. the raise in agriculture output; massive displacement of farmers which created the potential for an industrial proletariat; the extension of the division of labour which created a class of merchants and artisans located in towns; and the accumulation of capital in the heads of the rising class of merchants and wealthy peasants.

According to Baran there are four sectors that generate and utilize economic surplus in the third world countries viz. the rural sector, industrial sector, service sector and the state. Among these sectors, the rural sector contributes 50 percent of the total national product in underdeveloped countries. Thus, rural sector was the most important sector for generating and utilizing the economic surpluses. The economic surplus is squeezed out of laborers by landowners, moneylenders, merchants and out of peasantry. In underdeveloped countries, this surplus is not utilized in a productive way to expand the industrial output. The economic surpluses were largely used for excess consumption by the land aristocracy; which makes mechanizing the agriculture risky and unprofitable. Other factors like high price of machine, high interest rates, cheap labour, and unstable agriculture price etc. obstructed the agricultural productivity of the backward countries. Again the small land holders have no incentive to increase productivity because of smallness of their plots. The only way out is to start an agrarian revolution like the western Europe but the backward countries do not have the condition for this to take place. It is because of absence of indigenous bourgeoisies and existence of land aristocracy, who benefitted from the existing modes of exploitation.

In service sector, the economic surplus is appropriated by the merchants, moneylenders, trading stand operators, peddlers, dealers etc. whose income represents transfer of surplus from other class or a diversion of surplus that would otherwise be available to other classes. Baran termed this class as “socioeconomic stratum” whose size was very large. According to Baran there is a significant drain on capital accumulation without any significant compensating social contribution. The surplus earned from service sector remains within this sector and does not enter industrial production.

For industrial sector, Baran was of the view that this sector was largely self-expanding because under capitalism industries have the capacity to create its internal market. The economic surplus from industrial sector is very large, but much of it flows back to capitalist country as royalty payment, repatriated profits and as disguised foreign remittances. The portions of the economic surplus appropriated by local bourgeoisie were largely spent on

luxurious consumption, construction of rural and urban residents and servants, if not invested abroad.

The appropriation of surplus by the state represents a transfer of surplus from other groups as well as an addition to surplus in those cases where it is obtained by a corresponding reduction in consumption. According to Baran, surplus by the state represents large expenditure on “maintenance of sprawling bureaucracies and military establishments” representing a tremendous waste.

Baran, believes that a capitalist pattern of development is completely exploitative. Being completely socialistic in view, he considers socialistic pattern of development which is free from exploitation.

2.7 Myrdal's Theory of Cumulative Causation

Prof. Gunnar Myrdal gave the theory of ‘Circular Causation’ in his article, ’Economic Theory and underdeveloped Regions’ in year 1957. Myrdal was of the view that economic development result in a circular causation process which again result in rapid development in the rich or developed economy while the backward nation tends to be poor and remain behind. According to Myrdal, the ‘Backwash Effect’ is prominent and the ‘Spread Effect’ is dampened in underdeveloped countries. Myrdal’s theory is an explanation of the backwardness of developing and underdeveloped nations. He argues that in the context of development both economic and social sectors bring tendencies towards disequilibrium. Thus, he rejects the assumption of the traditional theory viz. assumption of stable equilibrium and the assumption that only economic factors are related to economic change. Myrdal replaces the traditional assumption of stable equilibrium with the hypothesis of circular and cumulative causation.

The Myrdal Thesis

Prof. Gunnar Myrdal theory of cumulative causation is a theory of economic development that explains why inequalities exist in the national and international plane. He tries to explain his theory with backwash effect and spread effect concepts. In the words of Myrdal, “Backwash Effect are all relevant adverse changes … of economic expansion in locality. I include under this label the effects viz. migration, capital movements and trade resulting from the process of circular causation, between all the factors, ‘Non-Economic as well as Economic’. The spread effect on the other hand refers to certain centrifugal “Spread Effects” of expansionary momentum from the centers of economic expansion to the other

regions". Thus, according to Myrdal regional inequalities arises due to strong backwash effect and weak spread effect in underdeveloped countries.

1. Regional Inequalities

Myrdal's thesis starts with the tendency towards regional inequalities in a single country. Developing regions exerts a strong agglomerating pull, accelerating their rate of growth which results in increasing stagnation or decline in other regions of the country. According to Myrdal, it is capitalist class that aims at maximizing profit. It is the profit that triggers development of regions where profit is high; while the other regions remain underdeveloped. The process of development does not itself generate any equalizing forces as a result; severe regional disparities may be planted. It is the free market forces and profit motive in the capitalist system that leads to regional inequalities. In this regards, he observed that if things were left to market forces unhampered by policy interferences, industrial production, banking, commerce, insurance, shipping and almost all other economic activities in a developed economy tends to give a bigger than average return. In addition, science, art, literature, education, and high culture generally would cluster in certain localities and regions, leaving the rest of the country more or less in darkness. Thus, regional inequalities are accentuated when some localities grow at the expense of the other regions.

a) Backwash Effect of Migration, Capital Movement and Trade

The migration of people from backward regions results in regional imbalances. The more developed region or economy will attract young people from other parts of the country which are economically backward. This will result in making the developed region more develop and depress the economic activities in the backward region from where people migrate.

Capital movement as a consequence of the free market forces leads to increase in regional imbalance. Capital is shifted from poor region to rich or developed region where high rate of return already exists. It is because of better and higher opportunities for investment that demand for capital in developed region is high. The scope of better investment opportunity in the progressive region may result in capital shortage in backward regions.

Another dis-equalising force is trade which act in favor of the developed countries and against the underdeveloped nations. The developed regions have better competitive advantages and market. The strong technological base and large size of the market can easily out power the market of the backward regions. Again, not only in manufacturing and other non-Agricultural sector, but also the agriculture sector in the underdeveloped region shows a much lower level of productivity than the developed nations. Therefore, trade results in the development of industries in the already developed regions, and may ruin the existing handicrafts of backward regions.

b) Spread Effects

The growth of industrial regions also has some positive effects on other areas too. When a region experience advantage regarding demand, market, technology etc. from developed regions, these favourable or positive effects are called Spread Effects. This will raise the backward regions near to developed. It is natural that the regions around a model center of expansion gain from increasing outlets of agriculture products. The spread effect tries to neutralize the backwash effects. In words of Myrdal, 'the spread effects in underdeveloped country are weak and they are not capable of balancing the backwash effects and regional imbalances'. Therefore, the outmost reason for backwardness of a country is very weak spread effect and a very strong backwash effects. Whereby, in cumulative process poverty becomes its own cause. It is not able to equalize the backwash and spread effects. In this regard Myrdal quotes two broad relations

a. Regional inequalities are much wider in the poorer country than in the richer country.
b. The regional inequalities are increasing in poor countries and diminishing in richer countries.

Higher the level of economic development of a country, stronger will be its spread effects. It is because development is always characterized by improved and better transportation and communication, higher level of education and more dynamic communion of ideas and values, which will strengthen the forces for the centrifugal spread of economic expansion of development.

c) Role of State

Government intervention is very necessary for strengthening the spread effects. The government should adopt egalitarian policies to reduce backwash effect and strengthen

spread effect in order to reduce regional inequalities and raise the tempo of continuous economic development.

2. International Inequalities

Rich and advanced countries are becoming richer while underdeveloped countries are becoming more backward. There are no equalizing forces operating to correct the inequalities in economic development. Myrdal believes that international trade and capital movement are the ways through which development can be achieved. International trade may have strong backwash effects on underdeveloped countries. The developed countries have a large base of manufacturing industries which in return have a strong spread effect. The developed countries industrial products are exported to underdeveloped countries at a cheaper rate. This results in underdeveloped countries producing primary products for exports. The demand for the primary products in the world market is inelastic and the importers of the primary products will pay cheaper rates since its demand is inelastic. Therefore, the products of the underdeveloped countries suffer from price fluctuations. The underdeveloped countries thus, specialized in production of primary products for exports under free trade system. Thus, international trade with advance countries results in wrong specialization which greatly hampers the growth of specialization in underdeveloped regions and leads to rise in inequalities. Therefore, Myrdal was of the view that new theories of international trade to develop and improve the economies of the underdeveloped countries as the need of the hour and should be given emphasized.

Capital movement has failed to remove international inequalities. Advance countries offer investors goods, profit and security. But capital will stun those underdeveloped countries. The normal flow of capital is not from the developed to backward countries but it tends to be in reverse direction. In the absence of exchange controls, capital will flow from underdeveloped to those countries that are progressive, international migration between underdeveloped and developed countries could not resolve the problem of international inequalities.

Conclusion

Myrdal's thesis marks a departure from other development theories. He has described how combined national and international forces keep the underdeveloped countries in the cumulative process and where poverty becomes its own cause. It is a fact that underdeveloped countries have a dominant backwash effects and weak spread effects.

International and national forces tend to perpetuate them and thus accentuate regional and world inequalities. The export potential of underdeveloped countries is cramped because of free play of market process and trade

2.8 Key Words

Dualism : Existence of traditional and advance sector
Equilibrium trap : a situation where in the equilibrium is static
Vicious : deplorable
Critical Minimum : a little above the minimum

2.9 Short Questions

1) Define vicious circle of poverty?
2) What is spread effect according to Myrdal?
3) What do you understand by backward sloping supply curve of labour?
4) Define shock and stimulants?
5) Define social dualism?

2.10 Long Questions

1) Discuss Boeke's dualistic theory of underdevelopment.
2) Discuss the causes of vicious circle of poverty in details.
3) What is Nelson's low level equilibrium trap? Illustrate your answer.
4) What are the factors responsible for regional and international inequalities? Support your answers with Myrdal's theory of circular causation.
5) Discuss Baran's view on underdevelopment.

2.11 Suggested Readings

Mishra, S.K and V.K Puri (2012). *Economics of Development and Planning*. Mumbai: Himalaya Publishing House.

Thirwall, A.P, (2011) economics of development Palgrave Macmillan, ninth edition.

Barone, C.A., *Marxist Thought on Imperialism: Survey And Critique*, pp 86-92

UNIT- III

CLASSICAL, SCHUMPETERIAN AND MARXIAN THEORIES OF GROWTH

Structure

3.0 Introduction

The growth theories are as old as economics itself. The great classical economists discussed different factors those leads to the growth and development of the European countries. The most famous early classical economist was Adam Smith. In this chapter, we have discussed the growth theories put forwarded by three famous classical economists Adam Smith, David Ricardo and Malthus. Schumpeter's theory of innovation is also discussed. At the end of this chapter, the Marxian theory of development is analysed.

3.1 Objectives

In this unit the learners are expected to know about the classical growth theories including the Schumpeter's analysis of growth under capitalism along with the Marxian analysis of capitalist society.

3.2 Adam Smith's theory of Growth

Adam Smith is known as father of economics. He gave his ideas about economic development in his well-known book, "An Enquiry into the Nature and Causes of Wealth of Nations" (1976). He advocated the policy of laissez faire, that is, non-intervention of government in economic activities of the individuals. He laid stress on individual freedom in conducting their economic affairs without any obstructions and restrictions by the government. He advocated free trade among nations of the world and urged that all restrictions on foreign trade should be removed to promote international specialization so as to increase the incomes of the nations. The crucial aspects of Adam Smith's development theory are – division of labour and capital accumulation. We explain below these factors in detail.

Division of Labour

A very important contribution made by Adam Smith to the analysis of the factors that bring about expansion of output is the division of labour. Among the benefits of division of labour he refers to increase in dexterity, saving in time, and invention of better machines and appliances.

One of the most significant contributions to economics by Adam Smith was to introduce the idea of increasing returns caused by division of labour. According to him, the gain from division of labour was a basic feature of social economy otherwise everyone, like Robinson Crusoe, would have to produce everything they want for themselves. Given the crucial significance of increasing returns based on division of labour, productivity of labour rises with the increase in the size of market. Along with division of labour it is acceleration of investment or capital accumulation that leads to the increase in growth of output and living standards of people. According to Adam Smith, industries generally have greater scope for division of labour or specialization than agriculture and, therefore, in rich developed countries industrialization had taken place to a greater extent.

Adam Smith points out that the degree of division of labour is limited by the extent of the market. Division of labour is profitable only if there is adequate market for the goods produced. If the extent of market is small, it will not be profitable to produce on a large scale

which requires introducing a higher degree of division of labour or specialization. This is because if size of market for a good (i.e., the magnitude of demand for it) is quite small, it will not be profitable to introduce a higher degree of division of labour along with the use of large capital stock. In the absence of adequate demand, only a little degree of division of labour or specialization can be used and a good deal of capital stock is likely to remain underutilized. It is in this context that he advocated for free international trade which leads to the increase in the extent of market for goods and makes their production on a large scale profitable and induces the capitalist class to accumulate more capital.

Accumulation of Capital

As a means of economic development, Adam Smith gave an important place to saving and accumulation of capital. The greatest obstacle to economic development is the deficiency of capital. In this respect, they are caught up in a vicious circle of poverty. Productivity of people is low because the capital stock is small; capital stock is small because savings of the people are small and savings are low because incomes of the people are small due to their low productivity. The way out of the vicious circle, according to Smith, is if capitalist class that saves most of their profits and invest in capital accumulation for accelerating economic growth. In fact, Adam Smith assumed that capitalist class save a very large proportion of their profits.

Besides, capital accumulation, according to Smith, facilitates a greater degree of division of labour which causes productivity of labour to rise. Without capital accumulation the extent of division of labour cannot be increased much. Increase in capital formation leads to the production of different types of specialized equipment which are operated by different classes of workers who are skilled and specialized in various tasks. Thus, capital accumulation along with division of labour leads to the increase in industrial output and employment.

