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UNIVERSITY OF JAMMU

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SELF LEARNING MATERIAL

FOR

M. A. ECONOMICS

SEMESTER - IIIrd | **UNIT : I - IV**

COURSE NO. : ECO 302 | **LESSON No. : 1 - 15**

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M. A. ECONOMICS

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DETAILED SYLLABUS

Course No. ECO 302 **Title : Theory of Economic Growth**

Credits : 6 **Maximum Marks : 100**

a) Internal Assessment : 20

b) External Examination : 80

Duration of Major Examination : 3:00 hrs

Theory of Economic Growth

Syllabus for the Examination to be held in December 2019 to December 2021

Preamble : After being acquainted with macroeconomic principles, the analysis of the macro economy in its dynamic state is of utmost importance. This course gives the students a overview of the determinants of growth, the role of various factors of production, technology, money as well as the policy implications of the various models of growth covered in this couse.

UNIT – I INTRODUCTION TO ECONOMIC GROWTH AND THE EARLY MODELS

Concept and importance of Economic Growth- The sylised Facts of Economic Growth, Sources of Economic Growth, Classical Theory of Economic Growth, Harrod's Model of Growth, Domar Model of Growth, Relevance of the Harrod- Domar Model to Contemporary developing Economies, Marxian Model of Growth and Collapse.

UNIT – II THE NEO-CLASSICAL MODELS AND THE MODELS OF THE CAMBRIDGE SCHOOL.

Solow's Model of Growth, with its various extensions, Meade's Model, The Neo-classical Model and the Golden Rule of Accumulation, Cambridge Models of Economic Growth-Joan Robinson's Model, Kaldor's Model, Pasinetti's Model, Samuelson and Modigliani on the Pasinetti Paradox.

UNIT – III THE TWO SECTOR MODEL, INTRODUCTION OF MONEY, OPTIMAL GROWTH AND TECHNICAL PROGRESS

The Extension of the Neo-Classical Model to two-sectors-Uzawa's Two Sector Model of Growth, Money and Economic Growth-Optimum Growth Models-Introduction and the Ramsey Model, Technical Progress-Different Types of Technical progress: Different Types of Techinical Progress.

UNIT – IV ENDOGENOUS GROWTH MODELS AND GROWTH ACCOUNTING

Models of Endogenous growth- Arrow's Learning By Doing- Model, The AK Model, the Production Function Approach to Economic Growth; Growth Accounting-Empirical Evidence, Limits to Growth.

NOTE FOR PAPER SETTING

There shall be two types of questions in each Unit - four short answer type (each of 250 words) and two medium answer type (each of 500 words). The candidate will have to attempt two short answer type questions and one medium answer type question from each Unit. Each short answer type question shall carry 4 marks and each medium answer type question shall carry 12 marks.

BASIC READING LIST

1. Barro, R. and X. Sale-i-Martin, Economic Growth, Prentice Hall India, New Delhi.
2. Branson, W. Macroeconomic Theory and Policy, Harper and Row.
3. Chiang, A.C. Element of Dynamic Optimization, McGraw Hill.
4. Sen, A.K.,Growth Economics, Penguin, Harmondsworth.
5. Solow, R.M. Growth Theory An Exposition, Oxford University Press, Oxford
6. Wan, I-I.Y., Economics Growth, Harcourt, Bracem, Jovanovich New York.
7. Chiang, A.C. Fundamental Methods in Mathematical Economics, McGraw Hill.
8. Robinson, J. The Accumulation of Capital, Macmillan.
9. Domar, B. Essays in the Theory of Economic Growth, Oxford University Press.
10. Thirlwall, A.P. Growth and Development, Palgarve.
11. Harrod R.F., Towards a Dynamic Economics, Macmillan.
12. Evans, M. Macroeconomic Activity, Harper and Row.
13. Kaldor N., Essay in Essays in Economics Growth and Stability, Gerald Ruckworth.

CONTENTS

M. A. ECONOMICS

COURSE NO. : ECO 302

SEMESTER III

PART I

M. A. ECONOMICS **LESSON NO. 1**

COURSE NO. : ECO 302 **SEMESTER III** **UNIT- I**

ECONOMIC DEVELOPMENT: CONCEPTS AND MEASUREMENT

1.1 INTRODUCTION

Economic development and economic growth are used interchangeably in normal day to day language. However, these two terms are as different as chalk and cheese. Generally, the term economic growth is associated with the developed countries while economic development with the developing ones. Yet, another distinction is made by describing growth as just quantitative by nature while development as both quantitative as well as qualitative. The early economic literature did not deal with economic development as a separate branch of economics. Economic growth, they believed, is natural or even inevitable which is an outcome of a market economy, cut throat competition, foreign trade, large scale production etc that lead to specialization of labour and increased efficiency whose benefits gradually spread to each nook and corner of the economy. In a nutshell they believed that economic growth was natural and needed no special attention and the national income and the standard of living of the general masses keep rising together. All that the government is needed to do is to ensure that there are no wild fluctuations to disrupt the market. The growth in national income would automatically remove poverty and inequality as benefits of economic growth will trickle down to the poor.

After the Second World War when a number of countries became independent from the colonial rule, they realized that the economies were stagnant with very low levels of national income. Apart from low level of income

with little growth, they were faced with a whole range of problems like lack of infrastructure, poverty, social backwardness, illiteracy, technological backwardness, small size of the market, lack of banking and financial institutions, dependence on agriculture etc. Their problem was that of economic development which means that growth of national income was only a part of their problem. They had to modernize their technique, their outlook and their institutions. Maddison believed that increase in income levels in developed countries is called economic growth and in underdeveloped countries, it is known as economic development. Mrs. Hicks is more accurate in remarking that problem of economic development is related to underdeveloped countries in the sense that they have unused resources though their uses are well known. Economic growth is related to developed countries where most of the resources are already being used. Schumpeter is of the view that growth is slow, gradual, continuous long run steady increase in income which is a result of increase in saving rate and population growth. Economic development according to him, is discontinuous and spontaneous change in stationary state that displaces the previously existing equilibrium level. Schumpeter is of the view that economic development is the result of innovation and enterprise. Friedman believes that growth is one-dimensional dealing with just increase in income while economic development is multidimensional. Todaro describes development as a multidimensional process in which increase in income is accompanied by changes in social structure, values, attitudes and institutions along with reduction in absolute poverty and inequality. Development in its finest form leads to a form of society which can easily satisfy its normal needs and desires, therefore, it must set the society free to follow its physical and intellectual pursuits.

An economy can grow without being developed if there is no reduction in poverty, inequality and unemployment. Therefore, economic development is a process related not just with increase in income but also increase in overall well being of the society. Professor Amartya Sen rightly says that economic development is not end in itself. The ultimate aim is to improve the quality of life. A person will still be poor despite his increase in income if there is no change in his abilities/capabilities. A quantitative increase in commodities is not

sufficient. What matters the most is how a society use these goods, how it wishes to use it and how it should be used? He remarks that the essence of development is freedom of choice, i.e. to live as you wish to live without your path being blocked by common needs. The ability to satisfy needs, to live with self-confidence and dignity and the freedom from slavery, according to Professor Sen, are the hallmarks of development.

1.2 OBJECTIVES

This lesson has the following objectives:

1. To discuss the debate on the economic growth and economic development.
2. To know about different methods to measure economic development along with their limitations.
3. To know about the importance of economic development.
4. To examine the factors determining economic development.

1.3 MEASUREMENT OF ECONOMIC DEVELOPMENT

Having defined economic development we move on another important question – can economic development be measured or quantified? If yes then how? From time to time as the concept of economic development underwent a change, so did its measurement and it became more polished and refined with time and experience. Some of these methods are discussed below :

1.3.1 Gross National Product and Real Per Capita Income : Economic development in its most crude and simplistic form can be measured with the help of gross national product (GNP). The logic is that GNP is a measure of the level of economic activity in a country. It is the sum total of final goods and services produced by all sectors of the country in a calendar year. A higher level of national income, therefore implies more goods and services, higher level of economic activity and higher level of development. By the same logic a country with higher GNP is more developed than the one with lower GNP.

The problem with GNP as a measure is that it does not take population of a country in to account nor does it account for fluctuations in prices. Real per capita income is a far better measure of economic development. National income is divided by population size at the first step to find the per capita income and it is further divided by the price index to cancel out the changes in price levels. The resultant real per capita income indicates the goods and services at the disposal of every individual of the country. Increase in real per capita income means that the purchasing power of the citizens has increased, so economic development has taken place.

These measures of economic development have some serious drawbacks. The measurement of GNP is based on goods and services that are bought and sold in the market. In poor countries most goods and services are produced for self-consumption and they never enter the market. A big chunk of activities by women in particular, is household work which is important for survival and well being but is unpaid. Last but not the least, a large share of goods and services is traded outside the market. This leads to wrong measurement of national income.

Secondly, the scale of black economy is quite high in underdeveloped countries. A large number of economic activities that involve black money, never get registered in these countries. Consequently, they do not enter in to GNP. Similarly, changes in stock do not get reflected in GNP. Transfer payments like old age pension, unemployment benefits, widow pension etc. though significant for welfare are not a part of GNP.

Thirdly, it is quite absurd and illogical that GNP does not distinguish between goods and services that perpetuate growth and that retard the growth. Expenditure on health, education and nutrition is no different from expenditure on tobacco, liquor etc. as far as GNP is concerned. Though the former is a very vital to economic as well as social development and the latter is a threat to it.

Fourthly, GNP is measured on basis of individual costs. Individual costs reflect half truths. Many industries in India deposit their wastes in to rivers and canals, conventionally passing the cost to the society. In case they are asked to bear the cost of safe disposal, they will have to shut down thus reducing GNP which means that current high level of GNP comes at the cost of future. The same can be said about any industrial/agricultural activity that eats in to resources of future g enerations or passes on the costs to future generations.

Fifthly, this measure does not take distribution of income and wealth in to account. The plain increase in GNP cannot be interpreted as economic development if the distribution of the gains is lopsided. The expanding GNP must be accompanied by improvement in living standards of masses, increasing awareness and increasing opportunities for all.

Finally, GNP measure just takes in account the level of output but it does not pay any attention to leisure time, entertainment, play that are the very essence of life. Development often comes at a very high cost in terms of work related stress that sometimes disrupts the social and family life and also it account for the irreparable damage to the environment or the amount of fossil fuel used in the process which are non-recoverable.

1.3.2 Physical Quality of Life Index (PQLI) : Realising the shortcomings of real per capita income measure, Morris D. Morris in 1979 developed PQLI to measure economic development. He used it initially to compare the development in 23 countries. His idea is to measure the variables which are indicators of living standards. He formulated a composite index based on three important variables given below that are indicators of development. These are:

(a) Infant Mortality Rate

(b) Life Expectancy at the age of one year

(c) Literacy Rate

He also used other variables like health, hygiene, education, availability of safe drinking water, sanitation etc. to gauge these indicators. PQLI is measured on a scale of 0 to 100, where the proximity to 100 is a symbol of higher economic development.

Morris is of view that level of income alone can never be taken as a sound indicator of economic development because it does not take distribution of income in to account. A highly unequal distribution can condemn millions of people to abject poverty even if the national income grows quickly. Therefore, Morris chooses those variables which are affected by distribution of income. Equality in distribution leads to improvement in these indices. Morris observes that infant mortality rate and life expectancy rate have a high positive correlation. National income growth is not just sufficient for an increase in PQLI because PQLI depends upon the overall structure of the economy. Morris confesses that his indices just reflect the physical quality of life. It does not map economic development or the structural changes in the economy. PQLI alone may not be sufficient but if we add income and consumption levels, it can complete the picture.

1.3.3 Human Development Index (HDI): Human development index, to date, is the most commonly used, most concrete and detailed measure of economic development. Constructed as a part of United Nations Development Programme, HDI has been in use since 1990 and Human Development Report has become an annual feature. HDI is based on three other indices that measure life span, knowledge and living standard. It is measured on the scale of 0 to 1, the higher the better.

(a) The Longevity Index: Expected life span is estimated at the time of birth. It indicates how long a person is supposed to live. Normally, the maximum value is taken as 85 years and the lowest value is taken to be 25 years. Life expectancy (LE) Index is calculated as follows:

$$\text{LE} = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

If the actual life expectancy is 65 years, then the life expectancy index will be $\frac{65-25}{85-25}=0.667$

(b) Educational Attainment Index: Education attainment is an important part of human development. It is calculated on the basis of adult literacy rate and combined enrolment ratio (CER). Let us assume that the adult literacy index is 0.6 and combined enrolment index is 0.9, the educational attainment index (EA) can be calculated with the help of following method with more weights being assigned to adult literacy index.

$$\text{EA}=\frac{2}{3}\left(\text{Adult Litercay Rate}\right)+\frac{1}{3}\ \text{(Combined Enrolment Ratio)}$$

$$=\ \frac{2}{3}\times 0.6+\frac{1}{3}\times 0.9=0.7$$

(c) Standard of Living Index: Standard of Living Index has undergone many changes and revisions. It is based on expressing the per capita income of a country in terms of international dollar in terms of purchasing power parity. The maximum value is taken as $40,000 and the minimum at $100. If the purchasing power of the per capita income expressed in dollar terms is $2500 then its standard of living index can be calculated using the natural logarithm as

$$\text{Income Index}=\frac{\text{In } 2500-\text{In } 100}{\text{In } 40000-\text{In } 100}=0.537$$

Finally, we can calculate the Human Development Index (HDI) as a simple average of above three indices

$$\text{HDI}=\frac{\text{LE}+\text{EA}+\text{Income Index}}{3}=\frac{0.667+0.7+0.537}{3}=0.637$$

Any increase in HDI over time is taken as a sign of economic development.

1.3.4 Purchasing Power Parity: Per capita income as a measure of economic development has several drawbacks. Besides it can not be used to compare development in two countries because of differences in currencies.

National income measurement is based upon those goods and services exchanged in the market which means that actual output in these countries is higher than measured. With the monetization of the economy, national income gets inflated even if no change in output takes place which means that some economic activities that escaped measurement once are being taken in to account. What appears to be economic growth might be a shift of subsistence economy to a market economy.

Another problem associated with national income as a measure of development and basis of comparison is its dependence on market prices which vary from time to time, country to country or even the stage of production. It is a well known fact that when a new commodity enters the market, its price is unusually high probably due to small scale of production. But as the production of that commodity increases, the prices tend to come down. Now a country where it is new may register higher national income compared to the other where it is not so new. Of course, the price index can be used to neutralize fluctuations in prices but using the right index is a problem in itself. In standard practice, a normal year is taken as a base year but a normal year in a country may not be normal in another country. Assigning due weights to different commodities is another obstacle because relative importance of different commodities varies from region to region, leave alone country to country.

It is difficult to understand that the fore-mentioned problems further complicated by different methods of calculation, access to the market do pose a big problem in international comparison. A rather simplistic way out of the problem is to convert the per capita income in to a common currency, let us say, in to US dollars which is done with the help of current exchange rate e.g. India's per capita income in dollars

will be equal to its per capita income in rupee terms divided by current exchange rate of dollar. Hypothetically, if India's per capita income in rupee terms is 20,000 and $ 1 = Rs 50, then India's per capita income in dollar terms will be 20000/50 = $400.