The Process of Development

Adam Smith points out that the development process once started gathers momentum and becomes cumulative, that is, it feeds upon itself. This happens in the following ways. First, increase in saving causes more accumulation of capital which in turn facilitates a great

degree of division of labour. The division of labour raises labour productivity, which ultimately leads to increase in income. Second, the higher incomes due to the capital accumulation and a higher degree of division of labour lead to the increase in the size of market or demand for goods. This expansion in demand for goods causes increase in national output and income which brings about more saving and further investment and capital accumulation. In this way spiral of economic growth rises higher and higher. Third, the increase in size of market and availability of capital induces improvement in technology.

This cumulative process of development provides a cheerful note for the developing countries. That is, if they start the development process in right earnest they can be sure of further and rapid economic development and can catch up with the presently advanced developed countries. According to him, the natural course of development is first agriculture, then industry and finally commerce. Agriculture creates a surplus and increases the purchasing power of the people which generates demand for industrial products. It also supplies raw materials for industries. Agricultural growth thus provides a base for industrial development.

3.3 Multhus Theory of Growth

Robert Malthus propounded his famous “Theory of Population”. It is well to remember that Malthus had also some important things to say about economic development. The problem of development, according to Malthus, lies in explaining why the actual gross national product differs from the potential gross national product. He thus points out the way in which the potentialities of economic development in a country should be realised. This can be done by larger production and fairer distribution.

Malthus contends that the process of economic development is not automatic. Rather conscious, deliberate efforts are needed to bring it about. For instance, Malthus explains that mere increase in population cannot by itself lead to economic development unless there is increase in effective demand; which is the anticipation of the Keynesian doctrine. He rejected Say’s Law which says “supply creates its own demand”.

Malthus’s important contribution is in showing that savings in the sense of not consuming is a mere negative act and instead of creating more demand it will lead to a decline in effective demand. Only savings which are furnished by increased gains and are

invested create an effective demand. Malthus brings out an important fact that in advanced economy consumption, saving and investment all should expand simultaneously.

Malthus attaches great importance to the accumulation of capital for economic development. He regards capital as indispensable to development. Besides, Malthus underlined the importance of foreign trade for speeding up economic development. Foreign trade provides incentives for investing, since it leads to the extension of the market for the goods produced and for greater division of labour resulting in increased output.

There is another important fact brought out by Malthusian analysis of economic growth, namely, the structured change that takes place in the process of economic development i.e., a decline in the relative importance of agriculture as the economy moves forward. The economic development in developing countries is regarded as synonymous with the development of industries. Naturally, agriculture is eclipsed by the speedier development of industries.

Of far greater importance than what has been pointed out above, is the anticipation by Malthus of the theory of 'dualism' as applied to underdeveloped economies. He envisaged the economy as consisting of the two major sectors, viz., the agricultural sector and the industrial sector. His analysis of the interrelation between these two sectors is quite interesting and enlightening. He brings out an important truth that when one of these sectors lags behind, it retards the development of the other sector. The development of the industrial sector of underdeveloped countries is limited by the poverty of the agricultural sector. This is due to the fact that the lack of purchasing power of the rural masses reduces effective demand in the economy and retards its growth.

Assessment of Malthus's Contributions:

There is no doubt that Malthus made a valuable contribution to the theory of economic development. His emphasising the importance of effective demand and its relation to saving and investment are indeed noteworthy for their modern touch. A great deal of what he wrote on the subject is applicable to an underdeveloped economy.

It has been pointed out by the critics of Malthus's theory of economic development; he concentrates on explaining the factors which hinder growth rather than the factors that promote economic progress. However, some elements of his theory make positive contribution to the growth process. For example, he considers production and distribution as the two grand elements of economic growth. The distribution of production is as important as production itself or sustained economic development. He also gives importance to capital accumulation in bringing about economic development.

At the same time, he emphasises that the capital accumulation will choke off if it is not possible for the additional goods to find consumers. That is, he points to the significance of effective demand for sustained accumulation of capital. Increase in effective demand, according to him, is as important as increase in production. He thinks that excessive parsimony will reduce aggregate demand leading to widespread depression and unemployment. He recommends a more egalitarian system of distribution in order to increase effective demand. He also recognizes the importance of non-economic factors in economic development.

Though Malthus is more well-known for his theory of population than his contribution to growth economics. According to his population theory, population increases so rapidly as to outstrip the food supply due to the operation of law of diminishing returns which has largely been falsified owing to the rapid increase in agricultural productivity. However, it is very helpful in probing the problem facing the labour-surplus developing countries of today. Thus, Malthus's contribution to economic growth contains several elements that are relevant to the developing economies.

Limitations of Malthus Theory of Development

(a) Capital accumulation leads inherently to secular stagnation is not correct. In reality, capital accumulation does not lead to a reduction in demand for consumer goods and fall in profits. Along with capital accumulation, there is an increase in wages, profits and aggregate national income and so does the demand for consumer goods.

(b) Malthus believed that it is the only landlords who save. But this is an absurd because the main source of savings in the present day society is the income earners and not profit earners.

(c) Malthus argues that the process of capital accumulation leads inherently to secular stagnation and this wrong notion that arises from the interpretation of Say's law. For Malthus, there is possibility of permanence under consumption of all commodities. But the fact is that the under consumption is not permanent phenomenon. Therefore, secular stagnation is not inherent process of capital accumulation.

(e) He suggests that the unproductive consumer tries to overcome under consumption and increase effective demand. This remedy tantamount to giving doles to workers and deliberately supporting idle persons. Such a measure slows down the rate of capital accumulation.

3.4 Ricardo's Theory of Growth

Ricardo was the first economist who presented the classical thought in a consistent body of economic analysis. His ideas were embodied in his book, The Principles of Political Economy and Taxation (1817). Although Ricardo is well known for his theory of rent; there are also ideas in his writings which throw light on economic development.

Diminishing Returns to Labour and Economic Growth

According to Ricardo, economic growth depends on capital accumulation. And capital accumulation depends on reinvestment of profits. Profits earned by the capitalists depend on the growth of agricultural output, especially food. Ricardo emphasized on diminishing returns to land, which occur as more doses of labour are used in agriculture.

It is diminishing returns in agriculture that causes food prices to rise and result in rise of wages of workers. It leads to decline in profit and investment, and the economy reaches a stationary state. According to Ricardo, there are three agents of production that participate in the process of growth of output. The capitalist hires labour and land and plays a key role in the process of economic development. Ricardo uses the term capitalist in the sense the modern economists use the term entrepreneur. In the Ricardian model capitalist undertakes

production, pays rent to the landlords and wages to the workers employed, and the residual is his profits. Ricardo stated that wages were determined at the minimum subsistence level of the workers. If wages rise above the subsistence level, population increases and brings them to the level of subsistence. Similarly, wages cannot go below subsistence level; as it is the minimum wage to maintain the lives of the labour.

Let us now explain Ricardian model of growth in detail. Ricardo makes two-sector analysis of the economy. He draws distinction between the agricultural sector and the industrial sector. He assumes that agriculture is subject to law of diminishing returns while industry is subject to constant returns. Further, Ricardo regarded real wages to be fixed. When labour is employed in land, they produce more than its subsistence. The difference between the output and subsistence wage is the surplus. This surplus output is shared between the land lord in the form of rent and the entrepreneurs in the form of profit.

Let us first consider the agricultural sector. As more and more doses of labour and capital are employed, due to diminishing returns to agriculture, marginal product of labour and capital would diminish. The capitalist employer will employ labour to the extent where marginal product of labour is equal to wage. The intra-marginal doses of labour employed would produce surplus over the expenses incurred on them. This surplus production is the source of capital, which will be reinvested in future for further production. The greater the volume of saving out of the surplus, the faster will be the rate of capital accumulation and more rapid the growth of output and employment. Graphically, the growth of agricultural output and employment of labour in Ricardian model is depicted in Fig. 3.1.

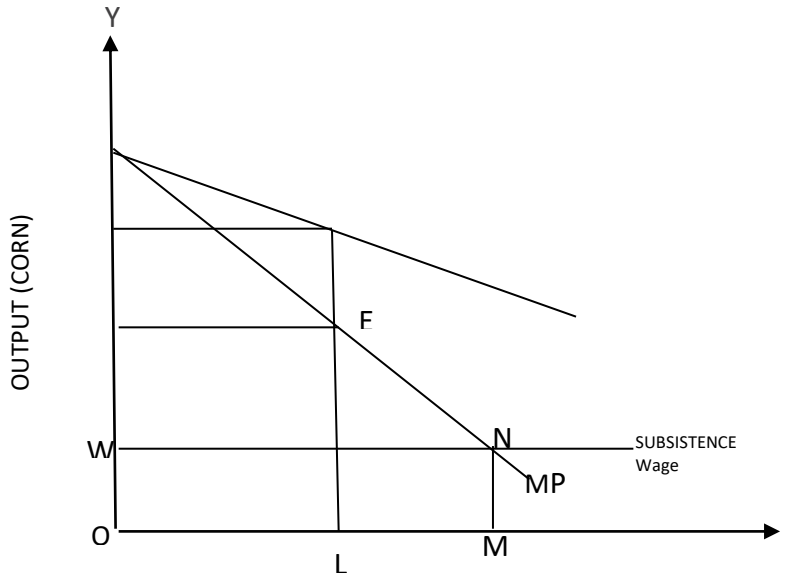

Figure 3.1

In Figure 3.1 output of labour is depicted on the Y-axis and the amount of labour employment on the X-axis. AP and MP are average product and the marginal product curves which will remain fixed as land is assumed to be fixed. If OP is the expenses on a dose of a labour and capital, then OL labour would be employed. It can be seen from the Fig. that the employment of OL labour produces the total output equal to OQHL. The total expenses of production incurred on capital and labour are equal to OPEL. Thus, it is clear that labour produces surplus over costs of cultivation incurred on labour and capital. The surplus is equal to PQHE. This surplus represents the rent which will be obtained by the landlords, the owners of the land. OW represents the minimum level of subsistence wage which is paid to the workers, and OWTL is the share of labour in the agricultural output. The remaining agricultural output WTEP is the profits made by the capitalist farmers.

According to Ricardo, profits earned by the capitalist farmers will be saved and reinvested. It leads to increase in both output and employment. Since the supply of land is fixed, marginal and average product curves of labour will remain unchanged. Due to diminishing returns, with the increase in more and more of employment of labour, its marginal product of labour will go on falling till it becomes equal to minimum subsistence level of wages OW. As a result, profits will disappear and rent of landlords will increase.

Total agricultural output OSNM will be distributed between wages and rent, and profits will be fallen to zero. Ricardo thought that the landlords who receive rent do not save anything.

Growth of the Industrial Sector

It should be noted that the food-grain surpluses generated in agriculture are essential to employ labour in the industrial sector. In the industrial sector the stock of fixed capital plays an important role in the growth of output and employment, while in agriculture the amount of land plays such role. In the agricultural sector, land as a whole is fixed and diminishing returns occur when more doses of labour is used. Increase in the stock of fixed capital in the industrial sector is possible since it is made by man. But workers engaged in building up of capital stock must be paid in real terms. As the stock of capital increases in the industrial sector marginal productivity curve of labour in the industry sector will shift upward. It implies that more labour will be employed at the minimum subsistence level of wages through capital accumulation.

In the short run real wages may rise above the minimum subsistence level, but this will lead to the increase in population and labour force. As long as food-grains are available at the same price, the minimum subsistence level of wage in terms of money will remain constant. As a result, supply of labour will be perfectly elastic at the minimum subsistence level of wage. However, if the prices of food-grains rise due to the operation of diminishing returns in agriculture, the wages in the industrial sector will rise. But, the wage rate in terms of corn or wage goods will remain the same and the labour supply will be perfectly elastic at this rate due to the growth in population and labour force.

However, availability of wage-goods surpluses is a constraint on the growth of industrial sector. If sufficient food surpluses are not forthcoming and demand for them increases as a result of the growth in labour employment in the industrial sector, the prices of food-grains will rise. The increased prices of food-grains will raise the subsistence wage rate in terms of money which will reduce the surplus of the capitalists. Since Ricardo and others assumed that agriculture was subject to diminishing returns, the prices of food-grains will rise as cultivation on land is increased.

Therefore, as a result of the rise in the prices of the food-grains and thereby the rise of the wages of labourers will reduce the profits made by the capitalists in the industrial sector. The rate of profit earned on the capital will go on declining till it becomes zero. When the rate of profit becomes zero, further capital accumulation in the industrial sector will cease and in this way a stationary state will be reached. Before the stationary state is reached, the level of output and employment of labour force during any given period in the industrial sector will depend on the stock of fixed capital on the one hand and the wage goods supply forthcoming from the agricultural sector on the other.

From the above, it is thus clear that in Ricardo's model the growth of output and employment depends on capital accumulation on the one hand, and the available supplies of food-grains or wage goods on the other which are constrained by the operation of diminishing returns in agriculture.

Critical Evaluation of Ricardo's Model:

We have seen above that Ricardo, emphasised on the wage goods as determinants of growth of output and employment in an economy. In the growth of output and employment, they ignored the role of aggregate effective demand.

However, in the context of developing countries, his emphasis on wage goods as determinant of income and employment is quite right. In developing countries like India, the cause of mass unemployment and disguised unemployment is to be found in the lack of fixed capital and other cooperating factors and the supplies of the wage goods on the other and not in the lack of aggregate demand. Therefore, a solution to the unemployment problem in labour-surplus developing countries lies in the accumulation of fixed capital as well as the expansion of wage goods supply in the economy. Keynesian remedy of curing unemployment through the increase in aggregate demand by expansionary fiscal policy financed by creating new money will not solve the problem of unemployment and disguised unemployment in developing countries.

However, it may be pointed out that the contention of Ricardo that agriculture is subject to the law of diminishing returns that will ultimately raise the prices of food-grains and reduce the profits in the industrial sector which will ultimately result in the occurrence of

the stationary state, is too pessimistic and unwarranted. Thus, Ricardo underestimated the role of technological progress in raising production which can suspend the operation of the law of diminishing returns. The increase in agricultural productivity due to technological progress can prevent the rise in prices of food-grains and therefore the reaching of the stationary state.

Ricardo's theory of development believes that all increase in the stock of fixed capital leads to an increase labour employment. It ignored the labour-displacing effect of capital equipment in which improved technology is embodied. Actually, much of technological progress made in advanced developed countries has been of labor-saving nature; which ultimately displace labour.

Ricardo was also not right in ignoring the effective demand in determining growth of income and employment. Ricardo thought that development process would not be constrained by lack of effective demand as he believed in Say's Law that supply creates its own demand. His predictions regarding the advent of stationary state have not turned out to be true, nor are about the changes in relative shares of the various agents of production borne out by history. The two fundamental principles in his model of economic development, viz., the principles of population and the law of diminishing returns, are only partially correct. All the same, it has to be admitted that he made a significant contribution to the theory of economic growth.

3.5 Schumpeter's Theory of Growth

Schumpeter's theory of development is also known as the innovation theory of development. This theory assigns paramount role to the entrepreneur and innovations in the process of economic development. According to Schumpeter, the process of production is marked by a combination of material and immaterial productive forces. The material productive forces arise from the traditional factors of production, viz., land and labour, etc., while the immaterial set of productive forces are conditioned by the 'technical facts' and 'facts of social organization'. The Schumpeterian production function can be written as –

$Q = f\ [k, r, I, u, v)$

Where, Q stands for the output, k for capital, r for natural resources, and l for the employed labour force. The symbol u represents the society's fund of technical knowledge

and ν represents the facts of social organization, i.e., the socio-cultural environment of the economy.

The above function shows that the rate of growth of the output depends upon the rate of growth of productive factors, the rate of growth of technology and the rate of growth of investment friendly socio-cultural environment. Schumpeter held that the alterations in the supply of productive factors can only bring about gradual, continuous and slow evolution of the economic system. On the other hand, the impact of technological and social change calls for spontaneous, discontinuous change in the channels of output flow.

Schumpeter regarded land to be constant. The growth component will, therefore, include only the effects of changes in population and of increase in the producer goods. But Schumpeter further maintains that there does not exist any a priori relationship between the changes in population and the changes in the flow of goods and services. In other words, Schumpeter considers the population growth to be exogenously determined. The increase in producer goods results from a positive rate of net savings. The major part of savings and accumulations are attributed by Schumpeter to profits. According to him, the profits can arise if innovations are introduced. Hence ultimately it is the change in the technical knowledge (i.e., variable u) which is responsible for any change in the stock of producer goods, i.e., the rate of capital accumulation directly depends on the rate of technical change. In other words, according to Schumpeter, the growth of output is geared by the rate of innovations.

No doubt, Schumpeter holds that the trend of economic growth shall be fixed by the exogenous variable of population growth, yet according to him, the process of economic development is synonymous with discontinuous technical change, i.e., innovations. The agent which brings about innovations is called by Schumpeter as entrepreneur. Thus, entrepreneur becomes the pivot of Schumpeter's model.

According to Schumpeter, the entrepreneurs play a key role in economic development. The credit for innovations and the outburst of economic activity goes entirely to the entrepreneur. According to him innovation may be of five types:

(i) Introduction of a new good,
(ii) Introduction of a new method of production,

(iii) The opening of a new market,

(iv) The discovery of a new source of supply of raw materials or semi-manufactured goods, and

(v) Introduction of a new organisation in an industry.

In a world characterised by a high degree of risk and uncertainty, only a few people have the exceptional ability and daring will be able to undertake innovations and launch enterprises and exploit opportunities for profit. But these entrepreneurs are not only lured by profit but are also motivated with a desire to found a dynasty in the business world or a desire for conquests in the competitive world or have the joy of creating. Thus, in the Schumpeterian analysis, the role of the entrepreneur is a determining factor of the rate of economic growth. In his absence the growth rate is bound to be slow.

The supply of entrepreneurs depends not only on the rate of profits (which is obvious) but also on the favourable social climate. They will appear and continue only in a society which honours them, where prestige is attached to them and the social rewards or recognition they are able to earn. Any tendency to squeeze profits, increase taxes, intensify welfare programmes, strengthening of the trade union movement or measures of redistribution of income will deteriorate the climate for investment and so for economic development.

Schumpeter's starting point in the "circular flow" is a stationary equilibrium in which there is no investment, population growth is at a standstill position and there is full employment. But there are numerous opportunities in business which the entrepreneurs are quick to exploit and innovations are undertaken. As the economy is in equilibrium, saving is equal to investment. So, when the innovators make investment, he does it bank loan. The banks provide loans to the innovators through credit creation. Thus, according to Schumpeter credit creating plays an important role in economic development.

The success of the original innovators attracts many others who follow them. Economic activity becomes more and more brisk and the boom gathers momentum with the result that prices and money incomes rise. There is then the secondary economic wave 'imitative investment' superimposed upon the earlier one, i.e., 'innovational investment'.

But soon follows the process of creative destruction. The boom gives way to slump or recession. Completion of innovations brings in a large supply of goods which cannot be marketed at profitable price. There are forced bankruptcies since the banks call back loans.

The repayment of bank loans accentuates deflationary forces. Business risks scare away the prospective entrepreneurs. In this unfavourable climate, the innovational activity comes to a halt. After this painful process of adjustment in which weak enterprises are liquidated, the businessmen find conditions again ripe for a further spurt of entrepreneurial activity. The economic activity is resumed at a higher equilibrium. This is how the circle of development process is completed. There is a new wave of innovations and the development cycle repeats itself.

Critical Evaluation of Schumpeter's Theory

Schumpeter has been a great 'theorist' whose writings contain brilliant thoughts and a deep insight into the working of an economy. However, his analysis of the entrepreneurial innovations is not applicable to modern conditions in which the act of invention and innovation is carried on not by individual entrepreneurs but by large corporations as a routine affair. It is not possible to identify entrepreneurs who introduced many actual innovations.
Critics point out that what Schumpeter gives is the theory of business cycles and not an analysis of economic development. Even Schumpeter's analysis of business cycles can be accepted only with some modifications to suit modern economic conditions. According to Schumpeter, crisis in capitalism is brought about by maladjustment caused by waves of innovations. But big businesses in modern times can absorb these waves and produce steadier and larger expansion of the total output.

The assumption that innovations are financed by borrowing from credit creation by the banks is also not very realistic. It is a well-known fact that most of the bank loans are short-term loans whereas the implementation of innovations requires long-term finances.

3.6 Marxian theory of Reproduction

Karl Marx, the father of scientific socialism, is considered a great thinker of human history. He is regarded as the father of history who prophesied the decline of capitalism and the advent of socialism. He is also known as the great enemy of capitalism. His famous book 'Das Kapital' is known as the Bible of socialism (1867). He presented the process of growth and collapse of the capitalist economy. Some of his views relating to economic growth are:

Historical stages of growth

Marx has analyzed the main stages which have taken place in human history. According to him, all historical events are the result of a continuous economic struggle between different classes in society. According to Marx, the mode of production which determines the general characteristics of social, political, and spiritual processes of life is the main cause of social change. As methods and techniques of production change the social relations which follow them also change. Against this background Marx describes four stages in history. They are: Primitive Communism, Slavery, Feudalism and Capitalism.

Primitive communism is the first stage. It was characterized by a classless society, where all factors of production were owned by the society and people lived in groups. Gradually a society having a few masters and many slaves remaining under the control of masters came into existence. It is the second stage of development. With the development of productive forces, feudalism replaced slavery. Under feudalism there were two classes namely, feudal lords and serfs. On account of friction between these two classes' namely feudal lords and serfs this system comes to an end. Serfs agitate and get emancipated from feudal lord ultimately feudalism gives way to capitalism. Under capitalism, merchants and entrepreneurs become leaders in the economic field. Industrial revolution and other changes which took place at the same time gave a new phase to the economic system which was taking a definite shape at that time. In a capitalist society, the capitalist controls the means of production and the workers depend on the capitalist for work. The main aim of the capitalist is to maximize their profits. They pay low wages to the labour, and made them to work for a longer hour. As exploitation increases conditions become ripe to overthrow of capitalism by the united proletariat. Thus, increasing antagonism between capitalist and workers creates conditions for the destruction of capitalism, and the emergence of socialism. Thus, class conflict leads to the collapse of capitalism and the rise of socialism. The inherent characteristics of capitalism are responsible for its own destruction. Under socialism, economic condition of the working class is improved according to Marx. Communism emerges as the last stage of socialism. Under communism: poverty is rooted out; class conflict is absent; every individual contributes to national income according to his abilities and receives according to his needs; and the state withers away. Thus, class conflict is the reason behind the social changes. Here, lies the importance of class conflict in the Marxian development model.

The theory of surplus value

The idea of surplus value has important place in Marxian theory of economic development. Under capitalism all the means of production are owned by a small group of people. The workers on the other hand sell their labour to the capitalist. The wage of the labour is equal to the value of subsistence necessary to maintain their life. The price of commodities is higher than the wages paid to the workers. The economy is capable of producing a surplus over and above the subsistence needs of the labourers, and the capital equipment used in production. Thus, according to Marx, the wages paid to workers are less than the market value of the commodity. Marx has identified this difference as surplus value, and the surplus value is appropriated by the capitalist. This surplus value according to Marx should go to the workers who are the real creators of it.

Marx argues that the total value of output produced in a capitalist economy can be divided in to three components:

(a) Constant capital (C): It represents the value of materials and machinery used up in production.

(b) Variable capital (v): It represents the amount of labour used in production or the wages paid to the workers.

(c) Surplus value (S): It represents the profit.

Thus the total value of product is equal to these three components that are C+V+S. According to Marx, workers get only a part of the output they produced, and the rest goes to the capitalist. Marx called it exploitation of labour.

The aim of capitalist is to increase the surplus value. The capitalist adopts three methods to increase the surplus value; viz. increase in the working hours of the labourers, reduce the wages below subsistence level and increased productivity of labourers through improved technology. The consequences of such exploitation leads to increasing misery of the workers and intensification of class struggle, increase in unemployment, fall in the rate of profit, and finally decline in the number of capitalist and concentration of capital in the hands of a few capitalists.

Class struggle

According to Karl Marx in the capitalist system, class conflict between the capitalists and the workers is inevitable. The interests of these two classes are opposed to each other. Though workers oppose exploitation they are disunited and hence ineffective. As supply of labour is generally more than the demand for labour, the payment of subsistence wages is enough to attract considerable workers needed by capitalist. The conditions of the workers become more miserable on account of low wages. The labourers who have opportunities to come together and exchange their ideas unite in to a force capable of opposing exploitation by the capitalist.

Increase in the supply of capital

As already discussed above capitalists pay lower wages to the workers and takes the surplus value. However, the wages paid to the workers is not enough to create demand for the products produced by the capitalists. This creates a situation where the supply of capital exceeds demand. Thus, capital formation production is no longer profitable. Demand falls as machines displace workers and industrial reserve army (unemployment) expands. To make matters worse, capitalist dump goods in the market and in the process small capitalist disappear. This results in a capitalist crisis. The ultimate cause of crisis is the poverty and limited purchasing power of the masses. The period of economic crisis is characterized by over production, lack of demand, low prices, unemployment and low wages. However, this does not continue forever. Recovery soon starts, the succession from recovery to boom is followed by crisis indicates that, trade cycles are common in capitalist economies. In each period of crisis big capitalist expropriate small capitalist. By this time the workers become united and get ready to over throw capitalist. Ultimately the new socialist society comes into existence.

Critical Appraisal of Marx Theory

The Marxian theory of economic development can be examined from two angles. Marx's prophecy that the capitalist system will collapse after reaching the advanced stage of development and that socialism will emerge in its place only afterwards has been proved false by history.

Marx has pointed out that the technological progress is helpful to capitalist and increases the misery of workers. But this has not happened in the capitalist countries. On the contrary, workers have been receiving high wages and other facilities in these countries. The introduction of social security measures in the capitalist societies has promoted the welfare of workers. According to Marx, the development of capitalism will bring the capitalist and workers in the opposite camps. However, such a thing is now a matter of the past.

Many capitalist societies have taken many steps to achieve the objective of full employment; therefore, the industrial reserve army (unemployment) is not increasing.

Marx argument that as capitalism progresses wealth, economic power gets concentrated in fewer and fewer hands is also not a sound argument. Because, capitalist have to work with the rules and regulations framed by the governments of these countries.

The doctrine of surplus value is regarded as the weakest point in his theory of economic growth. Critics argue that all factors of production are needed to produce a commodity and workers alone cannot claim the entire volume of the commodity.

Marxian theory of economic growth is applicable indirectly to developing countries. All though Marx did not think of the problem of the developing countries, yet some of the variables of his analysis do exist in such countries.

3.7 Key Words

Increasing return : when the output is more than proportionate to increase in inputs

Decreasing return **:** when the output is less than proportionate to increase in inputs

Innovation : to bring out a new product or to improve the existing product or the method of production which is more efficient than earlier

Class struggle : the constant struggle between two classes of people owing to differences in interest

3.8 Sample Short Question

1. What is surplus value?
2. What is innovation?
3. What are the different types of innovation?
4. What is meant by positive and preventive check of population growth?
5. What is division of labour?
6. What is class struggle?

3.9 Sample Long Questions

1. Critically discuss Malthusian theory of development.
2. Explain, the Ricardian theory of growth. What are the drawbacks of this theory?
3. Prepare a note on Adam Smith's view on economic growth.
4. Explain, according to Marx how capitalism leads to the emergence of socialism.
5. Explain, Adam Smith's view on division of labour.

3.10 Suggested Readings

1. Thirlwall, A. P. (2011): Economics of Development, Ninth Edition, Palgrave Macmillan.
2. Todaro, M. P. & S. C. Smith (2003): Economic Development, Pearson Education.