The major drawback of this approach is that the Rs 20,000 in India can be much more or less than $ 400 in USA. A lot depends upon the structure of demand, relative prices, institutional factors or even government intervention. The exchange rate itself is not a true indicator of the purchasing power of two currencies. It depends upon the monetary policies and other policy decisions. Even if we assume no intervention by the government, it is just based on the goods and services that enter in to international market or are the 'traded goods'. In developing countries, traded goods are only a small fraction of total economy, therefore, they are the poor indicators of the living standard. Traded goods move from low priced markets to high priced ones, leading to price equalization in long run. But this does not apply to non-traded goods which form a large part of the family budgets.

The labour abundant poor countries have lower wage rates. A large chunk of household consumption consists of cheap goods produced by labour intensive methods. Though their per capita income in dollar terms may appear to be quite low but its purchasing power in domestic market is quite high. So ideally, we should compare the purchasing power of per capita income rather than per capita expressed in dollar terms. Let us assume that a hair cut in India costs Rs 25 while we have to pay $5 in USA for the same service – a service that is non-traded. In this case the exchange rate is $1 = Rs 5. At this rate the per capita income expressed in terms of purchasing power parity would be 20,000/5 = $4000 not $400 as calculated on basis of market exchange rate. Purchasing power parity (PPP) measure is highly significant to those countries where the proportion of non-traded goods is relatively high.

Purchasing power parity in case of two countries can be calculated with the help of a simple method. The key is to formulate a list of comparable goods

in two countries; let us say, 'a' and 'b' the total value of output in each country is calculated by multiplying the quantities of various goods with their domestic prices. Then they are converted in to a common currency with the help of purchasing power rate of country 'a' with respect to 'b' which can be calculated as under

$$PPP_{ab} = \frac{\Sigma Q_i P_{ia}}{\Sigma Q_i P_{ib}}$$

Here, Q_i represents the level of output of any particular commodity in each country and P_{ia} represents the price level in country 'a' and P_{ib} represents the price level in country 'b'.

Purchasing power parity in case of more than two countries is a bit more complicated but highly useful. The crux of the problem is to express the purchasing power in a commonly accepted international currency. Irving Kravis and his associates attempted it first in 1975 and then in 1978 taking 100 comparable goods in 100 countries. The measurement of purchasing power in different countries in an international dollar enabled us to make international comparisons. It has been noticed that per capita income measured with the help of foreign exchange rate tends to underestimate per capita income as measured on the basis of purchasing power expressed at international prices. Let us assume that per capita income in terms of international currency depresses it by 1.25. The purchasing power parity approach does not use the prevailing exchange rate e.g. $1= Rs 50. It uses the exchange rate discounted by 1.25 which means $ 1= 50/ 1.25 = Rs. 40.

The approach developed by Kravis has led to further modifications and expansions to include more countries and more commodities. Summers and Heston used it in 1988 and 1991 to express real per capita incomes of various countries since 1950. It led to the development of Penn World table which is helpful in making international comparison of purchasing power.

To conclude, we can say that we have really come along way when we depended upon national income to compare the development of different economies. Our methods, today, are more sophisticated but really it is still a work in progress.

1.4 IMPORTANCE OF ECONOMIC DEVELOPMENT

The question of economic development is the most important question of our age and it has been asked for last many decades that why economic development is seen as the magic pill that can cure all the ills. Every country be it a socialistic economy, capitalistic or a mixed one believes that economic development and that too at a quicker rate can sole the problems being faced by them – from improvements in living standards, to removal of poverty, illiteracy, unemployment, social and economic backwardness to reduction in crime rate, social unrest etc. Economists go out of the way to assert that economic development can contribute to the world peace, the argument is that it is developed part of the world or the privileged sections of the society who demand peace and it is the poorer part or the deprived sections of the society that are the main threats to peace. In this context, it is often remarked that 'poverty anywhere is a threat to prosperity elsewhere'. Though, its importance is blown out of proportions, yet the fact remains that economic development is the single most important factor.

Consider the state of the Indian economy on the eve of independence. Ravaged by the colonial rules and the world wars, its growth had been close to 0.5 per cent since the advent of the 20th century or we can simply say that the growth was non-existent confined to a very few number of the industries. It was merely an economy/society shaped to serve its colonial masters. The literacy rate was barely 13 per cent. Around 80 per cent of the work force was dependent on agriculture which was bereft of modern techniques of production. It was overflowing with disguised unemployment, productivity was low and agriculture was dependent on nature. Agricultural markets were virtually absent. There were no dams or canals to support irrigation. The small, tiny and cottage industry was in tatters, most of it was being destroyed

systematically by our colonial masters. The service sector consisting of banking, insurance, health, education, power, transportation, communications etc. were non-existent for the common masses and producers. The industrial sector was developed in line with the needs of colonial masters rather than the needs of the local economy. Under such circumstances the incumbent governments after independence had to give priority to economic development along with economic growth. Keeping such situations in mind, let us discuss about the importance of economic development for any country.

1.4.1 Increase in National Income and Per Capita Income: Economic development is necessary for increase in national income which literally means that the economy produces more goods and services in an accounting year. It means an increase in amount of consumption goods as well as capital goods. While consumption goods lift people out of poverty and enhance the living standards, the increased output of capital goods ensures that productive capacity of the economy keeps on expanding and the development process can be sustained over a longer period of time. Economic development is not an end in itself, its ultimate aim is to ensure that goods and services at the disposal of society keep on increasing at a steady rate and at the first step, the society is able to satisfy its basic needs viz. food, clothing, shelter as well as basic education and health, without striving too hard.

1.4.2 Raising the Standard of Living: There is a huge difference in living and existing. In underdeveloped countries, a large chunk of population just exists. They spend the entire day, even the entire life working just to earn the daily bread or to say making both ends meet. They have no time or resources to appreciate the finer things in life and relish its beauty. Economic development propelled by scientific and technical advance can help raise the per capita income by proper utilization of resources and increase in productivity. An equitable distribution of gains from economic development means that the masses can earn their bread and butter with fewer working hours and the surplus

time and income can be used to follow dreams, pursue their interests, learn some art and cultivate their hobbies. Therefore, economic development can help them start living instead of just existing.

1.4.3 Improvement in Human Capital: A country is stated to be as good as its people are. Of course, systems and strategies are important but they take shape in hands of the people and are implemented through them. In the end, it all boils down to the quality of human capital. Economic development is needed to improve the living standards by placing more goods and services at their disposal. Proper healthcare and education is needed to create a fine balance between competition and co-operation, to inculcate a sense of creativity to harness their entrepreneurial urge, to work hard, to give due importance to personal and collective goals. The type of economic development that concentrates on material consumption only is bound to result in a society that is mentally sick. The right kind of development with its focus on human capital results in better kind of development.

1.4.4 Breaking the Vicious Circle of Poverty: Vicious circle of poverty is the greatest obstacle to economic development and the irony is that it can only be broken through economic development. Poor economies are trapped in vicious circle at a very low level of income. Backward techniques, unutilized resources and low level of productivity result in low level of income which in turn leads to low level of consumption as well as savings. Investment as a result is low because there is no demand, nor there are enough savings for the government to mobilize and invest. Small efforts fail to break the low level equilibrium trap. The only way out is that the government should invest in a big way on economic development through deficit financing or external borrowings and judiciously collaborate with foreign investors to enhance the level of economic activity. It should invest in physical and financial infrastructure as well as selective directly productive activities. The process of government backed economic development

may take decades before the vicious cycle of poverty is broken and the level of per capita income, saving rate, investment rate become high enough to take care of themselves.

1.4.5 Promotion of Economic Justice: The standard economic theory propagated by free market supporters is based on Simon Kuznets' hypothesis that economic development at the initial stage tends to increase inequalities in distribution of income and wealth but as the economic development enters in a mature state, the benefits of economic advance start trickling down to the poorest of the poor and the inequalities tend to decline. However, many critics, particularly, the latest work by Thomas Piketty (2014) has shown that Kuznets' approach is totally flawed. Using the data base spanning over a century, Piketty has been able to demonstrate, that the inequalities in wealth and income have been rising steadily in the last five decades or so. They are sharper in those countries where government intervention is less. So, we can say that uncontrolled economic development can not or does not promote economic or social justice. Government intervention in terms of curbs and controls, progressive taxation, its direct participation in vital productive activities and public services like health, education etc are important to make sure that benefits of economic development reach one and all. The fault does not lie with economic development as such but with the way it has been practiced. Economic development is meaningful only when it reaches the poorest of the poor, raises their standards of living and enhancing their chances to make use of their capacities and capabilities.

1.4.6 Utilisation of Natural Resources: Like most of the factors discussed above, proper utilization is both a cause and effect of economic development. Underdeveloped countries suffer from under-utilisation or non-utilisation of resources, natural resources being one of them. They have abundance of precious metal, fossil fuels and other raw materials but are not able to make optimum use of these resources

for want of capital, technical know-how and entrepreneurial skills. Most under-developed countries are just suppliers of raw materials. Economic development is all about building capacities in the local markets. It is about learning to use local raw materials to produce the finished goods at home. This may involve imports of costly foreign equipment and know-how but is always a better option than being the suppliers of raw materials for ever. One thing they need to be careful about is that they need not plunge for the latest technology in the name of modernization. Thus carefully planned and implemented economic development strategy can be helpful in proper and judicious use of natural resources which in turn can provide a great impetus to the growth process.

1.4.7 Awareness, Justice and Freedom: Economic development can be used as a perfect launching pad for creating awareness in the society – a society that realizes its rights and responsibilities and is prepared to act accordingly. Spread of education, new values, increase in information, communication, knowledge, mobility, coupled with increase in income and standard of living can help free masses of their factual and mental slavery, encouraging them to shed their backwardness. But the increase in income by itself is not sufficient to ensure that. Besides, old values do not change overnight. The barriers like caste system, feudal value system can only be eradicated by constant efforts over a long period of time. Here, the new value system promoted by expanding markets, new production methods, changing techniques brought about by economic development proves helpful in changing the old value system.

1.4.8 Emancipation of Women: Women constitute roughly half the population of a country. A country aspiring to grow can ignore half the population at its own risk. In underdeveloped countries in particular, women are grossly discriminated against and are usually made to perform less important activities. It will be more accurate to say that the activities they perform are considered less important, though it is a great misconception. Economic development creates opportunities

for women to move out of the household and perform outstandingly in a number of sectors that were once a male bastion. The economic development will be more beneficial and purposeful if it encourages and taps the unique feminine traits and strengthen their voice in the highest decision making bodies. The world as we see it, is in deep chaos and the reason is not difficult to fathom; it does not have a feminine voice. So, all economic development will be a sheer wastage of effort if it does not free the women of her chains and develops and uses her distinctive capabilities to build a better society.

1.5 FACTORS OF ECONOMIC DEVELOPMENT

Now we turn our attention to the main factors of economic development. It is important to know about the factors that convert a static, underdeveloped or poor economy trapped in a vicious cycle of poverty to transform in to an economy which grows automatically by itself on the back of high saving and investment rate. Economic development is not just an economic phenomenon related to per capita incomes and saving-investment ratios or growth rates, it is very closely inter-woven with social, political, cultural, religious and philosophical value system of the country. Let us analyse these factors one by one.

1.5.1 Economic Factors

(i) Rate of Capital Formation: One of the most important factors affecting economic development is capital formation which literally means that country must expand its productive capacity at a faster rate to make significant progress. The underdeveloped countries caught in a vicious cycle of poverty save and invest below 10 per cent of their income. The question therefore, before the underdeveloped countries is to transform an economy that saves and invests just 10 per cent of its national income in to an economy that saves and invests 25 per cent or more of its income. It is a long run process that needs a sustained effort on the part of the government. The saving capacity is low because of the low levels of income. So, it would be criminal on part of the government to force

people to save more with the help of the taxation. Public borrowings and printing new notes is a much better option. Government can borrow from abroad and enter into foreign collaboration to increase the level of investment. Simultaneously, attempts have to be made to mobilize whatever saving exist in the domestic market by placing checks on wasteful expenditure and speculative activities. Once the ball starts rolling it is easier to keep it rolling.

(ii) Transformation of Agriculture: Transformation and modernization of agriculture plays a very important role in economic development. 'Agriculture is a way of life rather than a profession' was a most common phrase used to describe India and other poor countries fifty years back when 75 per cent of the population was engaged in primary sector. Even today agriculture is a source of livelihood for more than 50 per cent of population. Barring few regions, agricultural productivity is very low, tools are primitive and it is full of disguised unemployment. Transformation of agriculture through better technology, improved seeds and very judicious use of fertilizers, improved irrigation etc. is important to meet the needs of a growing society. On the one hand, it will improve the living standards of those dependent on agriculture and on the other hand, it will provide cheap labour and surplus savings to facilitate the expansion of industrial sector.

(iii) Industrial Growth: Development of modern industrial sector is necessary to transform an underdeveloped economy. A country needs to build a strong industrial base if it intends to grow quickly and hold its own in the extremely competitive international market. Underdeveloped economies must develop basic and heavy industries independently or with foreign collaboration if needed. These industries like iron and steel, petroleum and natural gas, nuclear energy, engineering, metallurgy etc. all are very vital to the economy, which have far reaching consequences. Therefore, direct or indirect participation on part of the government is needed to them in the best

interest of public. These industries can contribute to growth of medium scale industries. Government needs to pay utmost attention to small scale and cottage industries and protect, promote them religiously. First of all, they cost very little, secondly, they generate a lot of employment, thereby contributing to equality and lastly, they can be used to preserve our heritage and traditional crafts which have a great export potential if properly marketed. Industrial growth can be of great help to agriculture as a provider of inputs and tools which in turn can provide raw materials to agro-based industries.

(iv) Banking and Financial Infrastructure: Banks play an important role in monetization of the economy. Obviously, the priority of the central bank, is to spread the banking sector to remotest corners of the country, to inculcate the banking habits in the masses, to mobilize the smallest of the savings and to widen the reach of the money market. If banking sector is needed to mobilize small, short term savings and advance small and medium term loans to a locality, the development banks, insurance companies, mutual funds are vital to the capital market for they provide medium and long term loans to the entrepreneurs making fresh investments. Equity shares, debentures, bonds etc. bring investors in direct contact with general public as well as the financial market. Thus, a strong and well integrated money and capital market is integral to the growing economies.

(v) Natural Resources: The development of an economy has a lot to do with the availability of natural resources which means the quality of land, its climate, bio-diversity, metals and non-metallic raw materials, minerals, rivers, availability of fossil-fuels etc. The abundance of natural resources is a great facilitator. But this availability is not sufficient in itself. It can also be a curse at the same time. Even a casual glance at the history will tell that those countries which had abundance of natural resources attracted most of plunderers including the European colonizers. Even after the end of the colonial rule, they continue to be

the exporters of raw materials. On the other hand, the countries with natural resources progressed because they worked hard to find alternatives and use their limited resources more judiciously, this made them more innovative and efficient. Therefore, it is not right to jump to the conclusion that the natural resources guarantee economic development, though they can be the facilitator but the real development depends upon their utilization for the growth of the society on a sustainable basis.

(vi) Technical Progress: Application of modern techniques of production in every sphere is a vital component of economic development. Industrial and agricultural growth and productivity is quite low in poor economies because of outdated techniques of production. Importing the latest technology is an easy option but not always the right one because it may make us dependent forever and secondly, the capital intensive techniques used by developing countries may not be suitable for the labour abundant economies. The investment in research and technological development can play an important role in economic development. They can help in moulding and adapting the foreign technology to suit the local conditions and requirements. In agriculture especially, the seeds or fertilisers used in other countries may not be suitable to our climate or the culture of the soil. Therefore, a great deal of research is needed before we adopt them. It is our duty to protect and preserve our bio-diversity. Higher growth rates are important undoubtedly but we must keep an eye on employment levels, conservation of nature etc.

(vii) Human Capital: In the last few decades, increasing importance is being attached to human capital. Other things being equal, a country with better human capital grows much quicker than the other ones. Human capital depends upon several factors like living standard of masses, health and nutrition, access to healthcare, clean drinking water, primary and higher education, technical skills, entertainment etc. These

factors in turn, depend upon distribution of income and wealth. If the gains from economic development are shared by large number of people, it will lead to better quality of human capital. It will also create a sense of belonging. A healthy, skilled, educated, responsible, motivated and committed public is the most important ingredient of economic development because it has the capacity to overcome thousands of the obstacles.

(viii) Social Overhead Capital: Social overhead capital that consists of roads, bridges, dams, transportation, means of communications, universities, research institutes, irrigation systems, electricity etc. is integral to the process of economic development. The major problem with the social overhead capital is that its effect on growth rate becomes visible only after a longer period of time and the rate of capital is very low to start with. There is another problem with the development of social overhead capital that it cannot be done in small parts, it takes a lot of time to bring the returns to its investments. Naturally, the private sector will not be much interested due to the lumpy and risky nature of its investment. Here, the government needs to step in and this type of government again needs a big push, particularly in the developing economies. Very selectively, the government may take some help from foreign investors but it can be risky for the long run. So, it is always advised to generate internal resources for the same.

1.5.2 Non-Economic Factors: Economic development as we have discussed above is not purely an economic phenomenon. It embraces and touches every sphere of life. It is a process that affects and is affected by social and political set up, the value system and the organization. Let us have a look at all such non-economic factors.

(i) Social Factors: Social values, faiths, beliefs etc, play a very important role in economic development. The industrial revolution in the west was accompanied by new set of social, moral and religious values

that promoted individualism, freedom, enterprise etc. that saw nothing wrong with promotion of self-interest. It placed high value on working hard, saving, investing and taking risks to earn high profits. It also leads to more mobile nuclear families replacing the joint family system.

The underdeveloped countries in contrast have a huge population which is ruled by old fashioned cultural and religious values. The religion preaches contentment where greed is a vice. Yearning for material goods and working hard to attain them is still looked down upon. Participating in festivities and celebrating is the way of life. Joint family system, kinship, caste system etc are all considered to be of paramount importance. The economists look at them as the barriers to growth. Education, communication and transportation can be used to change the age old values and practices. Any change forced upon them will be met with stiff resistance making them even more rigid. The only way out seems to be providing them with an incentive to change. The increased connectivity with the rest of the world can make them aware of other lifestyles and make them open and receptive to change. The gradual transformation of agriculture can be of immense help.

(ii) Political Factors: No economic development is possible if it is not backed by a strong political will. A country needs peace, political stability, protection, a suitable monetary, fiscal and commercial policy, far-sightedness and clarity of purpose to grow quickly. The duty of political set up is to formulate appropriate policies, to ensure justice and freedom so as to promote entrepreneurship and mobilize the masses. The administrative set-up is needed to make sure that the government policies are implemented in letter and spirit. It also provides the government with feedback which helps it to make the timely changes if any policy is flawed and needs correction. Professor Lewis remarked so accurately, “The behavior of government plays a vital role in stimulating and discouraging the economic activity”. Justice, peace and stability are vital to the development of entrepreneurship, invention and

innovation. Political class through the institutional support, helping in risking ventures, availability of easy credit, development of infrastructure and making investments wherever needed can expand the size of market besides providing subsidies and protection, can help in the development of domestic productive capacity and generation of employment. Through the choice of appropriate technology, it can optimize the use of resources in the best interest of the public.

None of the above listed factors can be termed as less or more important one. The strategy of development may vary from country to country depending upon the conditions and convictions. Some countries may depend more on public sector while others may relegate it to secondary role. Similarly, some may attach top most priority to industrial sector, others may choose agriculture. The reason may be that the underdeveloped countries do not have enough resources to invest in all sectors simultaneously. But ultimately, each sector has to be taken care of.

1.6 SUMMARY AND CONCLUSIONS

In this lesson, we have discussed about the concept of economic development and how it differs from that of the economic growth. We have observed various methods to measure economic development alongwith their limitations. Among many methods to measure economic development, the most popularly used are the real per capita GNP, Physical Quality of Life Index, Human Development Index, Purchasing Power Parity Index etc. It has been observed that for international comparisons among countries at different levels of development and economic structure, it is always appropriate to measure and compare their per capita income at the purchasing power parity rate instead of measuring it the official exchange rates. The Human Development Index, which also uses income as one of its three indicators in purchasing power parity terms is a much wider and most commonly used index to compare the level of development of different economies and how they change their ranking over a period of time. We have also discussed the importance of economic development and what are the main determinants of economic

development. Among various economic and non-economic factors one can not simply say which one is the most important and which one is not. Actually, all of the factors determined here are mutually reinforcing and resulting in faster economic growth only when they are grown simultaneously. Though, some countries may be giving priority to certain sectors initially depending upon their local needs and endowments but ultimately, a judicious mix of all the favourable factors is the key to self-sustained and long term economic development.

1.7 GLOSSARY

(a) International Currency: An international dollar has the same purchasing power as the U.S. dollar has in the United States. Costs in local currency units are converted to international dollars using purchasing power parity (PPP) exchange rates. A PPP exchange rate is the number of units of a country's currency required to buy the same amounts of goods and services in the domestic market as U.S. dollar would buy in the United States. An international dollar is, therefore, a hypothetical currency that is used as a means of translating and comparing costs from one country to the other using a common reference point, the US dollar.

(b) Penn World Table: The Penn World Table provides purchasing power parity and national income accounts converted to international prices for 189 countries/ territories for some or all of the years 1950-2010.

(c) Traded and Non-traded Goods: The goods that enter in to international trade or are perfectly mobile across nations are called the traded goods. On the other hand, a good that is not traded, either because it cannot be or because trade barriers are too high are often termed as non-traded goods.

1.8 SHORT ANSWER TYPE QUESTIONS

Q 1. Differentiate between economic growth and economic development.

Ans. Generally, the term economic growth is associated with the developed countries while economic development with the developing ones. Yet, another distinction is made by describing growth as just quantitative by nature while

development as both quantitative as well as qualitative. Schumpeter is of the view that growth is slow, gradual, continuous long run steady increase in income which is a result of increase in saving rate and population growth. Economic development according to him, is discontinuous and spontaneous change in stationary state that displaces the previously existing equilibrium level. Todaro describes development as a multidimensional process in which increase in income is accompanied by changes in social structure, values, attitudes and institutions along with reduction in absolute poverty and inequality. Development in its finest form leads to a form of society which can easily satisfy its normal needs and desires, therefore, it must set the society free to follow its physical and intellectual pursuits.

Q 2 Define Physical Quality of Life Index.

Ans. The Physical Quality of Life Index or PQLI is developed by Morris D. Morris in 1979 to measure economic development. He used it initially to compare the development in 23 countries. His idea is to measure the variables which are indicators of living standards. He formulated a composite index based on three important variables given below that are indicators of development. These are:

(a) Infant Mortality Rate

(b) Life Expectancy at the age of one year

(c) Literacy Rate

He also used other variables like health, hygiene, education, availability of safe drinking water, sanitation etc. to gauge these indicators. PQLI is measured on a scale of 0 to 100, where the proximity to 100 is a symbol of higher economic development.

Q 3. Write a short note on Human Development Index (HDI).

Ans. Human development index, is the most commonly used measure of economic development. Constructed as a part of United Nations Development Programme, HDI has been in use since 1990. It is based on three indices that measure life span, knowledge and living standard. It is measured on the scale of 0 to 1, the higher the better. These indices are:

(a) The Longevity Index: Expected life span is estimated at the time of birth. It indicates how long a person is supposed to live. Normally, the maximum value is taken as 85 years and the lowest value is taken to be 25 years. Life expectancy (LE) Index is calculated as follows:

$$\text{LE} = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

(b) Educational Attainment Index: Education attainment is an important part of human development. It is calculated on the basis of adult literacy rate and combined enrolment ratio (CER) by assigning greater weights to adult literacy index as given below.

$$\text{EA} = \frac{2}{3}\left(\text{Adult Litercay Rate}\right) + \frac{1}{3}\ \text{(Combined Enrolment Ratio)}$$

(c) Standard of Living Index : It is based on expressing the per capita income of a country in terms of international dollar in terms of purchasing power parity. The maximum value and the minimum per capita income is found among the group of countries at PPP rate in terms of international dollar then its standard of living index can be calculated using the natural logarithm as

$$(\text{Income Index}) = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

Finally, we can calculate the Human Development Index (HDI) as a simple average of above three indices

$$\text{HDI} = \frac{\text{LE} + \text{EA} + \text{Income Index}}{3}$$

Any increase in HDI over time is taken as a sign of economic development.

Q 4. Give the simple method to measure PPP rate in case of two countries.

Ans. Purchasing power parity in case of two countries can be calculated with the help of a simple method. The key is to formulate a list of comparable goods in two countries; let us say, ‘a’ and ‘b’ the total value of output in each country

is calculated by multiplying the quantities of various goods with their domestic prices. Then they are converted in to a common currency with the help of purchasing power rate of country 'a' with respect to 'b' which can be calculated as under

$$PPP_{ab} = \frac{\Sigma Q_i P_{ia}}{\Sigma Q_i P_{ib}}$$

Here, Q_i represents the level of output of any particular commodity in each country and P_{ia} represents the price level in country 'a' and P_{ib} represents the price level in country 'b'.

1.9 XAMINATION ORIENTED QUESTIONS

1. Discuss various methods to measure economic development.
2. Outline the problems of international comparison of per capita income of different countries and what is the way out?
3. Elaborate the importance of economic development for a country.
4. Discuss various factors determining economic development.

1.10 SUGGESTED READINGS

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1.12 MODEL TEST PAPER

I. Answer the following in brief.

Q1. Differentiate between economic growth and economic development.

Q2: Define Physical Quality of Life Index.

Q3. Write a short note on Human Development Index (HDI).

Q4. Give the simple method to measure PPP rate in case of two countries.

II. Answer the following in detail

1. Discuss various methods to measure economic development.
2. Outline the problems of international comparison of per capita income of different countries and what is the way out?
3. Elaborate the importance of economic development for a country.
4. Discuss various factors determining economic development.

THE CLASSICAL THEORY OF ECONOMIC DEVELOPMENT

2.1 INTRODUCTION

The Classical theory is based on the views of Adam Smith, David Ricardo, Malthus, J. S. Mill, J. B. Say to name a few. It was a time when economics as a separate branch of study was began to emerge. The works of the classical economists are spread over a century beginning with about 1776 A.D. with Adam Smith's work 'An Enquiry in to Nature and Causes of Wealth of Nations'. It continued to be refined, improved and expand. Later on David Ricardo published his work on Principles of Political Economy and Taxation. Malthus and J. S. Mill joined in later on to fill the gaps. Here in this lesson, we will focus on two major contributions to the classical approach of development viz. Adam Smith's theory of Economic Development and David Ricardo's views on economic development.

2.2 OBJECTIVES

The main objectives of this lesson are given below:

1. To discuss about the classical approach to economic development in general.
2. To examine the specific ideas of Adam Smith on economic development.
3. To find the limitations of Adam Smith's theory.
4. To examine the specific ideas of David Ricardo on economic development.
5. To find the limitations of David Ricardo's theory.
6. To examine the limitations of the classical theory in general.

2.3 ADAM SMITH'S THEORY OF ECONOMIC DEVELOPMENT

Adam Smith is known as the 'Father of Economics' for his pioneer work 'An Enquiry in to Nature and Causes of Wealth of Nations'. Adam Smith attracted a lot of appreciation as well as criticism for this work. Actually, he did not come up with any path breaking ideas. He just presented the existing ideas in a systematic way. He was a professor of Philosophy and Logic in Glasgow. He was greatly influenced by the ideas of his contemporary Physiocrats like Hutchison, Hume, Tucker and their predecessors like North, Locke and Mandeville. Adam Smith based his concept of self-interest under the influence of Mandeville's Classic work 'Fable of Bees'.

Smith's faith in optimistic natural outlook was influenced by Hutchison's 'System of Moral Philosophy'. Hutchison believed in man's moral tenderness than his kindness and selfishness. Hutchison's ideas of division of labour and values had great impact on Smith's ideas. The ideas of free market and division can be traced back to Ghazili 12th century and Tusi 13th century Islamic philosophers. David Hume's views helped Adam Smith understand the relationship between economic changes and their social effects. The ideology of individual interest being the driving force of the society was borrowed from James Tucker. From the Mercantilist school Turgot shaped Smith's views regarding individual freedom and non-intervention on the part of the government.

The genius of Adam Smith does not lie in producing new revolutionary ideas. Instead it lies in carefully analyzing vast amounts of contemporary and

past literature belonging to various schools of thoughts, selecting the relevant ideas and rejecting the useless ones. With his untiring efforts and his sharp vision he was able to present these ideas in an interconnected and consistent manner which were published in his book 'The Wealth of Nations'. Major points of his philosophy are outlined below:

2.3.1 The Operation of Natural Laws: Adam Smith's ideas must have been shaped by the developments in other sciences like physics which was discovering that every thing in universe follow a natural order, bound by natural laws as if helped by invisible hand or the hand of a superpower. Understandably Smith brought this philosophy to the core of economics.

Smith placed great emphasis on individual freedom and voluntary exchange. He believed that an individual should be given full economic freedom to take decisions on his own. He is the best judge of his own welfare, therefore only he can decide how to distribute his scarce resources among different uses. So, there is no place for government intervention in economic affairs of the society. All the individuals acting independently make their own economic decisions out of their own free will and enter in to voluntary exchanges to maximize their individual welfare. Everybody in the process of ensuring his own maximum welfare automatically ensures the welfare of the society. The economic freedom acts as an incentive to individuals to work hard and fine tune their skills which result in the betterment of the society.

Smith believes in eternal goodness of nature and natural laws which according to him are complete, useful and superior to manmade laws. Nature teaches man morality, it teaches him to be kind and honest for the welfare of the whole of the society. Government should believe in natural laws that govern the market and should not interfere with the market. The individuals should be left alone to take their economic decisions with their own free will to consume, to save, invest and enter in to voluntary exchange with others. The invisible hand in the form of market keeps the economy in balance.