UNIT-IV

NEO-CLASSICAL AND CAMBRIDGE MODELS OF ECONOMICGROWTH

Structure

4.0 Introduction

In this unit the learners may acquaint themselves with various models of growth accounting. The models particularly are off shoot of the Kenysian framework in the long run.

4.1. Objectives

Following are the learning objectives of the unit;

- Harrod model
- Damar model
- Neo-classical model of Solow
- Cambridge model (Joan Robinson only).

4.2 Harrods Model of Growth

Harrods model of growth arises out of the requirements of ensuring long run full employment equilibrium. In fact, the model extends the short run Keynesian problem of under-employment equilibrium to attain full employment in the long run. Under the Keynesian model the deficiencies of effective demand renders excess capacity in the system. In other words, if the short run problem of under-employment equilibrium is corrected

through investment in the short run, it creates further excess capacity in the system. Creation of such excess capacity gives rise to long run problem of ensuring a certain rate of growth of capital through continuous investment.

Based on the three basic postulates, Harrod process two theorem which governs his model of growth. First, is the Savings to Harrod communities income or the national output is one important determinant of savings. Second, the rate at which national output increases is another factor that determines the demand for savings. Finally, as in the long run every values tends towards equality, so does the demand and supply.

Based upon the three postulates, the first theorem states that;

There exists a rate of growth of national output or income, called as warranted rate of growth; g_w, such that if this warranted rate of growth holds in a given period, producers will repeat the same rate of growth of output (National income) in the subsequent period if it is physically feasible.

The second theorem states that if in any period if the rate of growth actually realized is different from warranted rate of growth, the difference or divergence between it will compound cumulatively. In other words, if the actual rate of growth (g_a), is higher (or lower) than the warranted rate of growth (g_w), then in the subsequent period, the actual rate of growth will be even more higher (or lower) and this will go on forever.

The razor edge equilibrium comes from the second theorem. It states that the actual rate of growth must be equal to the warranted rate of growth, unless so, the breach of this knife edge equilibrium may lead to even more divergence between both actual and warranted rate of growth.

The model considers two factors of production L & K, which is used in or fixed proportion implying L Shaped production function. Further, no outcome of the competitive economy, constant return to scale applies to it. There is no technical progression taking place for the time horizon set for the analysis. Finally, the population or the labour force grows at a constant rate (n).

The saving function is given as

$S_t = sY_{t-1}$

Where S is savings in aggregate, which is function of the proportion of national income. It is determined by the marginal propensity to save (s) times the national output produced in the previous year for the time period (t)

Also, the investment in any time period (t) is a constant proportion (v) of the difference between the income in time period (t) as well as (t-1). Hence,

$I_t = v(Y_t - Y_{t-1})$

Now, the equilibrium holds when I= S, as Y= C + I from demand side and Y=C + S from supply side. At equilibrium both demand and supply must be equal

$$\therefore C + I = Y = C + S$$

or ~~C~~ + I = ~~C~~ + S

I = S

But this condition of equilibrium is a flow concept as both investment and savings are flow items in accounting the national output. The flow condition although necessary is not a sufficient condition, unless backed up by or stock condition. The stock condition requires that the initial capital stock must be optimum capital stock.

Hence,

$K_o = K_o^*$

i.e. Actual initial capital is optimum capital stock. As such, the flow condition will imply that desired investment in any time period is realized through saving in that time period

i.e. $I_t = S_t$.

From our definition of savings and investments we can substitute

$V(Y_t - Y_{t-1}) = sY_{t-1}$

$\therefore \frac{Y_t - Y_{t-1}}{Y_{t-1}} = \frac{s}{v}$

Now the LHS of the above equation namely $\therefore \frac{Y_t - Y_{t-1}}{Y_{t-1}}$ is but the growth rate of income in time period (t). The equation implies that the income must grow at the constant rate of s/v (RHS

of the equation) in order to attain equilibrium in the commodity market. The$\mathcal{s}/\mathrm{v}$ is called the warranted rate of growth i.e. gw = $\mathcal{s}/\mathrm{v}$. Thus, warranted rate of growth is the ratio of savings ratio as well as the capital output ration (v).

Now, the first theorem above stated that if growth of income (national output) grows at the rate of warranted rate of growth, then this rate of growth, then this rate of growth will be maintained for all the subsequent time period to come.

i.e. if $\frac{Y_t - Y_{t-1}}{Y_{t-1}} = \frac{\mathcal{s}}{V} = gw,$

then $\frac{Y_{t+1} - Y_t}{Y_t} = \frac{\mathcal{s}}{V} = gw_2 \; and \; so \; on$,

Therefore, $gw_1 = gw_2 = gw_3 = \ldots. = gw_t$

The account theorem states that if actual growth rate does not correspond to the warranted rate of growth, i.e. if ga ≠ gw

Then $ga \gtrless gw$

ga =$\frac{Y_t - Y_{t-1}}{Y_{t-1}}$ $and \; gw = \frac{\mathcal{s}}{V}$

Hence, $ga \gtrless gw$ inverse

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} \gtrless \frac{\mathcal{s}}{V}$$

Or that, $V\ (Y_t - Y_{t-1}) >< \&\ Y_{t-1}$

Or $I_t \gtrless \mathcal{s}_t$

Now if $I_t > S_t$, there is excess capacity that has been created and to maintain that excess capacity it requires the continuous flow of investments. As such, more and more of excess capacity is created in the system.

However, if $I_t < S_t$ then there is excess of savings over investment implying underutilization of the capacity, leading to deficiency of investment demand. Hence, the underutilization of capacity will further deteriorate the demand and this will go on for all the subsequent period.

4.2.1 Introduction to Labour Market

As stated earlier, there are two factors of production capital and labour ad that labour enters in the system in the long run. In short run labour is assumed to be unlimited in supply, it is not a scarce factor, but in long run growth of labour force depends upon the rate of growth of population. To this long run rate of growth of population Harrod called the natural rate of growth which is constant and is designated as (n).

Since the labour supply grows at a constant rate (n) the labour supply function is given as

$L_t^s = L_o^s(Itn)^t$

Where L_t^s is the labour supply in period (t) and L_o^s is the initial or base period's supply of labour.

Also the labour demand is some fraction of the previous years income and is given as

$L_t^d = \propto Y_{t-1}$ Also $L_{t+1}^d = \propto Y_t$

Where L_t^d is the labour demand in time (t), $\propto$ is the labour –output ratio and is constant and the Y_{t-1} is the income in the preceding period of (t).

Now, in the long run when the initial demand for labour is L_{t-1}^d. If the output Y_{t-1} has to be realized at the end of the period (t-1) the demand for labour must be increased from L_{t+1}^d to L_t and so forth

$$\therefore L_{t+1}^d - L_t^d = \propto (Y_t - Y_{t-1})$$

Similar to the earlier stock and flow conditions, the labour market also requires the following conditions:

Stock condition where $L_o^d = L_o^s$ implying the initial labour supply and demand are equal and optimum. Also, the flow conditions is given as

$L_{t+1}^d - L_t^d = L_{t+1}^s = L_t^s$

Thus, both stock and flow condition imply that if the initial stock of labour demand and supply are at optimum, then the change in the demand for labour is equal to change in the supply of labour.

Now the equilibrium in the labour market is given as above equation as

$L_{t+1}^d - L_t^d = L_{t+1}^s = L_t^s$

But from our earlier definition we know that

$L_{t+1}^d - L_t^d = \propto (Y_t - Y_{t-1})$

And from the nature of labour supply function we also know that

$L_t^s - L_o^s(1+n)^t$

$Hence, \quad L_{t+1}^s = L_o^s(1+n)^{t+1}$

Therefore, $L_{t+1}^s - L_t^s$, the right hand side of the equation representing the equilibrium in labour market becomes

$L_{t+1}^s - L_t^s = L_o^s(1+n)^{t+1} - L_o^s(1+n)^t$

$= L_o^s(1+n)^t(1+n) - L_o^s(1+n)^t$

Factoring out, we get

$L_{t+1}^s - L_t^s = L_o^s(1+n)^t[\cancel{1} + n - \cancel{1}]$

Cancelling 1 and (-1), we get

$L_{t+1}^s - L_t^s = L_o^s(1+n)^t, n$

$Or\ L_{t+1}^s - L_t^s = nL_o^s(1+n)^t$

$Since\ L_o^s(1+n)^t - L_t^s$

by substitution we get

$L_{t+1}^s - L_t^s = nL_t^s$

Now, from the flow condition $\cancel{L_t^d = L_t^s}$we know that

$L_t^d = L_t^s$

But we also know that $L_t^d = \propto Y_{t-1}$

Hence, we can say that $L_t^s = \propto Y_{t-1}$ for the above equation.

We know that

$L_{t+1}^s - L_t^s = nL_t^s$

and $L_t^s = \propto Y_{t-1}$, therefore, by substitution of $L_t^s = \propto Y_{t-1}$ we get, $L_{t+1}^s - L_t^s = n \propto Y_{t-1}$

Also we know from our previous analysis that

$L_{t+1}^d - L_t^d = \propto Y_t - Y_{t-1}$

Now substituting the values of $L_{t+1}^s - L_t^s\ and\ L_{t+1}^d - L_t^d$ in our equilibrium flow equation

$L_{t+1}^d - L_t^d = L_{t+1}^s - L_t^s$ we get

$\propto (Y_t - Y_{t-1})_{t+1}^s = n \propto Y_{t-1}$

Or $\frac{\propto(Y_t - Y_{t-1})}{Y_{t-1}} = n \propto$

$Cancellng \propto throughtly, we\ get\ \frac{(Y_t - Y_{t-1})}{Y_{t-1}} = n$

Now $\frac{Y_t - Y_{t-1}}{Y_{t-1}} = ga$

$\therefore ga = n$

Thus, the above result shows no that, in order to attain the equilibrium in labour market, derived act of both the stock and flow conditions, it requires that the natural rate of population growth must be equal to the actual growth rate.

Now for the simultaneous equilibrium in both capital and the labour market requires that the actual rate of growth be in equation to warranted rate of growth, and that actual rate of growth must be equal to the natural rate of growth of population. In other words

$$ga = \frac{s}{V}$$

or $g_a = g_w$

and that $g_a = n$

Hence $g_a = g_w = n$

$$or\ ga = \frac{s}{V} = n$$

This condition is called the steady growth.

4.3 Domars Model of Growth

Although Domar bring about the same conclusion, he analysed his growth model from the point of view of productive capacity of the economy. As such, the economy is said to be in equilibrium state when the productive capacity equals the national income i.e. $P_t=Y_t$, in time period (t). The productive capacity is defined as

$P_t = \beta K_t$

Where P_t is the productive capacity, β is the constant output capital ratio and K_t is the capital stock in the time period (t). The productive capacity is, therefore, simply the maximum output obtainable when the labour force is fully employed.

Any change in the productive capacity can be obtained only by equivalent change in the capital stock. More specifically, the Supply of output is given as:

$$\Delta P_t = \beta \Delta K_t$$

The saving function is given as $S_t = sY_t$

Where S_t is the saving in time period (t) which is some proportion of the income (Yt) as determined by the savings ratio.

The required condition for equilibrium as in Harrod's model as

$I_t = S_t$

But as $S_t = \mathcal{s}Y_t$, therefore

$I_t = \mathcal{s}Y_t$

Or $Y_t = \frac{1}{\mathcal{s}} \times I_t$

In other words income (Y_t) in time (t) is a function of the inverse of savings ratio times the investment in the time period (t). Hence, any change in income (Y_t) can be brought about only by change in the investment (I_t) given the constancy of the saving ratio ($\mathcal{s}$).

i.e. $\Delta Y_t = \frac{1}{\mathcal{s}} \Delta I_t$

This is but the Keynesian multiplier.

Now, an economy will be in equilibrium over a period of time, if the following two conditions are fulfilled.

The flow condition i.e. $\Delta P_t = \Delta Y_t$ for any time period

t = 1, 2, 3, …….

Also the required stock condition is given as

$P_o = Y_o$

The conditions imply that change in the productive capacity or the supply is in equation with changed demand because the initial stock condition is fulfilled; implying initial productive capacity (supply) equals initial national output (demand).

Now from the flow condition $\Delta P_t = \Delta Y_t$

Since $\Delta P_t = \beta \Delta K_t$ from our earlier definition, and since $\Delta Y_t = \frac{1}{\mathcal{s}} \Delta I_t$

Hence, $\Delta P_t = \Delta Y_t \Rightarrow \beta \Delta K_t = \frac{1}{\mathcal{s}} \Delta I_t$

Now since change in the capital stock (ΔK_t) in any time (t) is investment in that time period, as there is no leakages in saving and investment by virtue of $I_t = S_t$. Hence,

$\Delta K_t = I_t$

Hence by substituting I_t for ΔK_t in the previous equation $\left[\beta \Delta K_t = \frac{1}{\mathcal{s}} \times I_t\right]$

We get

$\beta I_t = \frac{1}{\mathcal{s}} \times \Delta I_t$

Hence, $\mathcal{s}\beta = \frac{\Delta I_t}{I_t}$

Now, $\mathcal{s}$ is the savings ratio, β is the output-capital ratio and both $\mathcal{s}\ and\ \beta$ are constant. Further $\frac{\Delta I_t}{I_t}$ is nothing but the rate of growth of investment.

Thus, $\frac{\Delta I_t}{I_t} = \mathcal{s}\beta$ implies that if the productive capacity of the economy is to be fully utilized (full employment) the investment must grow at the rate of $(\mathcal{s}\beta)$. Only when the investment increases at the rate of $\left[(\mathcal{s}\beta) = \frac{\Delta I_t}{I_t}\right]$, the national output or income grows at the same rate. In other words,

Since, $I_t = S_t\ and\ as\ S_t = \mathcal{s}Y_t$

Or $I_t = \mathcal{s}Y_t$

Therefore any change in investment and given the constant savings ratio, the equation will be maintained only when there is some change in National output Y_t. Hence,

$$\Delta I_{t=}\mathcal{s}\Delta Y_t$$

Dividing thoroughly the above equation by I_t we get

$$\frac{\Delta I_t}{I_t} = \frac{\mathcal{s}\Delta Y_t}{I_t}$$

But $I_t = S_t$, hence by substitution in the RHS denominator we get

$$\frac{\Delta I_t}{I_t} = \frac{\mathcal{s}\Delta Y_t}{S_t}$$

Again $S_t - \mathcal{s}Y_t$. Hence by substitution

$$\frac{\Delta I_t}{I_t} = \frac{\mathcal{s}\Delta Y_t}{\mathcal{s}Y_t}$$

Cancelling the constant saving ratio in the RHS of the above equation

$$\frac{\Delta I_t}{I_t} = \frac{\Delta Y_t}{Y_t}$$

Now, we know that $\frac{\Delta I_t}{I_t}$ is the rate of growth of investment. Also $\frac{\Delta Y_t}{Y_t}$ is the rate of growth of income. In the other words, the rate of growth of income is exactly equal to the rate of growth of investment. It is only when $\frac{\Delta I_t}{I_t} = \mathcal{s}\beta$ that the $\frac{\Delta I_t}{I_t} = \frac{\Delta Y_t}{Y_t}$

Note that Harrods warranted rate of growth gw = $\frac{Y_t - Y_{t-1}}{Y_{t-1}} = \frac{\mathcal{s}}{V}$

Whereas, in case of Domar $\mathcal{s}\beta = \frac{\Delta I_t}{I_t} = \frac{\Delta Y_t}{Y_t}$ where $\mathcal{s}\beta$ is but the required rate of growth.

Now in Harrods model (v) is the capital-output ratio whereas in case of Domar model (β) is output capital ratio or the inverse of Harrods (V), or

$$\beta = \frac{1}{V}$$

Multiplying thoroughly by ($\mathcal{s}$) to the above equation we get

$$\mathcal{s}\beta = \mathcal{s}.\frac{1}{V} \; or \; \mathcal{s}\beta = \frac{\mathcal{s}}{V}$$

In other words, Domars required rate of growth is exactly the same as the warranted rate of growth of Harrod. The Crux of the model; both Harrod and Domar is that once the warranted or required rate of growth is achieved it will perpetuate for times to come. Any breach of this razor change equilibrium would rather compound the deviation and divergence from the initial equilibrium further and further away.

4.4 Solow Growth Model

The conclusion drawn by both Harrod and Domar was refuted by Solow through his growth model. Solow was of the view that both Harrod and Domar, inspite of their effort to analyse the long run equilibrium rather rested their conclusion upon short turn knife edge equilibrium growth. As such, whatever be the magnitude of slip by any of the parameters (saving ratio, capital-output ratio, and rate of growth of labour force) from the dead centre of the edge, the obvious consequence would be either growing unemployment or prolonged inflation. Hence, Solow gave an alternative treatment.

There is only one commodity, whose rate of production is designated as Y_t. Part of this output is consumed and rest is saved and invested. The fraction of output saved is a constant fraction ($\mathcal{s}$), so that the rate of savings is $S = \mathcal{s}Y_{(t)}$

The community's stock of capital is $K_{(t)}$

The net investment is then the rate of increase in capital stock overtime i.e. $\frac{dk}{dt} \; or \; \dot{K}$.

Hence, the basic identity is given as $\dot{K} = \mathcal{s}Y$

The output is produced with the help of two factors of production, labour (L) and Capital (K). The rate of growth of population or labour force is given as $L_{(t)} = L_o e^{nt}$ implying an exponential growth at rate (n). Unlike Harrod and Domar the technological possibilities are given by the production function

$$Y = F(K, L)$$

The output(Y) is to be understood as net output after eliminating the depreciation. The production function above is for the time being subject to constant Returns to scale, which automatically assures that it is homogenous of first degree.

Now since $\dot{K} = \mathit{s}Y \; but \; Y = F\,(K, L)$. Hence by substitution

$$\dot{K} = \mathit{s}F(K, L)$$

The above equation is a single/one equation with two unknowns. Nonetheless, we proceed in the spirit of Harrods Model and assume that the population growth is exogenous and so labour force grows at or constant relative rate of (n). Thus,

$L(t) = L_o e^{nt}$

In the equation $\dot{K} = \mathit{s}F(K, L), L$ stands for available total employment, whereas, in $L_{(t)} = L_o e^{nt}$, the (L) stands for the available supply of labour. Identifying both the (L) in above two equations, we assume that full employment is perpetually maintained. Hence, inserting $L_o e^{nt}$ in $\dot{K} = \mathit{s}F(K, L)$we get

$\dot{K} = \mathit{s}F(K, l_o e^{nt})$

Above equation determines the time path of capital accumulation that must be followed if available labour is to be employed. Also, $L_{(t)} = L_o e^{nt}$, implies that the labour force which is growing exponentially is employed completely. The equation $\dot{K} = \mathit{s}F(K, l_o e^{nt})$ is a differential equation in single variable ($K_{(t)}$) and its solution gives the only time profile of community's capital stock which will fully employ the available labour force. Once the time path of capital stock and that of labour force is known, it is possible to compute the time path of the production function corresponding the real output.

In other words, at anytime (t) the available labour supply is given by $L_{(t)} = L_o e^{nt}$, and the available stock of capital is a datum. Since the real return to factors will adjust to bring about the full employment of labour and capital, the production function Y=F(K,L) can be used to determine the current rate of output(Y). Since, propensity to save times output gives no the total savings we can also determine how much will be saved and invested, thereof. Thus, the net accumulation of capital during the current period and when added to already accumulated stock of capital gives no the capital available for investment in the subsequent period, and this process can be repeated.

Possible Growth Patterns

To examine whether or not there exists a capital accumulation path that is consistent with the growth of labour force we need to check the qualitative nature of equation$\dot{K} = \mathit{s}F(K, L_o e^{nt})$. It is but difficult to determine an exact solution without specifying the exact shape of the production function. However, we can get broad properties of it, even graphically.

To examine the above, we introduce a new variable $r = \frac{K}{L}$ or the ratio of capital per unit of labour. From above we get,

$rL = K$

$or\ K = rL_o e^{nt}$

$Since, L = L_o e^{nt}$

$differentiating\ K = rL_o e^{nt}$ with respect to time we get

$\frac{dk}{dt} = L_o e^{nt}.\frac{dr}{dt} + r.\frac{d}{dt}(L_o e^{nt})$

$Substituting\ \ \frac{dk}{dt} = \dot{K}, \frac{dr}{dt} = \dot{r}$

We get

$\frac{dk}{dt} = \delta L_o e^{nt} + nrL_o e^{nt}$

$or\ \dot{K} = L_o e^{nt}\ (\dot{r} + nr)$

Substituting the above value in the equation $\dot{K} = \mathit{s}F(K, L_o e^{nt})$

We get

$L_o e^{nt}(\dot{r} + nr) = \mathit{s}F(K, L_o e^{nt})$

Since the production function is subject to constant Return to scale, we can divide the variables in the function $F(K, L_o e^{nt}) by\ L = L_o e^{nt}$, provided we multiply the function by the same factor. Hence, we get

$L_o e^{nt}(\dot{r} + nr) = \mathit{s}L_o e^{nt}\ F\left(\frac{K,}{L_o e^{nt}}, \frac{L_o e^{nt}}{L_o e^{nt}}\right)$

$Or\ L_o e^{nt}(\dot{r} + nr) = \mathit{s}L_o e^{nt}\ F\left(\frac{K,}{L_o e^{nt}}, 1\right)$

$\dot{r} + nr = \frac{\mathit{s}L_o \cancel{e^{nt}}}{L_o \cancel{e^{nt}}}\ F\left(\frac{K}{L}, 1\right)$

since L = $L_o e^{nt}$

and hence

$\dot{r} + nr = \mathcal{s}F(r, 1)$

or$\dot{r} = \mathcal{s}F(r, 1) — nr$

the function F(r, 1) is the total product curve or the production function which states varying amount of capital employed per unit of labour. The equation $\dot{r} = \mathcal{s}F(r, 1) - nr$ states that the time rate of change of capital labour ratio is the difference of two terms, the $\mathcal{s}$F(r,1) represents the incremental capital and the second term nr represents the increment of labour. As such, where $\dot{r} = 0$, capital- labour ratio is a constant and the capital stock must be expanding at the same rate as labour fore. In other words, unless $\mathcal{s}F(r, 1) = nr, \mathcal{s}F(r, 1) - nr$ cannot be zero i.e. $\mathcal{s}F(r, 1) - nr \neq 0$.

It is only when $\mathcal{s}F(r, 1) = nr \; that \; \mathcal{s}F(r, 1) - nr = 0$

In such case,

$\dot{r} = 0$

and this would imply that the warranted rate of growth equals the natural rate of growth of population

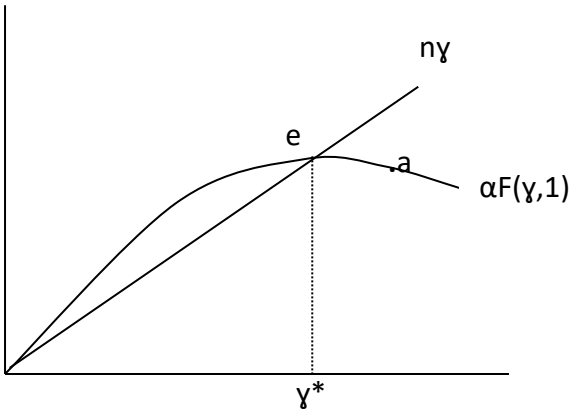

Figure 4.1

In other words, at pain (e) as r*=0 and $\mathcal{s}$F(r,1) = nr, in Harrodian scuse (e) = $^{\mathcal{s}}/_{V} = n = gw = ga.$

If the capital-labour ratio r* is established, it will be maintained perpetually and therefore, the capital and labour will grow in proportion thereafter.

By virtue of constant return to scale, real output will also grow at the same relative rate (n) and the output per head of labour will remain constant thereafter (L-shaped Production Function).

But in case of Harrod and Domar model, if $r \neq r*$ such that $r > r*$, it will imply a point right of (e). It can easily be understood that at any point right of (e), the curve (nr) >$\mathcal{s}$F(r,1)

i.e. nr >$\mathcal{s}$F(r,1)

Under the circumstance, as (n) is constant, the (r) will vary or decrease in the equation $\dot{r} = \mathcal{s}F(r,1) - nr$ thereby ultimately making back to point (e) and conforming to r*. In other words $r = \frac{K}{L}$ and $\frac{dr}{dt} = \dot{r} = \frac{d}{dt}\left(K/L\right)$ gives no the time rate of change in the capital- labour ratio. Whereas in the Right Hand side of the equation we have, $\mathcal{s}F(r,1) - nr$. Thus (r) decreases, reducing the Right Hand Side of the equation $\mathcal{s}F(r,1) - nr$ to recede back to point (e) ultimately realizing the $\dot{r}$ at r*.

Hence, Solow model unlike Harrod and Domar model, states the knife edge equilibrium as a myth.

Conversely, for any point left of (e) would imply that r*>r, in other words $\mathcal{s}F(r,1)\ nr$. Hence $\dot{r}$ will tend to move towards (e) and ultimately realizing the value (r*). Thus, the equilibrium value r* is a stable one.

Simply, Solow refutes the Harrod and Domars assertion of strict proportionality of $r = \frac{K}{L}$. Instead, his model states that whatever be the value of capital-labour ratio, the system (due to flexibility of $r = K/L$ will always lend towards a state of balanced growth at the natural rate of growth (n).

The time path of growth of capital and output is not exactly exponential but asymptotic. There is but an exception to it. That is if K = 0, then r=0 and the system cannot get started; without capital there is no output and hence no accumulation i.e. $\mathcal{s}Y = \mathcal{s}F(r,1), since\ Y = 0, Hence\ \mathcal{s}F(r,1) = 0$. But once there is any output; even if windfall, it will start the system towards (r*).

If the initial capital stock is below the equilibrium ratio, capital and output will grow faster than the growth in the labour force till it approaches the equilibrium at (e) thereby maintaining the ratio(r*) perpetually.

If the initial ratio (capital stock) is above the equilibrium value, capital and output will grow more slowly than the labour force. The growth of capital and output always lie around some intermediate value between those of labour and capital.

The strong stability is not inevitable or stand alone configuration. There may be other possibilities too.

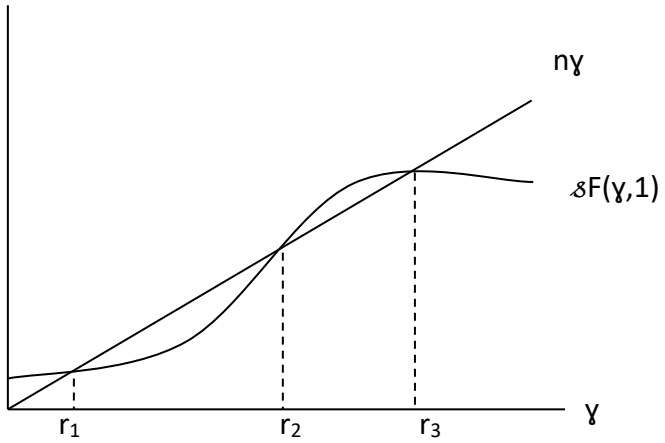

Figure 4.2

In the above diagram, there are three points of intersections r_1, r_2, r_3. amongst it r_1 *and* r_3. are stable as the $ꞩF(r,1)$ intersect the (nr) from above. In case of (r_2), the $ꞩF(r,1)$ intersects (nr) from below. Hence any disturbance at (r_2) may either push up or push below the system further and further away from (r_2). It is only in case of (r_1) and (r_3) that the system necessarily rest at r_1 *or* r_2. In either r_1 *or* r_3 the real output will asymptotically expand at the rate of natural growth (n).