2.3.2 The Division of Labour: Adam Smith attaches highest importance to labour as compared to other factors of production like land, capital, technique etc. Labour learns from experience and thus contributes to the improvement in other factors. Technological improvements play important part in rising in production but the technical progress itself depends upon division of labour. Hutchison and Smith used the example of watches and pins respectively but it had appeared in Islamic scholar Ghazili's works about five centuries prior to them. Smith used 16 different functions to produce a pin, Ghazili identified 25 in production of needles. The division of work in a number of separate functions increases the efficiency of the workers resulting in manifold increase in output of the firm. This increase can be attributed to two factors – firstly, a worker repeatedly doing a small part of work becomes a specialist, secondly, it saves time.

Smith believed that invention of new labour saving techniques increases the possibility of division of labour resulting in increased productivity of labour. However, he did not think that the technological development was the only factor affecting division of labour. He attached much importance to the size of the market. A huge size of market makes it possible to produce on a large scale which offers more scope for heavy machinery and technological development. This process increases the possibility of division of labour and specialization. Division of labour and specialization on the other part, help in technological advancement and in turn are helped by it.

2.3.3 Capital Accumulation and the Growth Process: The process of capital accumulation is fundamental to the growth process. It must precede the process of division of labour. Economic progress depends upon capital accumulation which itself depends upon the people's ability to save and invest. The savings come from the capitalists who reinvest their profits and partly from the landlord class who saves out its rental income. The iron law of wages keeps the wages at the subsistence level. So, workers are not in position to save at all. The classical

believed in a wage fund which is just sufficient to keep the workers at the subsistence level. If the wage fund increases, it leads to high wage rate and increased population of the working class. The end result is higher supply of labour, increased competition in the labour market and fall in wage rate to the subsistence level.

Adam smith remarks that wage rate falls to subsistence level but it has tendency to rise when capital accumulation rate is high. The increase in wage rate depends upon the rate of capital accumulation and rate of growth in population. If the net investment keeps rising, the wage fund would expand accordingly.

He observed that the capitalists are driven by the profit motive. The rate of investment therefore, is governed by the present rate of profit and the expected returns in the future. When the rate of capital formation becomes too high, the competition among the capitalists increases, the demand for labour goes up leading to increase in wage rate. The declining opportunities for profitable ventures together with increasing wage rate mean that profit rates start falling.

Adam Smith views that interest rates fall with growth, prosperity and capital accumulation. Due to fall in interest rates money lenders are forced to lend more money to maintain previous level of income. When interest rates fall too low, the money lenders find it more profitable to make direct payments rather than lend at such low rates. Thus, even under falling interest rates, the process of growth and capital accumulation continues.

2.3.4 The Role of Growth Agents: Smith identifies three economic agents that are integral to the growth process. These three agents are inter-dependent and they act and interact to make the economic progress possible. These agents are farmers, producers and traders. Each agent is driven by its self-interest but the growth in one sector benefits other sectors. The growth in industrial sector, for example, leads to expansion in size of

the market, more demand for goods from agriculture and more need for trading activities. Thus, agriculture and trade flourish on account of industrial growth. Similarly, growth in agriculture means increased in commerce and demand for industrial goods. Production of refined tools, equipments and implements in manufacturing sector helps growth in agricultural sector which in turn helps agro-based industries and both help the commercial service sector.

In a given set of institutional, social and political conditions, economic growth is partially dependent upon the growth rate of savings and the growth rate of population. The major factors inevitably are size of the market, technical advancement, division of labour and the resultant high level of productivity. The external disturbances may retard the growth process, otherwise the internal factor maintain the automatic steady march towards economic development.

Adam Smith divides the growth process into two states, the progressive state and the static state. In the progressive state all the three sectors i.e. agriculture, industry and commerce grow simultaneously. The growth process is cumulative in nature. The growth of agricultural output, manufactured goods and trade is accompanied by expanding size of the market, increasing specialization, better division of labour, improved technology, high productivity, high profits, high savings and high investments.

But these things do not last for ever. There is a limit to growth set by natural resources and population. The new avenues for investment ultimately dry up. Demand for labour overtakes the supply of labour. As a result wage rate starts moving well above the subsistence level. The two factors that contribute to smaller and smaller share of profits in income are constantly rising wage fund and increasing share of rent. The relative scarcity of natural resources acts as a barrier to growth. The growth process ultimately comes to an end when the rate of profit fall to zero and the economy reaches the static state.

2.3.5 Critical Appraisal of Adam Smith's Views: Adam Smith's contribution to economic theory is immense considering the fact that he had very little tools at his disposal as to present day economists. His was the first attempt of its own kind to understand the dynamics of growth, its determinants, various agents and their interrelations. His greatest contribution was to go through heaps of literature to put these ideas in to a systematic manner that established economics as a separate branch of study. He created a platform for others to build on it. He identified the process of capital accumulation as an essential feature of economic growth and the factor that contributed to it like rate of savings and investment, size of the market, technological advancement, division of labour and specialization. But his philosophy has several flaws. Some of these are discussed below:

(i) The greatest flaw in Smith's thinking was attaching utmost importance to self-interest. Going by his understanding, selfishness is placed on the highest pedestal as if it were the greatest virtue on earth. On the contrary, selfishness is one of the vices that is the root cause of much of the evil. Smith believed that pursuit of individual welfare naturally leads to collective welfare but the fact is that individual and collective welfare are rarely in alignment. More often than not, individual and collective interests conflict and collide with each other. Only when the society attains very high moral and ethical standards, the individual interests merge with collective interests. Bereft of these standards, the unfettered pursuits of self interest lead to exploitation, corruption and all kinds of malpractices.

(ii) The second major flaw is the concept of voluntary exchange. Smith believes that in the free market, buyers and sellers driven by self-interest enter in to voluntary exchange which ensures the welfare of the both. It happens only in Smith's imaginary world. In real world, the labourers are forced to sell their labour at the subsistence level of wages, not because they are willing to do it but because they are forced

to do it. The vast amount of population do not own any means of production. Sale of their labour power is their only mode of survival. They have no option but to sell their labour power at any rate prevailing in the market. One can hardly call this exchange to be voluntary. Once the basic assumptions i.e. the alignment of individual and social welfare and the voluntary exchanges are discarded as untrue, the whole theory is left without a basis to stand on.

(iii) Smith's theory divides the population in two broad classes i.e. the capitalist class and the labour class. The capitalists save and invest all while the labour class consumes all. This division is quite odd and unreal for modern society which has a sizeable chunk of middle class which itself is multi-layered in the form of upper and lower middle class.

(iv) This theory is based on competitive capitalism, free market and non-intervention on part of the government. The perfect competition, at least, on paper sounds very impressive but it has gone extinct long ago. Modern markets are imperfect based on competition among the few. Most of them are monopolistic or oligopolistic in character. Markets do not work properly and fairly under such circumstances. Government needs to interfere in such market to protect the consumers whose kingdom is threatened.

(v) Government interference is needed not just to correct the markets but also distribute the scarce resources in a most efficient manner, which is conducive to growth. The government is also expected to protect markets from large fluctuations which hamper growth. Through appropriate monetary and fiscal policies, the government can provide the necessary impetus to growth. In underdeveloped countries they need to make huge direct investments to build basic and heavy industries apart from infrastructure.

(vi) Smith does not distinguish between an entrepreneur and a capitalist. All capitalists are not entrepreneurs. An entrepreneur takes risk, makes innovations, introduces new techniques, raw materials,

products etc. He is the one who breaks the monotony of steady state while capitalists are mere profit seekers who merely entrepreneurs, just imitating the successful ones.

Despite its limitations, Adam Smith's views were a great breakthrough for economics as a separate branch of study. It invited a great appreciation and harsh criticism but it started a debate. One could take it or leave it but one could not ignore it.

2.4 DAVID RICARDO'S VIEWS ON ECONOMIC DEVELOPMENT

David Ricardo's views regarding economic progress came after the works of Malthus and Young. The primary concern of all these economists was increasing population and its effects on distribution of income. One can safely remark that they were more interested in distribution of income and its effect on development.

Thomas Malthus based his views on the accounts of Arthur Young which were based on his experiences of French Revolution. Young believed that rapidly increasing population in France lead to mass scale urbanization, overpopulation in agriculture and astronomical increase in land rent. The poor living standards of urban labour, he believed were partly responsible for the French Revolution.

Malthus feared that Britain would experience similar consequences if population continued to grow. In his famous essay on Principles of Population, published in 1798, he argued that increase in population would lead to crisis and chaos. He predicted doom to the economy and to avoid that he suggested all help to the poor should be stopped immediately.

Ricardo's views were shaped particularly by Malthusian theory of population. He presented his ideas in his book 'Principles of Political Economy and Taxation'. Rising population and rising output, according to Ricardo will put pressure on the land. Thus land tends to become increasingly scarce as compared to other goods and services. Land being fixed in supply, results in increased price of land as well as increase in rent. The share of rent in output

(income) goes up as compared to profits and wages. It can lead to very severe social crisis, the only way out being heavy taxation of rent income. Ricardo used the concept of marginal principle and scarcity rent to explain his thesis.

2.4.1 Assumptions: Ricardo's theory is based on following assumptions:

(i) Land is used for production of corn and the forces operating in agriculture influence the distribution in manufacturing sector.

(ii) The supply of land is constant and law of diminishing returns operates in agriculture.

(iii) The demand for corn is perfectly inelastic.

(iv) Wage rate is fixed at the subsistence level.

(v) Labour and capital are variable factors and all units of capital and labour are homogeneous.

(vi) All capital is circulating capital.

(vii) State of technology is given and constant.

(viii) There is perfect competition in the market.

(ix) The capital accumulation depends on profits.

(x) The demand for labour depends upon capital accumulation.

Ricardo attaches highest importance to agriculture because it is the sector which feeds the increasing population. The population that is involved in the production can be classified into three broad categories – the capitalist class, the landlords and the labourers. The national income is divided accordingly in three categories i.e. profits, rent and wages. The share of rent is determined first, then the remaining income is divided into profits and wages.

The rent per unit is calculated as the difference between average productivity and marginal productivity of labour. The difference between the two is then multiplied by number of labourers to find out the total share of rent in income. The share of wages is calculated by subsistence level of wages multiplied by number of labourers. After these two

deductions from the national income what remains is the share of profits that includes the interest on capital.

2.4.2 The Production Function: The production function according to Ricardo, is based upon three important variables i.e. labour, land and capital. In contrast to Adam Smith, Ricardo attached utmost importance to the operation of law of diminishing marginal productivity in agriculture. Ricardo believed that marginal productivity of all factors tends to decline; in case of intensive agriculture where additional units of labour are employed to a fixed quantity of land and in case of extensive agriculture where additional less fertile lands are brought under cultivation. Technological progress and new inventions can slow down or delay the application of diminishing returns on agriculture but these can not be stopped forever. But in case of manufacturing sector, technological advancement can be helpful in overcoming the law of diminishing returns to the extent of leading to increasing returns. The overall state of the economy depends upon the combined effect of two sectors. But Ricardo was not very optimistic about it. In his own words, "Although, then it is probable, under most favourable circumstances, the power of production is still greater than that of population, it will continue long; so, for the land being limited in quantity, and differing in quality, with every increased proportion of capital employed on it, there will be decreased rate of production, whilst the power of population continues always the same".

Here, Ricardo makes a significant departure from Adam Smith in the sense that he visualizes an economy growing at a decreasing rate. Ricardo's production function can be described as follows :

$Y = f (K, N, L, S)$

Here, 'Y' stands for output, 'K' for capital, 'L' for quantity of land, 'N' for units of labour and 'S' for technological knowhow. The growth process can be explained with the help of following equation:

$$\frac{dY}{dt} = \frac{\partial f}{\partial K}.\frac{dK}{dt} + \frac{\partial f}{\partial N}\frac{dN}{dt} + \frac{\partial f}{\partial L}.\frac{dL}{dt} + \frac{\partial f}{\partial S}.\frac{\partial S}{dt}$$

Here, $\frac{dy}{dt}$ stands for change in output over a period of time which depends upon marginal productivities of capital, labour, land and technical progress, represented by $\frac{\partial f}{\partial K}, \frac{\partial f}{\partial N}, \frac{\partial f}{\partial L}$ and $\frac{\partial f}{\partial S}$ respectively; and the rate at which these factors grow with respect to time denoted by $\frac{dK}{dt}, \frac{dN}{dt}, \frac{dL}{dt}$ and $\frac{dS}{dt}$. According to Ricardo, $\frac{dS}{dt}$ i.e. the technical progress is the most important determinant of economic growth because it affects the productivity of all other factors of production.

2.4.3 Accumulation of Capital: The accumulation of capital depends upon the size of profits because it is class of the capitalists who save and invest out of their profits including interest. The savings though depend upon the willingness and the capacity to save, yet it is the capacity to save that matters the most. The wage rate being fixed at the subsistence level means that the labourers can not contribute to savings. Therefore, savings depend upon share of national income accruing to landlords and capitalists after the deduction of wage fund from total output. Savings primarily come from capitalists who save out of profits and landlords who save out of rent. Capital accumulation depends on following three factors:

(i) The Profit Rate: The rate of profits is calculated by dividing total profits with the amount of capital employed. Because the capital is assumed to be working or circulating capital, therefore, it is equal to the wage fund. As long as the rate of profit is positive, the process of capital accumulation and the process of economic development go on. The labour power goes on increasing proportionately and the total wage bill keeps expanding. The profits depend on wage rate and the wage rate depends upon the price of the corn which in turn depends

upon the productivity of marginal land. The money wage rate keeps fluctuating with the price of corn so that the real wage rate remains constant at subsistence level.

The improvements in agriculture are reflected in higher production of corn. More output of corn means the prices of corn come down. Low price of corn will bring down the money wage rate because less money is needed to stay at the subsistence level. Lower wage rate implies higher share of profits in total output and capital accumulation goes up. Increase in capital accumulation leads to more demand for labour, more demand for corn, high price of corn, increase in wage rate, fall in share of profits and ultimately low rate of capital accumulation. The process of capital accumulation stops when the rate of profit falls to zero.

(ii) The Wage Rate: Wage rate is an important factor in Ricardo's scheme of things. The economic growth naturally means more demand for labour and the expansion of wage fund, workers spend a major chunk of their income on foodgrains. Consequently, higher wages mean more demand for foodgrains. In order to meet this demand, inferior, less fertile lands have to be brought under cultivation and it also means that demand for labour in agriculture sector goes up giving other push to demand for foodgrains. On one side, we see the increasing wage rates partly due to more demand for labour and partly due to price of corn, on the other hand, we see the increasing cost of production due to operation of law of diminishing returns. The net result is that profits shrink as both wages and rent go up.

(iii) Falling Profits in Other Industries: In the equilibrium state, the rate of profits in agricultural and industrial sector must be equal. The equality of profits is maintained by the definite proportional relationship between prices of the industrial products and prices of corn. Corn, we should keep in mind, is used as a factor of production in the industrial sector. When profits in agriculture sector shrink, there is corresponding decrease in industrial profits. The increasing price of

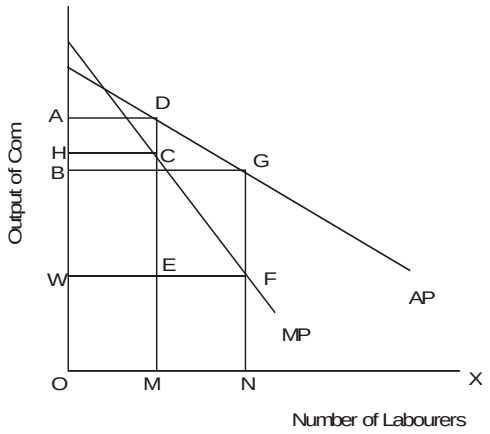
corn means that the wage rate in the industrial sector increases causing a fall in rate of profits in industrial sector.

2.4.4 Other Sources of Capital Accumulation: Capital accumulation according to Ricardo, depends upon gap between production and consumption, which quite obviously can be increased by increasing production and curtailing consumption. Production can be increased by technological advancements that encourages the application of capital intensive techniques. Ricardo does not support the capital intensive technique as they cause unemployment.

Taxation can be used to force the savings out of the community because they can bring down the level of consumption particularly the excessive and wasteful one. But taxation can be very severe on the labour class which is already at the subsistence level. Any further cut on their income level would be criminal. Taxation has a bad effect on investment because it cuts down profit levels. Taxing the rent earners is the best option.

Foreign trade can also be used for capital accumulation. The corn can be imported to keep down its prices which would increase the rate of profit (because low price of corn means low wages and low wages means more profits). But the import of corn at cheap rates means less resources will be used in domestic market to produce corn. So, demand for labour in agriculture sector will be low which will have an adverse effect on labour class.

Figure 1

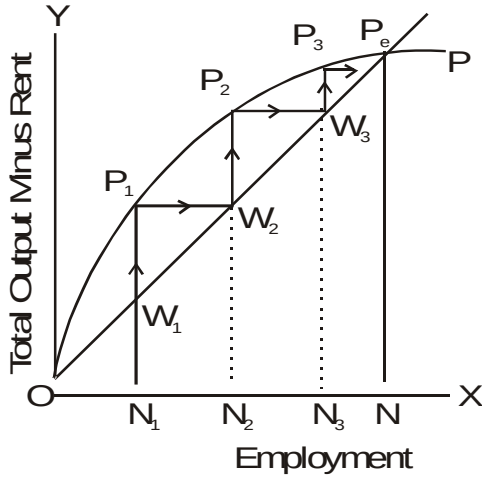


Ricardo's theory can be explained with the help of the figure : 1 where size of employment is measured along X-axis and output of corn along Y-axis. Curves AP and MP represent the average productivity and marginal productivity of labour, respectively. The initial level of employment is assumed to be OM where average productivity is MD (OA) and the marginal productivity is MC (OH) per unit of labour. The difference between the two CD (AH) is rent per unit of labour and the rectangle AHCD is total rent. OW (EM) is subsistence level of wages and the area OMEW is the total wage bill. The residual CE (HW) is the profit per unit of labour while WECH is the total share of profits. The profits are invested which leads to capital accumulation. The process ultimately comes to a halt at ON level of employment. At this level, the entire output ONGB is divided in two parts, area WFGB is rent while ONFW is wage bill while the profits disappear.

2.4.5 The Stationary State: As depicted in figure : 1, the share of profit is very high (WECH) when the level of employment is low at ON level. The profits are invested and the process of capital accumulation is set in motion but as the level of employment increases, the law of diminishing returns leads to fall in productivity. The scarcity

of land is reflected in increasing share of rent, and the increasing employment means increasing wage fund. The profits fall gradually until they totally disappear at ON level. The economy reaches, what Ricardo observes, a stationary state which is an outcome of the applicability diminishing returns. The diminishing returns may be postponed but they may not be reversed altogether. It can be further elaborated with the help of figure : 2. In this figure, the total population is measured along the X-axis while total output minus rent i.e. wages plus profits are shown on Y-axis. OW represents total share of wages which rises steadily with increase in employment as wage rate is fixed at the subsistence level. OP curve is based on a production function with diminishing marginal productivity and increasing rent. When employment is low at ON_1, the combined share of wages and profits is N_1P_1 which after the deduction of share of wages OW_1 shows the amount of profits at W_1P_1. The investment of profits means higher level of employment at N_2, where the size of profits per labourer after all deductions is W_2P_2. This leads to further expansions as shown by N_3 levels of employment. The rate of profits starts falling, till it totally disappears at ON level of employment and the whole output is divided between wages and rent.

Figure 2



Ricardo's predictions regarding the economic growth are quite gloomy. He foresees a future where rent becomes too large owing to the scarcity of land and to the operation of law of diminishing returns. The distribution in favour of land lords is bound to spillover to the social and political landscape leading to chaos and disorder.

2.4.6 Critical Appraisal: Ricardian theory is criticised on the following grounds:

(i) Ricardo predicted doom and stagnancy because he thought that technological advancement could not overcome the law of diminishing returns in agriculture. Land, he argued, has special natural and indestructible powers which no other factor of production could replace. The land being scarce would ultimately become a barrier to growth. He thought that there is a limit to the size of population that a piece of land can support. But Ricardo could not see that the technological growth in the industrial sector produces consistently increasing returns to offset the diminishing returns in agriculture and the combined effect always leads the economy out of stagnation.

(ii) Even the agricultural sector has the ability to shed the diminishing returns. With sophisticated techniques, improved seeds and fertilizers even the most barren lands have been converted into flourishing greenfields. The world population has grown manifold since Ricardo spelt doom.

(iii) Ricardo's prediction that the share of rent will continue to rise while profits would evaporate, has been proved incorrect historically. The share of rent did rise for a very short period but by 1850s, the spurt of technical progress saw the share of profits rise in national income. There have been periods when economies have stagnated or gone through depression, but they have recovered and started growing again.

(iv) David Ricardo based his views on Malthusian theory of population which itself was very flawed. Malthus argued that increase in living standards invariably leads to increase in population. His views are correct to a

certain standard of living. Up to a certain limit population does increase with increase in per capita income or rise in standard of living but after a certain level is attained, the population stagnates or even starts falling. The population of the developed world is fairly stable despite growth.

(v) Ricardo was wrong in ignoring the role of the government in economic development. The government can play a very important role in the redistribution of income, thus keeping the economy on the path of development. It was to be proved later on that the government intervention is necessary to protect the economy from fluctuations. More importantly, the government needs to participate actively in economic activities to break the shackles of vicious circles of poverty in under developed countries.

(vi) Ricardo does not pay any attention to interest rates. In a way he overlooks the importance of monetary policy in the stabilization process and the growth process. In the modern world, where the fiscal policies are regulated by the World Bank and the IMF, the monetary policies are very important tools.

Despite all the flaws in the Ricardian theory, it is as applicable today as it ever was. Ricardo brought into limelight the concept of scarcity of land or to be more accurate, the scarcity of all the natural resources. Though, agriculture is no longer a problem, but the other natural resources like petroleum are scarce and they earn a huge scarcity rent. Similarly, urban real estate rates are very high all over the world because the urban land is relatively scarce to its demand. The rent and income from property form a large part of national income as compared to income from work, skill and enterprise. The inequalities are at all time high and are increasing. They are threat to social and political order just as Ricardo predicted, some two centuries ago.

2.5 The Classical Theory of Development: A Generalised Version

The Classical theory of development is based on the views of Adam Smith, David Ricardo, J. S. Mill and Malthus. These economists differ on a

number of issues – like Ricardo's emphasis on rent and population were totally absent from Adam Smith's works, still they have many things in common. It is not difficult to find the shared views and the common tracts. They inevitably envision a situation when the economy reaches its peak, hits a ceiling, then it stagnates and no further growth is possible. The development, they all stress, is factored by technological progress and growth of population. Technological progress itself is perceived to be an outcome of capital accumulation, and capital accumulation is a process driven by rate of profits or to be more precise, the reinvestment of profits. The self interest or the lure of higher profits is the driving force of the economy. The reinvestment of rising profits, the capital accumulation, the technological progress all combine together to reap the benefits of the increasing returns till the diminishing returns take over. The profits rate fall to zero and the process of economic development comes to a standstill.

2.5.1 The Production Function: Almost all the Classical economists agree on a production function based on four factors i.e. labour, capital, land and technology. It can be expressed as

$Y = f (K, L, N, S)$

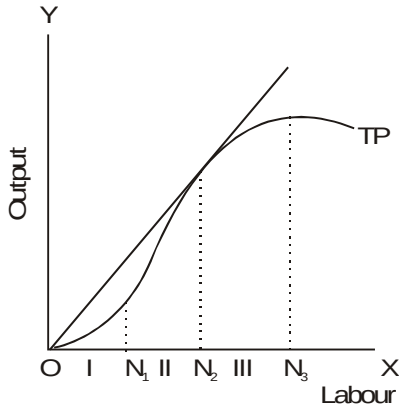
Here, 'Y' the output is shown as an outcome of the amount of capital (K), labour (N), Land (L) and the level of technical progress (S). One thing needs to be clarified here is that land, here is not restricted to just fertile land under cultivation but it is a broader concept that includes all kinds of natural resources whose supply is given and limited whose uses are known to mankind. Though in their writings they know and recognize the role of entrepreneur but it is queer that the entrepreneur has no place in the production function.

Adam Smith's views on production function are different from other economists from the classical school. While other economists stick to the concept of constant returns to scale meaning that the output will double if all factors of production are doubled. Adam Smith, however,

asserted that there is strong possibility of increasing returns to scale, especially in the manufacturing sector because of the division of labour, specialization and technical progress made possible by expansion in size of the market. But in the real life, it is not possible to increase all factors of production in the same proportion given the scarcity of land. Under such circumstances, the most important aspect is what happens to output when increasing doses of labour are used on a fixed amount of natural resources.

The classical view on this situation differ and the predominant view is that the relationship between increasing amount of labour and fixed natural resources can be divided into four distinct stages (see figure 3). The stage I being shown by ON_1, when marginal productivity of labour increases, stage II between N_1 and N_2, when marginal productivity of labour (MP_L) falls but is still above the average productivity of labour (AP_L) which is rising, in the third stage N_2N_3 when AP_L starts falling but MP_L is positive implying that total output increases. In fourth stage after N_3, total product falls.

Figure 3



2.5.2 Technical Progress is a Function of Investment: Classical economists did not view technical progress in isolation. It is something

that is embedded in the process of capital accumulation. It does not happen in isolation from capital accumulation or investment. The investment of profits helps in capital accumulation which leads to large size of the market and greater scale of production. The enlarged size of production on the one hand, creates the possibility of introduction of capital intensive technology but more importantly it offers greater scope for division of labour and specialization in turn lead to improvements in tools, equipments and techniques of production. Thus, the classical theory maintains that the investment is the factor that fosters the technical progress. It can be expressed as $S=f(I)$.

It implies that the technical progress i.e. 'S' is directly related to the size of investment (I). The technological progress may be capital saving (labour intensive) but the capitalists generally look for innovations that are more capital intensive.

2.5.3 Investment Depends upon Profits: One can see that investment is at the heart of the classical theory of development because it sets the process of capital accumulation rolling which expands the size of the market, offers scope for division of labour, specialization and innovation. Investment itself is determined by rate of profits. The capitalists are guided by profit motive. They make innovations in order to maximize their profits.

Though Adam Smith thinks that rent also contributes to saving and investment but Ricardo thinks otherwise. An increasing share of rent is perceived as a threat to growth process. So, the general agreement is that net investment (dK) and capital accumulation is a function of rate of profit 'R'.

$I = dK = f(R)$

Where, 'I' is investment, 'dK' is increase in capital stock and 'R' is profit.

2.5.4 Rate of Profit is a Function of Technical Progress and Supply of Labour: The Classical theory identifies two major factors that determine the rate of profit; one being technical progress (S) and the other is the supply of labour (N). The land being scarce, the only way to increase production is to use more units of labour. Its consequences are twofold – it leads to fall in productivity of labour or we can also say an increase in cost of production and secondly, it implies more demand for labour i.e. higher wage rates. The higher wage rates have an adverse effect on profitability in the industrial sector. The industrial sector can cope with this challenge if they are able to make sufficient technical progress to attain the state of increasing returns to scale and earn high profits. The magnitude of increasing returns in the industry should be large enough to offset the law of diminishing productivity in agriculture. If the technical progress is powerful enough, then the industrial sector would keep earning profits and the development process will go on. But this single dose may not last for long and the profits will ultimately fall to zero.

$R = f(N, S)$

This equation sums it up. The rate of profit 'R' is a function of supply of Labour 'N' and technological progress 'S'.

2.5.5 The Supply of Labour Depends upon Wage Fund: The Classicals believed that wage fund i.e. the amount of money that is used to hire workers determines the size of population or the supply of labour. If the wage fund is high, naturally the wage rates would rise given the size of the population. Higher wage rates mean higher standard of living, better nutrition, more capacity to rear up children and the overall effect is increase in population. The upsurge in population continues till the wage rate falls to the subsistence level. The classicals believed in 'Iron Law of Wages' meaning that the wages remain stagnant at the subsistence level. This law is refuted by the conditions prevailing

in the developed world where the production is stagnant despite high wages. The classical notion can be expressed as

$$N = f(W)$$

Where, 'N' is the supply of labour and is shown as the function of the wage fund (W).

The classical analysis is inconsistent in the sense that it takes note of the seven variables while the number of equations is six. We need seven equations to determine the equilibrium value of seven variables. This renders the whole classical theory to be indeterminate. In order to make it work, an additional equation is added.

$$Y = R + W$$

Which implies that the national income is made up of two components, profits (R) and the wage fund (W). The whole classical analysis can be summed up as

$$Y \rightarrow T \rightarrow I \rightarrow R \rightarrow W \rightarrow N \rightarrow Y$$

National income (Y) is determined by the level of technology (T) which has a huge impact on division of labour, specialization and returns to scale. 'T' itself is a function of capital accumulation or investment (I), then the investment depends upon the size of profits (R) which further depends upon wage fund (W), then wage fund is function of supply of labour (N) which according to Malthusian theory depends upon the level of income.

2.6 STYLIZED FACTS OF ECONOMIC GROWTH

According to Prof. Kaldor, a model of economic growth must be able to explain six stylized facts about the growth of advanced industrial economies. The six facts can be stated as follows:

1. Per capita output grows at a more or less constant rate, over fairly long periods of time. As if population grows at a constant rate, the total output will also grow at constant rate.

2. The stock of real capital grows at a more or less constant rate exceeding the rate of growth of labour input.

3. The rate of growth of real output and the rate of growth of stock of capital goods tend to be equal, so that the capital-output ratio remains more or less constant.

4. The rate of profit on capital remains more or less constant.

5. The rate of growth of output per man varies greatly from one country to another

6. Economies with high share of profits in national income tend to have a high saving ratio.

2.7 SUMMARY AND CONCLUSIONS

The Classical theory is based on the principle of free market economy driven by self interest, individual profits that would ensure the welfare of all. It also assumes the applicability of diminishing returns for a constant technology due to which the economy ultimately reaches the stage of stationary state. These very points of the classical approach are criticized as the economies in all around the world are still growing, the profits have not fallen to zero and populations have been stagnant in many economies inspite of higher wages. But it should also be kept in mind that the classical economists formulated their views at a time when information was a very scarce commodity. They virtually had no data base to test and formulate their opinions. No one at that time could have anticipated the changes in technology that have taken place in their wildest dreams. The technological growth has turned out to be an exponential phenomenon. It has enabled all sectors including agriculture to cope with the threat of diminishing productivity that loomed large on the views of Ricardo, Malthus and Mills. The classical economists successfully explored the relationship between agriculture and industry and how the relative scarcity of good fertile land can become a drag on economic development. The scarcity of natural resources, particularly the sources of energy is slowing down growth.