However, at (r_1) there is less capital than that at (r_3), thereby rendering the output at (r_1) as less than at (r_3). The relevant balanced growth equilibrium is at (r_1) for any initial ratio of Capital-output (r) ranging in between (0 to r_1). With respect to the value of (r) any where above (r_2) is at (r_3).

Even this does not exhaust the possibilities of configurations. It may so happen that there exists no balanced growth path. Since a non-decreasing function F(r,1) can be converted to yield constant return to scale production function by multiplying the function by L, there can be many possibilities and configurations. The diagram below, for instance, gives us two possibilities.

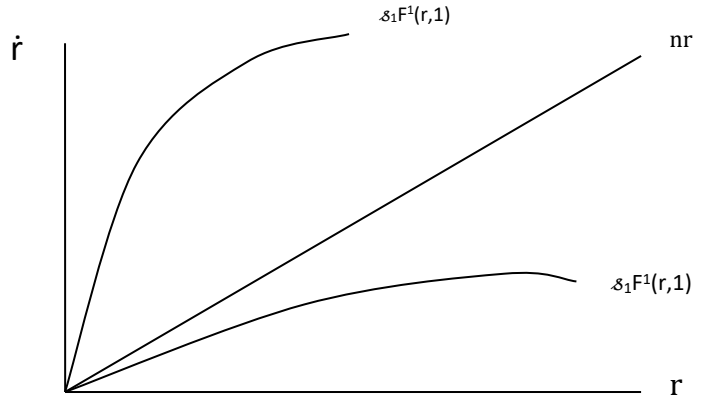

Figure 4.3

In other words, since F(K,L) is divided by (L) reducing the function into a $F\left(\frac{K}{L},1\right)$ implying capital per unit of labour (Labour given), Ultimatgely realizing a diminishing marginal productivity, but not interesting (nr) curve.

For the system representing $s_1F^1(r,1)$, it is so productive that accumulation is too high rendering the capital-labour ratio(r) too high, realizing increasing output per head, further leading to greater quantum of accumulation and so forth the output beyond limits. Hence capital and income bother increase more rapidly than the supply of labour.

The second system $s_2F^2(r,1)$, is so unproductive that the full employment path leads to diminishing per capita perpetually. Hence, net income can only rise because of the net investment which is always positive and so forth will be the labour supply.

The basic conclusion of Solow's analysis consequently yields that when production takes place under the usual neoclassical conditions of variable proportion and constant return to scale, no strict equality between natural and warranted growth rate is a necessary outcome. The system can adjust to any given rate of growth of labour force and eventually realize steady state of proportional expansion or growth. At most, there

can be a case of Cobb-Donglas production function but can never be any razor or knife edge.

4.5 Cambridge Model of growth (Joan Robinson)

The essence of Robinson's growth theorization can be summarized in her propostion: "If they have no profit, the entrepreneurs cannot accumulate, and if they do not accumulate they have no profit." Infact, the model explains the fundamental nature of economic growth in a capitalist system.

The basic equation gives the distribution of total output into two categories as between workers and entrepreneurs. Hence,

$$\rho\gamma = wN + \pi pK$$

Where (Y) is total output of the economy, (N) is the quotient of labour employed, (K) is the amount of capital, ρ is the averaged price of both output and capital, (w) is the wage rate and (π) the gross profit rate.

Dividing the above equation thoroughly by ρ we get,

$$\frac{\rho Y}{\rho} = \frac{wN}{\rho} + \frac{\pi\rho K}{\rho}$$

$$or\ Y = \frac{w}{\rho}N + \pi K$$

From the last equation $Y = \frac{w}{\rho}N + \pi K$ we can determine the gross profit rate as

$$or\ Y = \frac{w}{\rho}N + \pi K$$

$$or\ \pi = \frac{Y - \frac{w}{\rho}N}{K}$$

Dividing both numerator and the denominator by (N), we get

$$\pi = \frac{\frac{Y}{N} - \frac{w}{\rho}\frac{N}{N}}{\frac{K}{N}}$$

$$or\ \pi = \frac{\frac{Y}{N} - \frac{w}{\rho}}{\frac{K}{N}}$$

$$Substituting\ \sigma = \frac{Y}{N}\ and\ \theta = \frac{K}{N}\ We\ get$$

$$\pi = \frac{\sigma - \frac{w}{\rho}}{\theta}$$

The above equation shows that gross profit rate depends on three factors, namely; average productivity of labour ($\sigma = \frac{Y}{N}$), the real wage rate $\frac{W}{\rho}$ and the capital-labour ratio $\theta = \frac{K}{N}$. The expression $\sigma = {}^{W}/_{\rho}$ is the net output obtained from one unit of labour minus the real wage paid to one unit of labour.

Thus, gross profit rate depends directly upon the magnitude of net return ($\sigma = {}^{W}/_{\rho}$) and inversely with the capital-labour ratio (θ).

The production function is given by Y= F(K, N) and is assumed to be homogenous of degree one. Also, it is subject to constant Return to scale. In fact, the production function is the production counterpart o the distribution equation given above as $\rho\gamma = wN + \pi pK$

Considering the Keynesian GNP identity Y= C+I+G; demand side and Y=C+S+G; supply side, the equilibrium holds when demand is equal to supply. Hence,

$$C+I+G = Y = C=S=G$$

Cancelling the common terms, the equilibrium situation is best described as

$$I = Y = S$$

or simply as,

$$I = S$$

We can assume that the workers do not save in any significant proportion out of their income, instead, consumes their entire incomes (wage). This in macro aggregate means that the entire wage bill of the economy is consumed. As an off shoot to this assumption, we can intuitively derive that the capitalist consumption do not constitute any significant proportion to the total consumption of the economy, instead, they save. In other words they save for investments.

Hence we can write the consumption of the economy as

$$C = {}^{w}/_{\rho} * N$$

In other words, consumption expenditure in real terms is equal to the total wage bill of the economy. Where, ${}^{w}/_{\rho}$ is the real wage and N is the amount of labour. Also, for the total savings in the economy,

$$S = \pi K$$

Implying that total savings is equal to total profit in real terms. Where, π is the real rate of profit and (K) is the amount of capital employed. Also, the amount of change in the stock (K) is but the investment. Hence, we have

$$I = \Delta K$$

Hence by substituting ΔK for I and πK for S in the equilibrium equation $I = S$, we get

$$\Delta K = \pi K$$

By transposing the (K) in the above equation to the left hand side of the equation we get,

$$\Delta K/_K = \pi$$

But we already know the value of π from our previous analysis $\pi = \frac{\sigma - \frac{W}{\rho}}{\theta}$

Hence,

$$\Delta K/_K = \pi$$

Also implies

$$\Delta K/_K = \pi = \frac{\sigma - \frac{W}{\rho}}{\theta}$$

or $$\Delta K/_K = \frac{\sigma - \frac{W}{\rho}}{\theta}$$

In other words, the rate of growth of capital (given by $\Delta K/_K$) is given by profit rate as determined freely in the market by the market forces in the capitalist system. The rate of growth of capital is determined by the relative strength of the numerator and the denominator. In other words, if the net return per unit of the labour (given as $\sigma - \frac{W}{\rho}$) rises in greater proportion than the capital labour ratio (given as θ), then the rate of growth of capital increases and *vice-versa*. On the other hand, for a given level or constant σ ($\equiv \frac{Y}{N} i.e. output labour ratio$)and θ ($\equiv \frac{K}{N} i.e. the\ capital\ labour\ ratio$), then the rate of growth of capital ($\Delta K/_K$) increase (or decreases) as and when the real wage rate falls (or increases). In other words, the fall in the real wage increases the rate of growth of capital and *vice-versa*.

The Golden Age

The golden age is a situation where in all the capital and all the labour are fully employed. This can be derived as below:

By definition, $\theta = \frac{K}{N}$

which can be also be rewritten as

$$N = \frac{K}{\theta}$$

At the equilibrium as $\theta = \frac{K}{N}$ is constant and optimal, any change in the labour force can be brought only by change in the amount of the capital employed. Hence,

$$\Delta N = \frac{\Delta K}{\theta}$$

The rate of growth of labour force which can be fully be employed is then given as $\frac{\Delta N}{N}$. In other words,

$$\text{as} \frac{\Delta N}{N} = \frac{\frac{\Delta K}{\theta}}{N}$$

But from our previous derivation we know that $N = \frac{K}{\theta}$. Hence by substitution in the denominator, we get;

$$\frac{\Delta N}{N} = \frac{\frac{\Delta K}{\theta}}{\frac{K}{\theta}}$$

or,

$$\frac{\Delta N}{N} = \frac{\Delta K}{\theta} * \frac{\theta}{K}$$

Or,

$$\frac{\Delta N}{N} = \frac{\Delta K}{K}$$

Thus, fully employed labour force grows at the same rate as the fully employed growth rate of capital. This is the golden age.

4.6. Questions

1. Discuss the Harrods model of growth.
2. Show how Harrods warranted rate of growth is equivalent to Domars required rate of growth.
3. In the backdrop of Solows Neo-classical growth model criticize both Harrod and Domar model.
4. Discuss critically the golden rule of accumulation.

4.7 Key Words

Warranted Rate of growth	:	Rate of growth that is required to be maintained for a given level of saving ratio and capital output ratio.
Optimal Stock	:	The optimum amount of capital that is given at equilibrium when all the resources are fully employed
Natural rate of growth	:	The long run rate of growth or the relative rate of growth of population

4.8 Suggested Readings

Adelman, J., *Theories of Economic Growth and Development*, Stanford University Press, 1961.

Domar, E.D., *Essays in Theory of Economic Growth*, Oxford University Press, New York.

Kaldor, N., *Essays on Economic Stability and Growth*, Duckworth, London, 1980.

Solow, R. M., *Growth Theory: An Exposition*, Oxford University Press, 2000. .

Thirwal, A.P., *Growth and Development*, Macmillan, London, 1999.

Meier, G, *Leading Issues in Economic Development*, Oxford University Press, New Delhi, 1990.

Todaro, M.P., *Economic Development*, Longman, London, 1996.

Myrdal, G., *Economic Theory and Underdeveloped Regions*, Duckworth, London, 1957.

Ray, D., *Development Economics*, Oxford University Press.

UNIT - V

TECHNICAL CHANGE

Structure

5.1 Introduction

Technical progress is important for economic growth. It implies an increase in total output which is obtained without any increase in the factors of production employed. In other words, when a higher output is achieved with the given amount of factors of production then it is called technical progress of change. This means that the technical progress shifts the production function upward showing higher output with the same inputs or factors. Thus, technical progress is important and perhaps the main factor for economic growth. The

technical progress may take different forms. This unit covers the discussion on different types of technical progress endogenous growth theory and vintage capital model.

5.2 Objective

The objective of this unit to discuss the importance of technical change in economic growth and also to understand the different types of technical changes.

5.3 Hicksian and Harrodian Versions of Neutral Technical Progress

5.3.1 Hicks-neutral technical changes

The technical progress can be neutral or non-neutral. A technical progress is neutral when the relative share of labour and capital remains constant under certain conditions. On the other hand a technical change in non-neutral if it increases either the share of labour or capital.

The concept of Hicks neutrality was first put forth in 1932 by John Hicks in his book *The Theory of Wages.* A technical change is considered to be Hicks neutral if the change does not affect the balance of labour and capital in the production function. More formally given the Solow model production function.

$$Y = A(t)\, f(K,L)$$

Where A is technical progress parameter and is also referred to as the total factor productivity. A technical progress is Hicks-neutral change if it raises the total factor productivity (A).

The technical progress is said to be neutral if the ratio of the marginal productivity of labour to the marginal productivity of capital remains unchanged when the capital labour ratio remains unchanged. Mathematically, technical progress is Hicks neutral if the proportionate change in relative share i.e. I=0, along the path where the capital – labour ratio is constant. The Hicks neutral technical progress can be analysed with the help of diagram as follows.

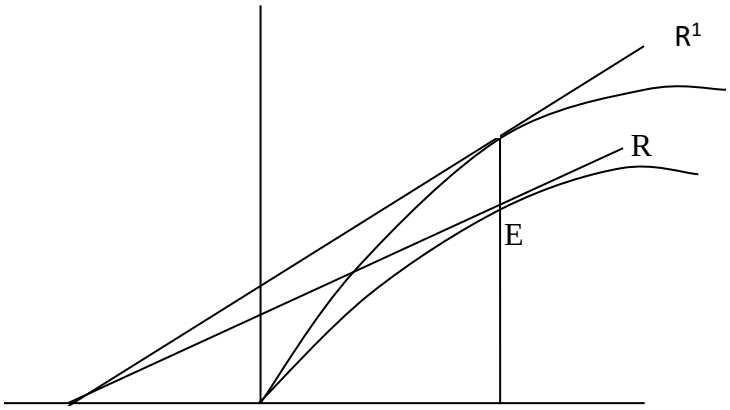

Figure 5.1

The capital-labour ratio is plotted along the horizontal axis and per capita output is measured along the vertical axis. There are two production functions which have been drawn to show the technical progress. The production functions before and after the technical progresses are OF and OF^1. The production function OF^1 in such a way that at an unchanged capital-labour ratio ON, the tangents to the two productions has the same intercepts OM from the horizontal axis. At point E, MP_L/MPk = OM. At point E' also MP_L/MP_k = OM. Therefore, MP_L/MPk is the same at points E and E^1 and capital-labour ratio remains the same. The technical progress is therefore neutral in the Hicksian sense. In the Hicksian neutral technical progress the marginal productivities of labour and capital change in the same proportion so that their ratio remains the same. The increase in output is obtained by raising output per head for all values of capital-labour ratio in a certain proportion. In the figure, EE'/EN is the proportion increase in output with unchanged capital-labour ratio. This proportionate increase in output is called the rate of technical progress.