The share of rent in national incomes is quite high. Ricardo very rightly pointed out that if the income moves into the hands of unproductive segments of the society, the rentier class, the economy would reach the state of standstill and it is only the investors who may keep the economy going on the growth path.

2.8 GLOSSARY

Invisible Hand: The unobservable market force that helps the demand and supply of goods in a free market to reach equilibrium automatically is the invisible hand. The phrase invisible hand was introduced by Adam Smith in his book 'The Wealth of Nations'. He assumed that an economy can work well in a free market scenario where everyone will work for his/her own interest.

Iron Law of Wages: The Iron Law of Wages is a proposed law of economics that asserts that real wages always tend, in the long run, toward the minimum wage necessary to sustain the life of the worker.

Stationary State: Stationary State is a condition of economic stagnation whereby a society, having reached the physical limits of economic growth, would simply reproduce wealth by replacing worn-out goods, maintaining capital stocks, and carefully husbanding non-renewable resources.

Subsistence Wages: Subsistence wage is the lowest wage upon which a worker and his family can survive. It may merely be covering the cost of basic necessities i.e. food, shelter and clothing.

2.9 SHORT ANSWER TYPE QUESTIONS

Q 1. Discuss growth agents as discussed by Adam Smith.

Ans. Smith identifies three economic agents that are integral to the growth process. These three agents are inter-dependent and they act and interact to make the economic progress possible. These agents are farmers, producers and traders. Each agent is driven by its self-interest but the growth in one sector benefits other sectors. The growth in industrial sector, for example, leads to expansion in size of the market, more demand for goods from agriculture and more need for trading activities. Thus, agriculture and trade flourish on account

of industrial growth. Similarly, growth in agriculture means increased in commerce and demand for industrial goods. Production of refined tools, equipments and implements in manufacturing sector helps growth in agricultural sector which in turn helps agro-based industries and both help the commercial service sector.

Q 2. What are the assumptions of Ricardian theory of economic development?

Ans. Ricardo's theory is based on following assumptions:

(i) Land is used for production of corn and the forces operating in agriculture influence the distribution in manufacturing sector.

(ii) The supply of land is constant and law of diminishing returns operates in agriculture.

(iii) The demand for corn is perfectly inelastic.

(iv) Wage rate is fixed at the subsistence level.

(v) Labour and capital are variable factors and all units of capital and labour are homogeneous.

(vi) All capital is circulating capital.

(vii) State of technology is given and constant.

(viii) There is perfect competition in the market.

(ix) The capital accumulation depends on profits.

(x) The demand for labour depends upon capital accumulation.

Q 3. Discuss Smith's views on natural laws.

Ans. Adam Smith believes in eternal goodness of nature and natural laws which according to him are complete, useful and superior to man made laws. Nature teaches man morality, it teaches him to be kind and honest for the welfare of the whole of the society. Government should believe in natural laws that govern the market and should not interfere with the market. The individuals should be left alone to take their economic decisions with their own free will to consume, to save, invest and enter in to voluntary exchange with others. The

invisible hand in the form of market keeps the economy in balance. Smith placed great emphasis on individual freedom and voluntary exchange. He believed that an individual should be given full economic freedom to take decisions on his own. He is the best judge of his own welfare, therefore only he can decide how to distribute his scarce resources among different uses. So, there is no place for government intervention in economic affairs of the society. All the individuals acting independently make their own economic decisions out of their own free will and enter into voluntary exchanges to maximize their individual welfare. Everybody in the process of ensuring his own maximum welfare automatically ensures the welfare of the society. The economic freedom acts as an incentive to individuals to work hard and fine tune their skills which result in the betterment of the society.

Q 4. Examine the production function as discussed by classical theory of economic development.

Ans. Almost all the Classical economists agree on a production function based on four factors i.e. labour, capital, land and technology. It can be expressed as

$= f (K, L, N, S)$

Here, 'Y' the output is shown as an outcome of the amount of capital (K), labour (N), Land (L) and the level of technical progress (S). One thing needs to be clarified here is that land, here is not restricted to just fertile land under cultivation but it is a broader concept that includes all kinds of natural resources whose supply is given and limited whose uses are known to mankind.

Q 5. Examine Ricardian views on stationary state.

Ans. The economy reaches, what Ricardo observes, a stationary state which is an outcome of the applicability diminishing returns. With economic development as the employment increases, the total share of wages rises steadily along with rise in the share of the rent in total income. Consequently, the rate of profits starts falling, till it totally disappears and the whole output is divided between wages and rent. Finally, there will be no new investment and the economy will

come to a standstill. Ricardo's predictions regarding the economic growth are quite gloomy. He foresees a future where rent becomes too large owing to the scarcity of land and to the operation of law of diminishing returns. The distribution in favour of land lords is bound to spillover to the social and political landscape leading to chaos and disorder.

2.10 EXAMINATION ORIENTED QUESTIONS

1. Critically analyse Adam Smith's theory of economic development.
2. Discuss David Ricardo's Theory of economic development. What are its shortcomings?
3. Evaluate the generalized version of classical approach to economic development. Discuss the points of departure in Adam Smith's and David Ricardo's approach to economic development.
4. Explain the stylized facts given by Prof. Kaldor.

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2.13 MODEL TEST PAPER

I. Answer the following in brief.

Q 1. Discuss growth agents as discussed by Adam Smith.

Q 2. What are the assumptions of Ricardian theory of economic development?

Q 3. Discuss Smith's views on natural laws.

Q 4. Examine the production function as discussed by classical theory of economic development.

Q 5. Examine Ricardian views on stationary state.

II. Answer the following in detail

1. Critically analyse Adam Smith's theory of economic development.

2. Discuss David Ricardo's Theory of economic development. What are its shortcomings?

3. Evaluate the generalized version of classical approach to economic development. Discuss the points of departure in Adam Smith's and David Ricardo's approach to economic development.

HARROD-DOMAR'S MODEL OF ECONOMIC GROWTH AND AN INTRODUCTION TO NEO-CLASSICAL THEORY OF GROWTH

3.1 INTRODUCTION

The 'Great Depression' of 1930s that rocked the world prompted Keynes in to writing his most well known work 'The General Theory of Income, Output and Employment'. It brought into forefront the central role played by investment. Keynes was able to establish through his analysis that the fluctuations in investment produce wide fluctuations in levels of income and output. He asserted that depression was a consequence of fall in aggregate demand and it could be cured by increase in public investment. The increase in investment would lead to an increase in income many times the initial level of income due to multiplier effects. Hence, after the depression, it was realized that the regulation of investment not only be used to counter the cyclical fluctuations but can only be used to set the growth process in motion or control. The growth models of Harrod and Domar are essentially based upon the important role played by investment in the process of growth. Both models, though developed completely independent of each other are very similar and reach the same conclusions. The techniques are different but the conclusions are similar. Harrod and Domar build on the importance assigned to investment by Keynes. Keynes' views were confined to the effect of investment on the demand side i.e. how investment can be used in the short run to control aggregate demand and control the fluctuations in income. Harrod and Domar go a step further by analyzing the 'dual' role of investment. Investment has a 'demand effect' as advocated by Keynes, as it is instrumental in raising the level of effective demand, income,

output employment etc. The other more important long run impact of investment is that it expands the productive capacity of the economy which is reflected in increased output. It is known as the 'supply side effect' of investment or the 'capacity effect'. The complete effect of the net investment in an economy can be comprehended fully if both the demand effect and capacity effect are taken into account. In case the net investment in the economy in any period of time is equal to saving in the economy, it produces the demand effect that removes the excess production from the market caused by savings. Thus, net investment brings a balance between aggregate demand and aggregate supply. Keynes does not analyze the effect of net investment on the output of the following period. Obviously Keynes concentrates on the short period and does not bother about the subsequent periods. The expanded productive capacity in the future period will be utilized or unutilized depending upon the increase in aggregate demand in the future time periods. The expanded capacity in the subsequent period has to be used fully by a matching increase in aggregate demand in the subsequent period, otherwise further increase in productive capacity will be discouraged. The economy needs to choose the level of investment that maintains the equilibrium between aggregate demand and aggregate supply period after period. The growth in aggregate demand on regular basis can only be ensured if the net investment rises continuously which is made possible only by growth of real national income. If the real national income does not grow then the net investment may not be fully utilized or it may replace old stock of capital or labour. Thus, the net investment has to be accompanied by the increase in output or real income, otherwise, it may cause the excess supply of labour or capital or both. Therefore, the corresponding real growth of income is vital for consistent increase in the level of net investment.

3.2 OBJECTIVES

This lesson has the following objectives

1. To understand the importance of investment in economic growth.
2. To examine the Domar Model.
3. To understand the working of Harrod Model of growth.

4. To know about different types of growth rates in any economy.

5. To understand the problem of knife-edge balance.

6. To examine the similarities and dissimilarities in Domar's and Harrod's Model.

7. To have an introductory view of the Neo-Classical Model of growth.

3.3 THE DOMAR MODEL

The Domar Model based on the views of E. Domar emphasizes on the conditions of equilibrium and how, under what conditions the equilibrium can be maintained in a growing economy under the dynamic conditions. Domar says that the economy will be in equilibrium only when its productive capacity will be equal to its national income. The main thing is to find that the ideal, unique rate of investment that can ensure the steady continuous growth while keeping the economy in a state of full employment all the time.

3.3.1 Assumptions:

Domar Model is based on following set of assumptions:

(i) The economy is assumed to be in a full employment equilibrium state.

(ii) The economy is a closed one with no foreign trade.

(iii) The government does not interfere in the economic activities.

(iv) There is no time gap between investment and the increase in productive capacity.

(v) The marginal propensity to save is constant and is equal to the average propensity to save.

(vi) There is no depreciation of capital goods.

(vii) Saving and investment depend upon the income of the same time period.

(viii) Rate of interest is given and fixed.

(ix) Price level is fixed. It means that there is no difference between the money income and the real income.

(x) The capital and labour have a fixed proportion.

(xi) No distinction is made between variable and fixed capital.

(xii) The capital coefficient or the capital output ratio is constant.

Domar severely attacked the Keynesian model for its short run vision and its failure to provide any clue to the growth rate. Under very difficult conditions only, our focus may shift totally on the short run and we may be forced to ignore the long run consequences but not always and under the normal circumstances. Domar contends that the standard Keynesian approach lacks the tools to help us find the equilibrium rate of growth. The employment is expressed as a function of national income where the growth rate as a variable is absent from it. This short run approach has serious errors because investment has a dual role which is expressed fully over a long period of time. The dual character of investment has to be understood to have a clear idea of economic growth. Keynes confined himself to the 'demand effect' of investment while Domar goes into both the demand and supply sides. He remarks, "If investment both increases productive capacity and generates income, it provides us with both sides of the equation the solution of which may yield the required rate of growth". The crux of the Domar Model is that the growth rate depends upon net investment which has a dual effect. It leads to increase in aggregate demand as asserted by Keynes but it also increases the productive capacity of the economy. The rate of growth or the size of the investment has to be chosen very carefully so that the increase in demand is just equal to the corresponding increase in supply, so that the economy retains its equilibrium at full employment level. It is not a one-time problem. The question is what should be the rate of investment year by year, so that the demand side and the supply remain in balance. Steady growth with equilibrium is the major issue for Domar.

3.3.2 The Supply Side: Net investment leads to increase in capital stock and the level of output. The effect on the supply side or one can say increase in output depends upon two factors. One is the size of net

investment (I) which brings about a change in capital stock, say ΔK. The larger the investment, the greater will be increase in output. The other factor that determines the magnitude of the increase in output is marginal productivity of capital 's' (or ΔY/ΔK) which measures the increase in income produced by an additional unit of capital. Let us assume that 4 dollars of additional investment are required to produce 1 dollar of income then the marginal productivity of capital is ¼ or 25 per cent. Here, 's' is used to represent the marginal productivity of capital for whole of the economy, all the sectors taken together. It is really a simplification given the fact that the economy consists of a large number of sectors –some capital intensive, some labour intensive which have varying degrees of productivity of capital.

Given the annual investment 'I' and the marginal productivity of capital 's', the annual increase in income works out to be I.s. However, it can be argued that the new capital stock always leads to some destruction of the old stock. Some industries go out of business as new ones enter in to the fray. The actual increase has to be less than I.s, let us say, it is equal to Iσ, where σ (< s) according to Domar is potential social marginal productivity of capital. He uses the term social average productivity for 'σ' because it is a term used to describe whole of the economy which is quite different from 's' which is just related to marginal productivity of new plants. More importantly he used the word 'potential' to describe 'σ' which does not have any effect on the current level of national income. It merely refers to the productive potential of the economy and a high 'σ' means the economy has something potential to raise its output level very quickly. So, I.σ is the increase in income that the economy can produce.

$$\Delta Y_S = I.\sigma \qquad \ldots\ldots(1)$$

ΔY_S is the potential increase in output, 'I' is the net investment and 'σ' is potential social average productivity of capital.

3.3.3 The Demand Side: The effect of change in investment on the income can be explained with the help of the Keynesian multiplier. Domar makes use of the static multiplier as he does not take time gap between increase in investment and the final increase in income. The level of investment is hardly relevant here. What matters is the increase in investment (ΔI) which leads to manifold increase in income determined by the marginal propensity to save denoted by 'α'. The coefficient of multiplier is inversely proportional to the value of marginal propensity to save (MPS) 'α' which is assumed to be a given constant equal to average propensity.

$$\Delta Y_d = \frac{1}{\alpha}.\Delta I \qquad \ldots\ldots(2)$$

Where, ΔY_d is change in aggregate demand.

3.3.4 The Equilibrium: Domar tries to find out the rate of growth that does not disturb the full-employment equilibrium. Out of many possible rates, Domar is interested in annual rate of growth of investment which maintains the already existing balance between the aggregate demand and aggregate supply. It is possible only if increase in demand is equal to the increase in supply.

$$\Delta Y_d = \Delta Y_S$$

$$\Rightarrow \frac{1}{\alpha}.\Delta I = I.\sigma$$

$$\Rightarrow \frac{\Delta I}{I} = \alpha.\sigma \qquad \ldots\ldots (3)$$

The left side of above equation i.e. $\frac{\Delta I}{I}$ is the annual rate of increase in investment or the rate of growth which can keep a steadily growing economy in a state of continued equilibrium. It depends on the product of two important variables 'α' and 'σ' where 'α' is the marginal propensity to save while 'σ' is the potential social marginal productivity

of capital. The maintenance of a continuous state of full employment requires that investment and income grow at a constant annual compound rate equal to the average (marginal) propensity to save multiplied by average productivity of capital. Hypothetically, if α= 12 % and σ= 25 %, rate of growth of investment $\left(\frac{\Delta I}{I}\right)$ can be calculated as

$$\frac{\Delta I}{I} = \frac{12}{100} \times \frac{25}{100} = \frac{3}{100} = 3\%$$

It means that the investment must grow annually at a rate of 3% so that the economy grows at a steady rate without disturbing the equilibrium.

3.4 THE HARROD MODEL:

Like Domar, Harrod is also interested in finding the ideal rate of growth that keeps the economy in a steady state equilibrium. He examines various conditions under which such growth is possible. He uses the acceleration principle which is based on the impact of investment on the level of income. Harrod also studies various other possible paths along which the economy can grow. He takes account of various other possibilities and the situations which can hamper the growth process and take the economy away from the equilibrium path. Harrod uses three different concepts of growth rates to present his case – these are the actual growth rate, the warranted growth rate and the natural growth rate. The actual growth rate is the rate of growth of income which actually prevails in the economy and is determined by the saving rate (s) and the capital-output ratio (c); the warranted growth rate is the rate of growth that ensures full utilization of the existing stock of capital. If warranted growth rate is achieved by the economy, it implies that the entrepreneurs will be happy with their decisions that they have produced the right amount. Finally, the natural growth rate is the rate that the economy can attain given the natural resources, current growth rate of population and the existing potential for technical progress. Natural growth rate is independent of public's wishes especially in the context of savings.

Harrod contends that if the economy is able to grow at the warranted rate, then the entrepreneur will be happy with their decisions and they will be prepared to repeat them. It is the rate at which saving and investment, demand and supply will be in equilibrium. The planned and realized investment are equal. Once attained, the warranted rate of growth will sustain itself. If it diverges from the path of the warranted rate, it will move farther and farther away from it.

3.4.1 Explanation of the Model

(i) The Actual Growth Rate: Harrod starts his explanation with his basic equation about the actual growth rate.

$G.c = s$ .....(4)

Here, 'G' is the actual growth rate equal to $\Delta Y/Y$ i.e. the rate of change in income (Y), 'c' indicates the ratio of investment to increase in income $I/\Delta Y$ and 's' is the average propensity to save given by S/Y. Putting these values in equation (4)

$$\frac{\Delta Y}{Y}.\frac{I}{\Delta Y}=\frac{S}{Y}$$

or, $I = S$ .....(5)

Thus, Harrod's equation of Actual growth rate is nothing but a simple truism that expost savings and expost investment are always in equilibrium.

(ii) The Warranted Rate of Growth: The warranted rate of growth basically deals with the expectations and the behavior of entrepreneurs. It is the rate that keeps the investors satisfied. They invest in order to make profits. At the warranted growth rate they are happy with the decisions they have and they are prepared/willing to repeat their decisions. It implies that increase in demand is sufficient to wipe out the additional output offered for sale. The producers will be happy with the rate at which they increased the investment in the previous period and they will make arrangements for the additional capital to keep growing at same steady rate. If the economy grows at the warranted rate then ex-ante savings are equal to ex-post savings and at the same time ex-ante and ex-

post investments are in balance. It can be expressed with the help of the following equation :

$G_w.C_r = s$ ...(6)

Here, G_w is the warranted rate of growth which is equal to $\Delta Y/Y$ and C_r is required capital-output ratio to attain the warranted rate of growth with given propensity to save. It is different from 'c' in the equation (4) as C_r is the capital output ratio required as against the prevailing or actual capital i.e. 'c'.

The propensity to save (s) being constant in equation (4) and (6), we get

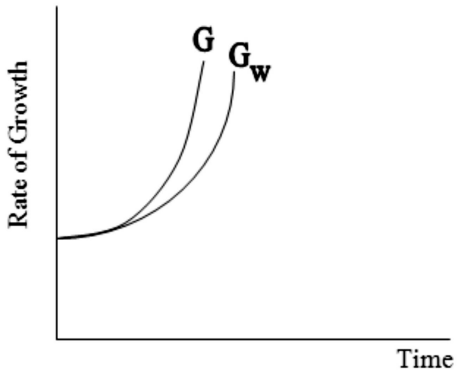
$G.c = G_w.C_r = s$ ...(7)

Harrod points out that long run steady state equilibrium growth is possible only if $G = G_w$ i.e. the actual growth rate is equal to the warranted growth rate. It leaves us to the conclusion that $c = C_r$ implying that actual investment made to produce increase in income is precisely equal to what was required. The economy continues to grow at a steady rate because the producers attain what they want.

Any diversion between the warranted rate and the actual growth rates is destabilizing. If $\neq G_w$, the result is disequilibrium and the economy is set on a path which moves farther and farther away from the ideal path. The scale of the disequilibrium keeps growing all the time. In case, the actual growth rate (G) happens to be greater than warranted growth rate (G_w) i.e. if $G > G_w$, then given the identity $G.c = G_w.C_r$. one can conclude that $c < C_r$. The actual capital output ratio is less than the required one. It will indicate that there will be shortage of capital stock. It leads to the creation of inflationary gap as the ex-ante investment will be greater than the ex-ante savings. In other words, aggregate demand will be more than the level of output. It marks the onset of chronic inflation (see figure 1) as '*G*' pulls farther up and away from G_w. Producers invest more to meet the higher demand for goods and services but the shortage of capital does not allow the

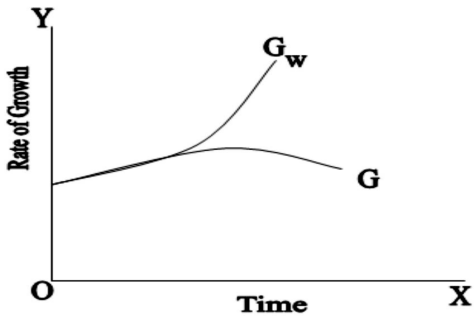
output to rise quickly enough. Therefore, the gap between G and G_w keeps on growing.

Figure 1



Let us consider another possibility i.e. $G < G_w$ when the actual growth rate (G) happens to be less than warranted growth rate (G_w), meaning thereby $c > C_r$. There will be abundance of capital goods. The existing stock will be more than the required. The ex-ante investment is less than the ex-ante savings. From a different angle one can say that the aggregate demand will fall short of aggregate supply, resulting in losses, deflationary gap and unemployment. As shown in the diagram, the actual growth rate keeps on falling down and down with time (see figure : 2).

Figure 2



The steady state equilibrium in Harrod's model is often described as the 'razor-edge equilibrium' because of its strict adherence to $G = G_w$ i.e. the actual rate and warranted rate must remain equal all the time. The slightest of diversion between G and G_w will set in to motion the forces that either result in inflation or severe depression.

(iii) The Natural Growth Rate (G_n): The natural growth rate is the maximum rate that can be attained given the population, natural resources and the state of the technology. It can be expressed with the help of following equation:

$$G_n.Cr = s \neq s \quad ...(8)$$

It may or not be consistent with the given saving rate. G_n is the maximum long run growth rate that the society can attain. Under normal conditions G is always less than G_n but during the periods of recovery, it can be higher than G_n for a certain phase.

3.4.2 Equilibrium among G, G_w and G_n: The economy grows at a steady rate in the long run if

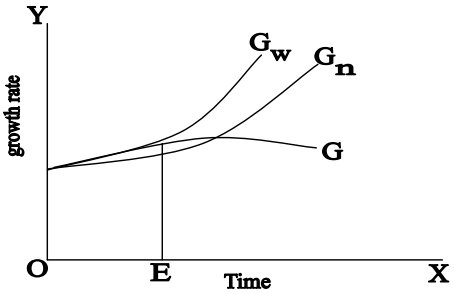
$$G = G_w = G_n \quad ...(9)$$

This is known as the 'knife-edge equilibrium' as the actual, warranted and natural growth rates are equal. Any divergence between G and G_w, we have seen is self aggravating, that does not correct itself. The balance can not be restored because both the average propensity to save and the capital co-efficient (capital output ratio) are assumed to be fixed. If $G > G_w$, it will cause unlimited expansion but there is upper limit to it set by population, natural resources, technology etc. represented by G_n, however, this upper ceiling is itself variable. Harrod believes that G_w is not a single unique rate which itself depends upon the phase of trade cycle. The warranted rate consistent with full employment is called 'proper warranted growth rate'.

Harrod points out that even the proper warranted rate is not good for the economy if it is greater than the natural growth rate (G_n). If $G_w >$

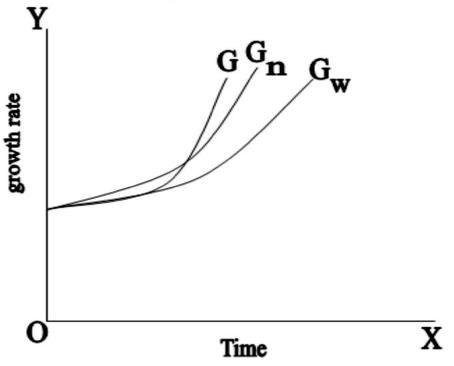
G_n, then it will also be greater than G, the reason being that G_n is the upper limit of G, when $G_w > G_n$, then $c > C_r$. This is a situation when there is excess of capital stock and the labour power is not sufficient to support it. Obviously there will be excess capacity in the economy as the productive capacity is high in relation to demand. There is no incentive to invest and the economy heads towards depression. We can see in the figure : 3 that $G_w > G_n$, which causes the G to fall over a period of time.

Figure 3



On the other hand, if $G_w < G_n$ then the warranted rate will fall below G, then $c < C_r$. It implies that the capital is scarce as compared to labour, the returns on capital will be high and it will induce the producers to invest more and the outcome will be rising inflationary gap as shown in figure 4. The steep rise in G in this figure shows indicates inflationary tendencies in the economy.

Figure 4



3.5 A COMPARATIVE STUDY OF HARROD-DOMAR MODEL:

The Harrod and Domar Model as based upon the dual character of investments which on one side affects the aggregate demand of the economy via multiplier effect and on the other side it increases the productive capacity of the economy. They point out that not all growth rates lead to growth and prosperity. The growth rate should be carefully chosen to make sure that the economy is not exposed to threats of inflation and depression.

3.5.1 Similarities: Harrod and Domar models are very similar, in fact so similar that they have been clubbed together. Both models stress on dual role of investment. Both look forward to find a unique rate of growth of investment that needs to be undertaken year by year so that the economy is in a steady state equilibrium over the long period of time. Both models are based upon the role of the capital, they assume average and marginal propensities to save to be fixed and equal. Same can be said about the constancy of capital coefficient or the capital output ratios.

According to Domar Model

$$\frac{\Delta I}{I} = \propto .\sigma \quad \text{(from equation 3)}$$

or,

$$\frac{\Delta I}{I} = \frac{\Delta S}{\Delta Y}.\frac{\Delta Y}{I} \qquad \left[\because \propto = \frac{\Delta S}{\Delta Y}, \sigma = \frac{\Delta Y}{I}\right]$$

or,

$$\Delta I = \Delta S$$

According to Harrod (from equation 5)

$$G.c = s$$

$$\frac{\Delta Y}{Y}.\frac{I}{\Delta Y} = \frac{S}{Y} \qquad \left[\because G = \frac{\Delta Y}{Y}, C = \frac{I}{\Delta Y}, S = \frac{S}{Y}\right]$$

$$I = S$$

Both models conclude that given the constancy and equality of average and marginal propensities to save, the balanced growth can be obtained through equality of saving and investment. Harrod's G_w is the same as Domar's α, σ

$$\sigma = \frac{\Delta Y}{I} \text{ or } \Delta Y = I.\sigma \qquad ...(10)$$

$$\propto = \frac{S}{Y} \text{ or } \alpha.Y = S = I \qquad ...(11)$$

Replacing '*I*' with $\alpha.Y$ in equation (10), we get

$$\Delta Y = I.\sigma = \alpha.Y.\sigma$$

or,

$$\frac{\Delta Y}{Y} = \alpha.\sigma$$

or,

$$G_w = \alpha.\sigma$$

$$\because G_w = \alpha.\sigma,$$

also, $G_w.C_r = s$ or, $G_w = \frac{S}{C_r} = \alpha.\sigma$

3.5.2 Dissimilarities: The differences between the two models are listed below:

(i) Domar's model is based on one single rate of growth i.e. $\frac{\Delta I}{I} = \propto .\sigma$ which is necessary for steady state equilibrium growth while Harrod's analysis is based on three concepts of growth G, G_w and G_n. He explains why these three rates need to be equal to follow the optimal growth process and how the divergence among the three can lead to great imbalances that can disrupt the growth process.

(ii) The second major difference is that Domar lays emphasis on the rate of investment that is considered to be the most important factor that influences other factors. Harrod attaches more importance to growth in income which influences investment, savings etc.

(iii) Domar in his model relies on the multiplier effect to explain the effect of investment on income. Harrod by contrast, uses the acceleration effect to map the effect of increase in income on induced investment.

(iv) Investment is the most important factor in the Domar model. He measures growth by rate of change in investment i.e $\frac{\Delta I}{I}$. He tries to find the rate of change in investment that will help economy grow at a steady full employment rate over a long period of time. Investment does appear in Harrod model only through capital output ratio $I/\Delta Y$ and it has a role to play but it does not occupy the central place.

(v) Harrod assigns a considerable importance to the knife edge equilibrium produced by $G = G_w = G_n$ and the divergence among them can produce cyclical fluctuations which are self-perpetuation. The threat of trade always looms large in his analysis. Domar hardly seems to play any attention to it. The constancy of social average productivity (σ) rules out the possibility of trade cycles though not completely because he admits that σ can vary.

(vi) Domar restricts himself to the technical relationship between increase in capital stock and the subsequent increase in output. Harrod goes further than technical aspects. He concerns himself with how changes in income and demand influence the changes in investment and output, how the entrepreneurs react to it, how they adjust their capital stock to the changing conditions.

(vii) Professor J. K. Mehta says that the mathematical equations of Harrod and Domar do not differentiate between cause and effect. He says, "Both Harrod and Domar prove that for the equilibrium growth of income the rate of this growth must be $\frac{s}{C_r}$ which is the same thing as $\alpha.\sigma$. How this

equality is reached at is hidden in their postulates and in their treatment. Harrod says the investment is C_r multiple of increment of income. But it is that amount which adjusts itself to the increase in income. Income changes first and the investment merely adjusts itself to it. Domar says that investment multiplied by σ is equal to increase in income. But he does not say that investment is such an amount because the income has first increased. In his exposition, the investment first increases and the income resulting from it is σ times the investment. The causal relationship between investment and income is reversed.

3.6 CRITICAL APPRAISAL OF HARROD-DOMAR MODEL

The major weakness of Horrod-Domar model are:

3.6.1 Unrealistic: Harrod and Domar make several simplification that make the model unrealistic. The capital and labour can only be used in a fixed proportion and they can not be substituted with each other. In that case, labour and capital need to grow at the same rate, otherwise there will be unemployment of one factor or the other. If we take capital labour ratio to be variable, it will make the models more realistic and more flexible.

3.6.2 Wrong Assumptions: Harrod Domar models are based on the constancy of marginal propensity to save and average social productivity of capital. The constancy of α and σ gives the model the 'knife-edge' equilibrium character where any deviation from the steady state will take the system farther and farther away from it. The reality is that α and σ can rise or fall or restore the balance. In the long run with the changes in population and its composition, the propensities to save can always change. Domar felt that the average social productivity of capital is very likely to change over a long period.

3.6.3 Over-Emphasis on Disequilibrium: The Harrod Domar model concentrates too much on the equilibrium path of economic growth, for they felt that the system once disturbed will move away and away. The

reality is very different because whenever some forces act to cause an imbalance, other forces in the economy spring into action to restore the equilibrium. The equilibrium and growth are very difficult to attain at the same time, the growth process does produce some fluctuations but they are not as dangerous as Harrod-Domar make them look.