5.3.2 Harrod Neutral Technical Progress

The technical progress is Harrod neutral if the rate of profit remains the same at the unchanged capita-output ratio. In case of Hicks neutrality the two points on the two production function have the same value of capital – labour ratio. But in the case of Harrod neutrality the two points on the two production functions have the constant output-capital ratio. Under the competitive the rate of profit is equal to the marginal productivity of capital. Therefore, it can be said that in the case of Harrod neutral technical change, the marginal productivity of capital will remain the same when the average productivity remains the same. Thus, the technical change is Harrod neutral, if the proportionate change in relative share (I) is zero along the path where capital-output ratio (K/Y) is constant. If capital –output remains

constant, it implies that marginal productivity of capital (MP_k) is constant and the technical progress is said to be Harrod-neutral.

If the marginal productivity of capital is not constant when the capital-output ratio is constant, then the technical progress is non-neutral. If the change in marginal productivity of capital is positive when capital-output remains constant, the technical progress is capital using or labour saving. Harrod neutral technical progress can be represented with the help of diagram as below:

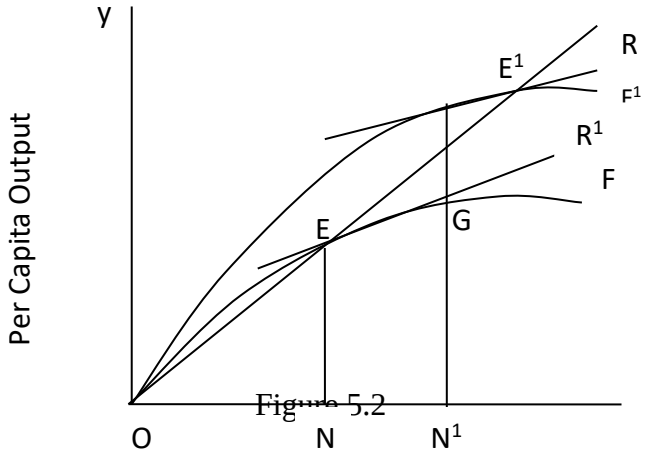

Figure 5.2

In the figure the capital-labour ratio is measured along the horizontal axis and per capita output is measured along the vertical axis. OF is the production before the technical progress and when the technical progress takes place the function shifts to OF'. The ray through the origin OR intersects the production functions at E and E' respectively. The slop of OE gives the output-capital ratio. Thus, the output-capital ratio is the same at points E and E'. The slop of the tangents at E represents the marginal productivity of capital or the rate of profit. If the slope of the tangents at E and E^1 are the same, then the marginal productivity of capital at E and E^1 are also the same. If that is so, then the technical progress is neutral in Harrod's sense. The ratio EG/EN or E^1G/GN^1 gives the rate of technical progress.

5.4 Labour and capital Augmenting Technical progress (Harrod and Solow versions)

Technical progress may be neutral or non-neutral. A technical progress is considered neutral if it raises the productivity of both labour and capital equally. On the other, hand, a

non-neutral technical is one which raises the productivity or one factor more than that of the other factor.

5.4.1 Harrod Version

According to Harrod, a technical progress is neutral the rate of profit remains the same at unchanged capital output ratio. In other word, a technical progress is neutral if the marginal productivity of capital will remain the saving. But, the marginal productivity of capital is not constant, then, the technical progress is said to be non-neutral. But is the change in marginal productivity of capital is positive when capital-output ratio is constant, the technical progress is capital augmenting or labour savings. On the other hand, if the rate of profit is constant when the output-capital ratio is rising, the technical progress is said to be labour augmenting or capital savings.

Given the production function

Y=F (K, L, t) where t represent time. It is assumed that the technical progress increases the output with passage of time even if L and K remain the same. Technical progress shows the increase in efficiency of at least one input which causes the total output to increase with the same inputs. The efficiencies increase with the passage of time so that they can be regarded as functions of time.

Let A (t) be the efficiency function associated with capital and B(t) be the efficiency functions associated with the labour. Now, incorporating these efficiency functions in the production function we get,

Y= F[A(t) K, B(t) L]

This is called factor augmenting production function. The expression A (t) K is called capital efficiency units and the expression B(t)L is the labour efficiency units. K and L are factors in physical units. Although factor quantities remain unchanged in physical units their supply increases in efficiency units.

Thus, given the production function in factor augmenting form as above, it can be stated that:

A Technical progress in is Harrod neutral or labour augmenting if $B(t) > 1$ and $A(t) = 1$.

On the other hand, the technical progress is capital augmenting, if $A(t) > 1$ and $B(t) = 1$.

5.4.2 Solow Version

Solow-neutral technical progress is just the opposite of Harrod-neutral technical progress. According to Solow, technical progress is neutral if the marginal productivity of

labour remains at constant labour output ratio (L/Y). The technical progress is said to be Solow neutral if the proportionate change in relative share of factors (I) is zero i.e. I = 0, along the path where Y/L is constant. Thus, if the output-labour ratio (Y/L) is constant and the marginal productivity of labour is also constant, then the technical progress is Solow – neutral.

However, if the marginal productivity of labour is not constant along a path when Y/L is constant, the technical progress is non-neutral. If the change in marginal productivity of labour is positive, the technical progress is labour augmenting. On the other hand, if the change in marginal productivity of labour is negative, then the technical progress is capital augmenting.

Given the production function;

Y= F (K, L,t) where t represents time. If the technical progress takes place, the output will increase without any increase in inputs. This is because the technical progress increases the efficiency of factors. Let A (t) and B(t) be the efficiency function associated with capital and labour respectively.

Now, by incorporating these efficiency functions in the production function, we get,

Y= F[A(t) K, B (t) L]

This is called factor augmenting production function. Given the production function, if A(t) > 1 and B(t) =1, then the technical progress is called Solow neutral. Thus, Solow neutral technical progress is capital augmenting. This means that efficiency of labour has remained constant and that of Capital has increased. This encourages the use of more capital and discourages the use of labour. So, it is called capital augmenting or labour- saving technical progress.

Thus, we find that a technical progress is Harrod neutral, if the rate of profit or the marginal productivity of capital remains constant, along the path where capital-output ratio is constant. The increase in output is achieved due to increase in productivity of labour so, Harrod neutral technical progress in labour augmenting.

In the case of Solow neutral technical progress, the marginal productivity of labour remains constant along the path where output-labour ratio is constant. The increase in output is achieved due to increase in productivity of capital. So, Solow neutral technical progress is capital augmenting.

5.5 Disembodied and embodied Technical Progress

The technical progress can be embodied or disembodied. The attempt to measure the contribution of technical progress was made by Abramovitz in 1956 followed by Kendrick and Solow. They considered the technical progress to be disembodied.

5.5.1 Disembodied Technical Progress

Disembodied technical progress is one which allows more output to be produced from the same inputs. Disembodied technical progress is based on the assumption that all labour and capital are homogenous. Disembodied technical progress affects all factors of production which are in current use equally and alike. It improves the productivity of all factors of production and of those already in existence. In case of disembodied technical progress, technical knowledge is assumed to come from outside the system like the falling of manna from the heaven. If the rate of technical progress depends on non-economic factors it can be regarded as exogenous. But if it depends on the economic factors like rate of capital formation or the rate of profit then the technical progress can be regarded as endogenous.

Disembodied technical progress shifts the production function in such a way that leaves the balance between capital and labour undisturbed in the long-run. The production function for such technical change is:

$$Y = F(K, L; t)$$

Where, Y is the output and K and L are capital and labour and t represents the technical change. Taking Hicks-neutral technical change as the basis, the production function in the special form can be written as;

$$Y = A(t)\ F\ (K, L)$$

Where A (t) in the index of technical progress which shifts the production function. It implies that the technical progress is organizational in the sense that its effects on productivity do not required any change in the quantity of the factors. It just shifts the production function upward through time.

Criticism

The disembodied technical progress suffers from the following drawbacks;

a) It emphasizes only on the technical progress and undermines the role of investment in the growth process.
b) It is based on unrealistic assumption of perfect competition, constant returns to scale and homogeneity of the capital stock.
c) It assumes that the output changes only due to technical progress. But output may also change due to change in quality of inputs, economies of scale and advances in knowledge.

5.5.2 Embodied Technical Progress

On the other hand, embodied technical progress is one in which the technical progress comes from within the system. In case of embodied technical progress all factors of production are not equally affected. It considers new capital formation as the vehicle of technical progress. The technical progress increases the productivity of only some factors. Embodied technical progress increases the productivity of only those machines which are built in the current period compared to the machines built in the previous periods. Technical progress does not increase the productivity of machines already in existence. In this case, the technical progress is said to be 'embodied' in new machines or the currently employed labour. Machines built in different dates are called machines of different vintages. Embodied technical progress is based on the assumption that machines built in different vintages are not similar and hence capital is not homogeneous. Similarly labour of one vintage is different from the labour of other vintages. However, each vintage consists of homogenous capital and labour. Therefore, a separate production function is needed to analyse the each vintage. Accordingly labour may also be treated in a similar way. Men of different vintages can be distinguished by age and training. Men of current vintage may be more productive than those of early vintages due to provision of better education and training.

Thus, the main point of difference between the disembodied and embodied technical progress is that while the former assumes that labour and capital are homogenous, the later holds that labour and capital of different vintages are not homogenous.

5.6 Overview of Endogenous growth theory

The endogenous growth theory explains that the long-run growth rate of an economy is determined by the exogenous factors. Since the growth is taken to be endogenously determined, the theory did matters the role of government. The endogenous growth theory criticized the neoclassical growth theory and extended the theory by introducing endogenous technical change.

The endogenous growth models have been developed by Arrow, Romer and Lucas. The endogenous growth models emphasis on technical progress which comes from the rate of investment, capital stock, the stock of human capital and serving rate.

Assumption

The endogenous growth models are based on the following assumptions;

1) There are a number of firms in the market.
2) Technological advance is a non-rival good.

3) There are increasing returns to scale to all factors taken together and constant returns to a single factor.
4) Technological advance is based on innovative ideas of people.
5) The individuals and firms earn profits from their innovations.

Given these assumptions, the three models of endogenous growth can be briefly explained as follows;

5.6.1 Arrow's learning by doing model

Arrow in his famous article "The Economic Implications of learning by Doing" in 1962 introduced the concept of learning by doing for the firm. Inthis model technical progress is regarded as an increase in some kind of knowledge and skill which come from the learning process. Learning is the product of experience. More is the experiences greater will be the learning and the faster will be the rate of technical change. According to Arrow, it is the cumulative gross investment in the economy which is used as an index of experience and not the cumulative output. Arrow uses a vintage approach in which technical progress is embodied in new machines. Labour requirement per unit of output on new machines decline over time as experience increases.

Arrow uses the following function expressing the labour requirement of the latest machine in a specific form as – G^{-M}, where G is the total number of machines ever produced and M is a parameter, $O< M < 1$. The technical progress is assumed to be embodied in new machines. So are act of investment does not raise the productivity of labour working on existing machines, but it raises the productivity of labour working on any machines that are built subsequently as it raises G.

Arrow shows that output in this model is capable any steady growth at the rate $\frac{n}{I-M}$. Where n is the rate of growth of population. The steady growth requires an equal rate of increase of G and output. The population growth provides a source of increase in output and experience which comes from the investment in learning process provides additional impetus to the growth. Growth could be maintained at a steady rate if there are some exogenous technical progress going on as well as learning.

5.6.2 The Romer's Model

Paul M. Romer in his paper 'Increasing returns and long-run Growth' in 1986 presented a variant of Arrow's model which is known as learning by investment. According to Romer knowledge which is the product of investment has two components. The first component is the human capital which specific to person and can be regarded as a rival good.

The second component is the technology which is available to the public and is a non-rival good. It is non-rival in the sense that its use by one firm does not limit its use by others. But human capital is a rival good because the person who invests in its accumulation solely receives the rewards from it. Technology is non-rival as the benefits of new technology come to the others as well. That is the benefits do not come only to the discoverer. The knowledge spillovers and will also use the new technology. Hence, there is a positive externality of investment which leads to creation of knowledge.

Romer assumes human capital to be fixed. A part of it is used for the production of the final good and a part is used for improvement of technology.

Suppose S_o is the fixed supply of human capital, S_y is the amount of human capital used in production of final goods (Y) and S_A is the supply of human capital for the improvement of technology (A), then,

$$S_y + S_A = S_o$$

The technology A is not fixed as it can be created by using a part of human capital (SA) in research and applying the existing technology A as follows:

$$\dot{A} = \sigma S_A . A$$

$$\dot{A}/A = \sigma S_A$$

Where; $\sigma$is the research success parameter. $\dot{A}/A$is the rate of growth of technology. $\dot{A}/A$will be positive so long as both σ and S_A are positive. Thus, research is assumed to be human capital intensive and technology intensive with no capital (K) and ordinary unskilled labour (L) engaged in that activity.

Romer takes knowledge as an input in the production function which is specified as follows:

$$Y = A (R) F ((R_i K_i, L_i)$$

Where Y is the output, A is the stock of knowledge from R research and development, R_i is the stock of results from expenditure on research and development by firm I, and K_i and L_i are capital and labour of firm i respectively.

He assumes the function to be homogeneous of degree one in all inputs.

The three key elements of the model are: internalities, increasing returns in the production of output and diminishing returns in the production of new knowledge. According to Romer, it is the research efforts by a firm which leads to creation of new knowledge or technology. The new technology spills over to the other firms and across the entire economy. To Romer, new knowledge is the ultimate determinant of long-run growth and knowledge is

determined by investment in research. But research technology exhibits diminishing returns. Moreover, the technology created by a firm spills over to other firms due to inadequacy of patent protection. The other firms also use the new technology and increase their production. Thus, the production of goods from increased knowledge exhibits increasing returns. Romer takes investment in research technology as an endogenous factor in terms of the acquisition of new knowledge by profit maximizing firms.

5.6.3 The Lucas Model

Robert Lucas in his article on the Mechanics of Economic Development in 1988 regarded investment in human capita as endogenous factors. He assumes that investment on education leads to creation of human capital which is the key determinant of growth. He distinguishes between the internal and external effects of human capital. Internal effects of human capital makes the workers undergoing training more production. The external effects of human capital refer to the spillover which increases the productivity of capital and other workers in the economy. Thus, it is the investment in human capital which ahs spillover effects and increases the level of technology.

The production function of firm i can be written as ;

$Y_i = A (K_i) . (H_i). H^e$

Where A is the technical coefficient, K_i and H_i are the physical capital and human capital used by the firm i.

Y_i is the output produced by firm i, the variable H is the average level of human capital of the economy, e shows the strength of the external effects from human capital to each firm productivity.

In this model each firm experience constant returns to Scale, while the economy as a whole experiences increasing returns to scale. Each firm benefits from the average level of human capital in the economy. Thus, it is the average level of skills and knowledge in the economy which is vital for growth.

The endogenous growth models showed that it is the endogenous factor which determines long-runs growth. However, the theory suffers from certain problems such as too much emphasis on the role of human capital and neglects the role of institutions, no clear distinction between physical and human capital.

5.7 Growth under vintage capital model

The vintage capital approach is based on the embodied technical progress. The model considers capital accumulation as the vehicle to technical progress. In this model, the technical progress which is the source of growth in output is embodied in machines built in

any particular period compared with machines built in the previous period. The technical progress increases the productivity of new machines but it does not increase the productivity of old machines. This is because the technical progress in embodied in the new machines. The machines built in different dates are the called the machines of different vintages. They are not similar in quality and they are not similar in quality and they cannot be aggregated into single measures of capital so a separate production function is required to measure the contribution each vintage.

The total output can be obtained by aggregating the outputs from all the vintage in use.

Assumptions: The model is based on the following assumptions:

1) The machines of different vintages constitute capital stock.
2) the machines of different vintages are not homogeneous.
3) New machines are more productive than the older ones.
4) the technical changes takes place at some proportion rate.
5) The technical changes are embodied in new machines.
6) Machines embody all the latest knowledge at the time of construction.
7) It considers only gross investment in new machines.
8) All technical change is uniform.
9) The production functions is linear homogeneous of Cobb-Douglas type.

Given these assumption, the model can be explained as follows;

In this model we need two time variable; one for the time in usual sense, say t, and the other, say V, for date of vitages of machines in use at time t.

Machines may be subjected to depreciation so as machines get older, their quasi-rent falls and eventually becomes zero when the machines are scrapped. For Simplicity it is assumed that there is no depreciation. Hence, it is important to find out the economic life (J) of machine of a particular vintage as a variable in the model. Generally, the machines in use at time t are of vintages V, where, $t - T \leq V \leq t$.

The model assumes that technical progress falls from the outside only on new machines. At time t, machines of vintages V are benefited from the technical progress. It is important to consider the substitutability between machines and labour before and after the installation of new machines. The substitutability between machines and labour can be assumed according to a smooth production. In general, the function will vary from one vitage to another.

Now, the production function for machines of vintage V, at time t, may be written as;

$Q_v = F_v (K_v, L_v)$ ---- (1)

Where, $K_v$is the number of machines L_v is the number of labour inputs and Q_v is the output. For simplicity, let us assume that the same function is applicable for all vintages. In Cobb-Douglas form, the above function may be written as –

$$Q_v = \alpha^{\partial v} K_v^{\alpha} L_v^{1-2} \quad ----(2)$$

Where ∂ is the rate of technical progress, $\partial > o \; and \; o < \alpha < 1$

If the production function is of the Cobb-Douglas from

$Q_t = e^{\partial t} \dot{K_t^{\alpha}} L_t^{1-\alpha}$

$\partial > o \; and \; O < \partial < 1$

In Harrod-neutral technical change, it can be written as

$Q_t = K_t^{\alpha} (e^{\frac{\partial t}{1-\alpha}} L_t)^{1-\alpha}$

$= K_t^{\alpha} (\bar{L}_t)^{1-\alpha}$

Where,

$= \bar{L}_t = e^{\frac{\partial t}{1-\alpha}} . {L_t}^{1-\alpha}$

$= e^{mt}.L_t$

Here, m = $\frac{\partial}{1-\alpha}$

or, ∂ = m (1- α)

It is the efficiency units of labour m represent the Harrod-neutral technical progress.

In Solow-neutral technical progress, the production function may be written as,

$Q_t = (e^{\frac{\partial}{\alpha} t} K_t)^{\alpha} . L_t^{1-\alpha}$

$(\overline{K}_t)^{\alpha} . L_t^{1-\alpha}$

Where, $\overline{K}_t = e^{\frac{\partial}{\alpha} t} K_t \overline{K}_t$ is the efficiency units of machines = $e^{m\prime t} K_t$

Where m' = $\frac{\partial}{\alpha}$ is the rate of Solow-neutral technical progress.

m' = $\frac{\partial}{\alpha} = \frac{m(1-\alpha)}{\alpha}$

Thus, the Cobb Douglas production function represents both Harrod-neutral and Solow – neutral technical progress.

The question that arises in this model relates to the substitution between machines and labour at any time after the installation of the machines of Vintage V in time t. There are two alternative cases which are possible:

Case I – The substitution between labour and capital countries.

Case II- After the installation of new machines, labour and capital are used in fixed proportion.

Let us consider the first case, which has smooth substitution between labour and capital both before and after the installation of new machines. This case is called Putty-Putty case following Phelps. Machines are installed in a continuous of vintages. The number of machines of vintage V is K_V which varies with V. K_V is the rate of installation per unit of time and $K_V dv$. The machines are assumed to of infinite life and the number of machines of vintage v in use at time t remains as Kv for all t. v.

The production function is assumed to be Cobb-Douglas form for all vintages. It can be written as ;

Qv(t) = $e^{m(I-\alpha)v} K_v^{\alpha} \{L_v(t)\}^{I-\alpha}$ ----- (3)

It shows that technical progress at Harrod neutral rate m is operative up to the time v at which the machines are brought in, but not thereafter. The number of machines of vintage V in use remains constant at K_V. So, Lv(t) and Qv(t) are only the time variable in the equation ---(3)

Regarding the contribution of labour to the total output, it is assumed that under perfect competition in the labour market all homogeneous units of labour must receive the same wage. Hence, the wage rate W(t) equals the marginal product of labour for machines of each vintages at time t

$W(t) = \frac{\partial Q_v(t)}{\partial L_v(t)}$ $for\ each\ v\ \alpha + > v.$

From equation (3) we get

$\frac{\partial Q_v(t)}{\partial L_v(t)}$= w(t) for each V and t ≥ v ---- (4)

The allocation of labour follows from (3) and (4) which determines Qv (t) and Lv(t) at ruling wage rate W(t).

From (3) we have –

Qv(t) = $e^{m(1-\alpha)} K_v^{\alpha} \{L_v(t)\}^{1-\alpha}$

But from equation (4) we get

Lv(t) $= \frac{(1-\alpha)Q_v(t)}{W(t)}$

Thus, we have,

Qv(t) = $e^{m(1-\alpha)v} K_v^{\alpha} \{\frac{(1-\alpha)Q_v(t)}{W(t)}\}^{1-\alpha}$

$Or, \{Q_v(t)\}^{\alpha} e^{m(1-\alpha)v} K_v^{\alpha} (1-\alpha)^{1-\alpha} \{W(t)\}^{-(1-\alpha)}$

$\therefore\ Q_v(t) = e^{\frac{m(1-\alpha)}{\alpha}v}.K_v.(1-\alpha)^{\frac{1-\alpha}{\alpha}}.\{W(t)\}^{\frac{-(1-\alpha)}{\alpha}}$

$Or, Q_v(t) = e^{m\prime v}.(1-\alpha)^{\frac{1-\alpha}{\alpha}}.\{W(t)^{\frac{-(1-\alpha)}{\alpha}}.K_v - - - - - (5)$

Where m' = $\frac{m(1-\alpha)}{\alpha}$

Again Lv(t) = $\frac{(1-\alpha)Q_v(t)}{W(t)}$

$\frac{(1-\alpha)}{w(t)}.e^{m(1-\alpha)v} K_v^{\alpha} \{L_{v(t)}\}^{1-\alpha}$

$Or, \{L_v(t)\}^{\alpha}.e^{m(1-\alpha)v} K_v^{\alpha}$

$\therefore\ L_v(t) = (1-\alpha)^{\frac{1}{2}}.e^{\frac{m(1-\alpha)}{\alpha}v}.K_v$

Or, $L_v(t) = e^{m\prime v}.(1-\alpha)^{\frac{1}{2}}.W(t)^{\frac{1}{2}}.K_v$

The equation, (5) and (6) shows that labour and output per machine for any vintage V depend only on the changing wage rate overtime. If W(t) increases then the allocation of labour to a machine of a given vintage will decline and output from the machine will also decline.

If Q(t) is the output obtained from all machines and L(t) is the labour employed, at time t, then the total output is given by the integration over all layers of capital stock. Thus, we have –

$$Q_t = (1-\alpha)^{\frac{1-\alpha}{\alpha}} \{w(t)^{\frac{-(1-\alpha)}{\alpha}} \int_{-\infty}^{t} e^{m'v} K_v.d_v$$

$$and\ L(t) = (1-\alpha)^{\frac{1}{2}} \{w(t)^{\frac{1}{2}} \int_{-\infty}^{t} e^{m'v} K_v.d_v$$

$$\therefore \frac{Q(t)}{L(t)} = \frac{1}{1-\alpha} w(t)$$

Here, Q(t), L(t) and W(t) are time variables.

$$w(t) = (1-\alpha)\frac{Q(t)}{L(t)} - - - - - (7)$$

And,

$$Q(t) = (1-\alpha)\frac{1-\alpha}{\alpha}.\left\{W(t)\frac{-(1-\alpha)}{\alpha}.J9t\right) - - - -(8)$$

$$L(t) = (1-\alpha)\frac{1}{2}.\{W(t)\}\frac{-1}{2}.J(t) - - - (9)$$

Where,

$$J(t) = \int_{-\infty}^{t} e^{m'v}.K_v d_v$$

J(t) represents the aggregate capital stock which is obtained by integrating the numbers of machines of various vintages. Solow calls the 'J" variable as the effective stock of capital which is productivity weighted sum of all the existing machines. Solow sound that the higher is the rate of embodied technical progress, the more productive will be the new capital than the older ones and the greater the scope for raising economic growth by increasing investment.

5.7.1 Limitations

The model suffers from certain limitations which are as follows:

1. It does not take into account the influence of wage expectations on machine construction.
2. The model does not consider the factor market imperfections as it is based on perfect competition which is unrealistic.
3. It assumes that machines depreciate exponentially which is not true for most machines.
4. The model assumes that machines are of different vintages and new machines are better than old ones. But it does not consider capital in general which is known as the aggregation of capital stock.
5. The model assumes that technical progress is embodied in new machines and ignores the innovations which come through the learning process and investment in research.

Despite, this limitation, the model has very interestingly explained the role of embodied technical progress in economic growth.

5.8 Let's Sum UP

The technical progress plays an important role in economic growth. Technical progress can neutral and non-neutral. In case of neutral technical progress, the productivity of both labour and capital equally and encourages their use. It is neither labour saving nor capital saving. But in case of non-neutral technical progress, the productivity of one of the factors raises more than that of others so the non-neutral technical progress can be either labour saving or capital saving. In Harrod neutral technical progress the productivity of capital or the rate of profit remains constant at unchanged capital output ratio. But in case of Solow-neutral of Solow-neutral technical change the marginal productivity of labour remains constant at unchanged output-labour ratio.

On the basis of source of origin, the technical progress can be disembodied and embodied. Disembodied technical progress is one which came from outside and is exogenously determined. On the other hand, embodied technical progress is one which comes from within the system and is determined by endogenous factors like rate investment. The technical progress is considered to be embodied in now machines which increases the productivity of only some factors.

The endogenous growth theory which was developed against the neo-classical growth theory showed that the growth is determined by the endogenous factors. These endogenous factors are the investment in education and research and development which creates knowledge, human capital and technology. The vintage capital model shows that the growth is determined by the technical progress which embodied in the new machines. the model assumes that capital goods or machines of different vintages are not homogenous. The new machines are more productive than the older ones as technical progress is embodied in new machines. The total output is obtained by integrating over all layers of capital stock.

5.9 Key Words

Capital-Output ratio:	It is the amount of capital required to produce one unit of output of a given commodity.
Capital-labour ratio:	It the amount of capital needed to employ one unit of labour.
Homogenous:	It is used to denote identical or similar products or factors.

Human capital: It refers to the skills, knowledge and experience possessed by an individual.

Vintage capital: It refers to the machines or capital built in a particular period.

5.10 Questions

1. Distinguish between neutral and non-neutral technical change. Explain the Harrod neutral technical change.
2. Explain the Hicks-neutral technical change.
3. AnalyseHarrod and Solow versions of labour and capital augmenting technical change.
4. Differentiate between disembodied and embodied technical change.
5. Outline the overview of the endogenous growth theory.
6. Evaluate the growth under vintage capital model.

5.11 Further/Suggested Readings

Sarkhel, J., *Growth Economics*, Book Syndicate Pvt. Ltd.

Thirwal, A.P., *Growth and Development*, MacMillan, London.

Solow, R.M., *Growth Theory-An Exposition*, Oxford University Press.

Sen, A., (Ed.), *Growth Economics*, Penguine

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