3.6.4 Price Level are not Constant: Harrod and Domar assume that there is no change in the price levels which is quite impossible in a growing economy. This unrealistic assumption is accompanied by another one that is absence of time lag in increase in investment and the residual increase in output. While analyzing the dual character of investment, it should be clear that the effect of demand is almost immediate while the effect of supply often lags behind. The length of the lag often depends upon the nature of the industry. A certain amount of price rise is inevitable. Moreover, there can be a mismatch between demand and supply due to a number of factors.

3.6.5 Wrong Concept of Natural Growth Rate: Harrod's model makes use of natural growth rate which is the highest rate of growth that the economy can attain over a long period of time given the size and rate of growth of population, natural resources, capital equipment and the state of technology. The problem with this model which it shares with the classical economists is that it does not give due importance to technological progress. Technological changes particularly in the long run can totally upset our calculations of what is maximum and what is attainable.

3.6.6 Lacks Empiricism: This theory lacks empiricism as pointed out by Herrick and Kindleberger who observe 'This Model also has the shortcomings on narrower empirical grounds. Observed growth has been faster than can be accounted for by the rate of physical capital formation and a fixed capital output ratio. The theory can be 'saved' by allowing the capital output ratio to change, but then it ceases to a theory and lapses into the category of a tautology'.

Despite all these shortcomings, Harrod and Domar deserve all the credits for raising the question of growth. It was to become the most important question of their time and the times to follow. From the Keynesian short run static approach, they proceeded to take the economic theory a big step forward making it dynamic.

3.7 HARROD-DOMAR MODEL AND ITS RELEVANCE TO UNDER-DEVELOPED ECONOMIES

By the end of the World War II, the developed economies were grappling with the problem of secular stagnation. These models were designed basically to help the war hit developed nations to overcome the problem of secular stagnation. The developed countries did not need much help from these models as they were able to recover more quickly than expected. At the same time i.e. by the end of World War II many new countries gained independence from their colonial rule. Because of the colonial exploitation, most of these countries were economically backward, designed (developed) by their colonial masters to be suppliers of raw materials. The end of colonial rule gave way to sovereign states many of which turn their attention to economic development. They looked to the west, for development of the economic theory in these countries as they themselves had very little expertise and competence. Most countries adopted or made use of Harrod-Domar model with some modifications.

Hirschman commenting on the relevance of these models to underdeveloped countries says, “The Domar model, in particular, has proven to be remarkably versatile, it permits us to show not only the rate at which the economy must grow if it is to make full use of the capacity created by the new investment, but also the required savings and the capital output ratio if the economy is to attain a certain targeted growth rate. In such exercises, the capital output ratio is usually assumed at some value between 2.5 and 5; sometimes some alternative projections are undertaken; with given growth rates, overall or per capita and the population projections, in the latter case, total capital requirements for five to ten year plans are then easily derived”.

Let us assume that the economy wants to grow at 5 per cent per annum and the capital output ratio is 4:1 or the productivity of capital α=1/4, then according to Domar model

$$\frac{\Delta Y}{Y} = \alpha.\sigma \Rightarrow \frac{5}{100} = \alpha.\frac{1}{4} \text{ or } \alpha = 20\%$$

Which means that the economy must save 20 per cent of its income to grow at 5 per cent per annum. Same conclusion can be drawn from Harrod's model as follows:

$$s = G_w.C_r \Rightarrow s = \frac{5}{100} \times 4 \Rightarrow s = 20\%$$

These equations show that if a country is able to compute the warranted rate of growth, then at the given capital-output ratio, it can easily estimate the part of its income that needs to be saved and invested in order to attain the warranted rate of growth. Sometimes, it is beyond the underdeveloped countries to estimate the warranted rate to grow, still they can control the rate of investment or capital formation to predict the growth rate they are likely to attain. However, it needs to be pointed out that the over simplified functional relationships expressed in the equations can not capture the process of economic development in its entirety. Under these conditions when the information may not be reliable, application of these models may further complicate the task.

The problems of underdeveloped economies are unique in many ways. Their unique characteristics limit the usefulness of these models in underdeveloped countries as listed below:

(i) Unlike developed economies where saving and investment decisions are highly correlated in underdeveloped countries. More than the level of income or rate of interest, in underdeveloped economies, savings are influenced by the opportunities for investment. When opportunities for investment grow, saving rate also moves up.

(ii) Government intervention plays a very important part in the UDCs because market size is small, money and capital markets are almost non-existent. The infrastructure is poor. The inducement to investment

is very low. Such a large scale transformation in a short span of time is unthinkable without direct government participation.

(iii) Another feature of UDCs is economic and social dualism and its implication is that different capital output ratios. To make things worse, several techniques of production are found to be present in the same sector e.g. cloth in India is produced with ultra modern, intermediate and very primitive techniques. There is no such thing as the unique capital output ratio.

(iv) At best, these models take into account the unemployment caused by shortage of effective demand. The nature of unemployment is completely different. A large chunk of it is disguised in nature where more people are working in agriculture than needed. Then there is seasonal structural and underemployment to go with the disguised unemployment.

(v) Poor countries are trapped in a vicious cycle of poverty in a low level equilibrium situation which can not be overcome with small doses of investment. They need large doses of investment, consistently to overcome the lower level of equilibrium trap. Nurkse and Rosenstein Rodan in their theories of Balanced growth and Big Push argue that there are indivisibilities of savings, demand and social overhead capital that need large scale investment in a number of complementary sectors. Similar views were echoed by Harvey Leibenstein in his critical minimum effort thesis in which he argued that investment below a certain minimum level will be of little use.

3.8 NEO CLASSICAL MODELS: AN INTRODUCTION

Harrod Domar models are considered to be starting points of growth economics. They added dynamism to Keynesian static model of effective demand which was confined to short run impact of investment on the aggregate demand. Keynes was merely addressing herself to the question of stability and full employment. Harrod and Domar brought development to the centre of economic discourse. Growth or development depends upon a number of

factors such as capital, population, land, natural resources, technology, production function, capital output ratio etc. Harrod-Domar model restricted itself to the dual role of investment in the economy which was a big departure from the Keynesian approach. They take into account the supply side effect of investment but they assume land and natural resources to be constant and given. It is assumed that population and capital stock grow at same rate so that there is no change in capital labour ratio. They also assumed capital output ratio to be constant alongwith the marginal and average propensities to consume. Under this tight set of assumptions they set out to explore the possibility of steady state equilibrium rate of growth. Not just Harrod and Domar but also most of the economists that contributed to the theory of growth concentrated on the growth with steady states and stability. The Harrod-Domar Models largely depended on the constant capital labour ratios and the economy moves on a narrow razor edge balance.

The Neo-Classical growth models drop the highly restrictive condition that labour and capital can be used only in fixed proportions. The razor edge equilibrium can be avoided if we assume that there is possibility of substitution between capital and labour. The production, therefore can take place with many different proportions and unlimited number of combinations of labour and capital. It implies that '*c*', the capital output ratio can be varied to change the warranted rate of growth G_w and retain the balance between G_n and G_w in case they happen to differ. In real life, the natural and the warranted growth rate differ more often than not but still the economy manages to avoid wild fluctuations because the gap between G_n and G_w can always be bridged with the help of variable proportions production function which allows for substitution between labour and capital. The warranted growth can be changed by changing the capital-output ratio or by changes in saving ratio '*s*' or both. But the Neo-classicals lay emphasis on just variable capital output ratio. The Neo-classicals search for the steady state equilibrium growth rate with a more realistic production function which is based upon variable proportions. Let us assume that $G_w > G_n$, which really means the $\frac{s}{c} > G_n$ i.e. the economy is growing at a higher rate than the

population growth allows for. The producers will naturally switch to capital intensive or labour saving techniques. The resultant increase in capital-output ratio will bring down G_w till the balance G_w and G_n is restored.

Alternatively, if $G_n > G_w$ i.e. $G_n > \frac{s}{c_r}$, the population will be growing at a faster rate than the capital accumulation. Natural outcome will be unemployment of the labour force causing the real wage rate to come down. This will encourage the labour-intensive techniques, the capital output ratio will keep falling to appoint where G_w rises to become equal to G_n. Besides, the Neo-classicals also permitted the technology to change by giving a one time rise in the production function. However, they measured the contribution of technical progress as a residual variable only. All these factors are discussed widely in the next unit on neo-classical growth models.

3.9 MARXIAN MODEL OF GROWTH AND COLLAPSE

3.9.1 Introduction: The traces of Karl Marxian model of economic growth are available in his famous book "Das-Capital". He rejects the salient features of classical model of economic growth. Afterwards, he presents his own theory which has a social and historical framework where the economic forces play an important role. Marx model rejected the law of diminishing returns. Marx says that the outcome of stationary state in classical model is not a natural process, rather it is due to human arrangements. He also rejects Malthusian theory of population.

3.9.2 Theory: Marx analyses the economic development from social and historical point of view and each stage of economic development is based upon the Heagle's philosophy where a thesis and then its anti-thesis have been presented, and then their contradictions have been mentioned. Marx says that in capitalism 'Social relationships of production' are more important than 'Distribution of goods'. He says that the productivity of labor is not a gift of nature rather it is the result of history which embraces thousands of centuries. The concepts of relations of production is vague. In this concept he includes the 'Organic

Whole' which is characterized by the labor organization and skill, the standing of the labor in the society, the technological and scientific knowledge and its use in certain environment. In Marx model those relations of production determine the socio-cultural setup of a society. Marx was of the view that the capitalism would not end up in a quiet classical 'stationary state', rather it would break up with a 'Bang' when the expropriators are expropriated. In his model of economic growth, we will just discuss only the economic aspects, ignoring social and institutional aspects.

3.9.3 Marx model is based upon following dynamic laws

(i) Law of Capitalistic Accumulation: According to this law the prime desire of the capitalist class is to accumulate more and more capital.

(ii) Law of Falling Tendency of Rate of Profit: According to Marx the profits have a tendency to come down and it plays an important role in the break down of the capitalistic economy.

(iii) Law of Concentration of Capital: Marx says that in a capitalistic economy the capital is concentrated and centralized in a few hands. In other words, with the growth of capitalism the cut-throat competition will develop amongst the capitalists. As a results, the big firms will throw away the small firms, monopolies will grow and power will be concentrated into few hands.

(iv) Law of Increasing Pauperization: According to this law as the capitalism grows the miseries and agonies of laboring class increase. It is because of the reason that the labor are given subsistence wages, and the number of unemployed which Marx calls 'Industrial Reserve Army of Labor' increase when the technical changes occur and capital is substituted for labor.

3.9.4 Basic Frameworks : According to Marx, because of simultaneous inter-play of these laws such circumstances will rise whereby the class

conflict between capitalists and workers or between 'have' and have-nots' will sharpen Eventually, the capitalism will face a violent death in the final confrontation when the expropriators will be expropriated. Hence, Marx gave the clarion call: Workers of the world, unite, as they have nothing to lose excepting their 'Chains'. Now we describe the law of falling tendency of rate of profit. This law plays an important role in the whole process of change.

According to Marx, the value of commodity (w) is given by the sum of "constant capital" (c) or the plant and machinery used up in production plus the "variable capital" (q) which is paid to labor in the form of wages plus the 'surplus value' (s) which is earned by labor but it is pocketed by the producers.

The concept of 's' is further explained as:

If the working day is consisted of 8 hours and only 4 hours are required to produce a commodity then for the remaining 4 hours the worker is producing a surplus which is expropriated by capitalists. It is expressed as:

$$\mathbf{w = c + q + s}$$

If 'x' is used to represent rate of surplus value or the rate of exploitation and it is shown as:

$$\mathbf{x = s/q}$$

Reference previous example:

$$\mathbf{x = s/q = 4/4 = 100\ \%}$$

The rate of profit (p) in Marxian model is given as:

$$\mathbf{p = s/(q+c)}$$

Dividing the numerator and denominator by q then:

$$\mathbf{p = \frac{s/q}{q/q + c/q}}$$

$$p = \frac{s/q}{1 + c/q}$$

As x = s/q (rate of exploitation) and if c/q = j which he calls 'organic composition of capital', then putting them in the above equation:

$$p = \frac{x}{1 + j}$$

This equation shows that if 'x' remains constant, then there exists an inverse relationship between"p" and "j". As the capitalistic system grows the amount of organic composition of capital (j)increases. Moreover, whenever the wages exceed the subsistence wages the producers substitutecapital for labor in order to maintain their profits. This situation promotes unemployment. On theother hand, due to cyclical fluctuations and fall in the rate of profit the capitalistic system facescrisis. The falling tendency of the rate of profit would lead to cut-throat competition amongst the capitalists. This would promote monopoly capitalism. But the conflict between 'Immiserized Proletarians' and the capitalists would toll the death knell of capitalism.

According to Marx the law of a tendency for the rate of profit to fall may not always be observed within an economic system. In other words, the tendency of fall in the rate of profit can be checked. It is shown as:

$$p = \frac{x}{1 + j}$$

Differentiating 'p' with respect to 't':

$$\frac{dp}{dt} = \frac{(1+j)\left(\frac{dx}{dt}\right) - x\left(\frac{d}{dt}\right)(1+j)}{(1+j)^2} = \frac{(1+j)\left(\frac{dx}{dt}\right) - x\left(\frac{dj}{dt}\right)}{(1+j)^2}$$

As $p = \frac{x}{1+j}$, solving it for x we get $x = p(1+j)$ and putting it in place of x.

$$\frac{dp}{dt} = \frac{(1+j)\left(\frac{dx}{dt}\right) - p(1+j)\left(\frac{dj}{dt}\right)}{(1+j)^2} = \frac{1+j\left(\frac{dx}{dt}\right)}{(1+j)^2} - \frac{p(1+j)\left(\frac{dj}{dt}\right)}{(1+j)^2}$$

$$= \frac{1}{(1+j)}\left(\frac{dx}{dt}\right) - \frac{1}{(1+j)}(p)\left(\frac{dj}{dt}\right) = \frac{1}{1+j}\left[\frac{dx}{dt} - p\left(\frac{dj}{dt}\right)\right]$$

According to Marx if rate of exploitation of labor increases more than amount of capital, the rate of profit will increase. If amount of capital is more than the rate of exploitation whether it will lead to decrease the rate of profit or not, it depends upon the difference between dx/dt and p .dj/dt.

If p . dj/dt which is negative term exceeds the dx/dt, the rate of profit will decrease. But a fixed rate of exploitation and increase in capital intensity may not go together because a rise in organic composition of capital would raise productivity which would either raise the rate of exploitation or raise the real wages. But Marx says that instead of rise in real wages, there would be an increase in the rate of exploitation.

3.9.5 Criticism:

(i) On empirical basis Prof. Kaldor has concluded that in case of long run the proportion of wages to national income has remained constant in rich countries. Again, so many socialist countries which followed Marxian philosophy failed to remove poverty. The labor residing in socialist and communist countries were always found dreaming for the life standard enjoyed by their western counter-parts. Such all led to a reaction against socialism in Russia which culminated in disintegration of Russian Federation. The prosperity enjoyed by laboring class in

US, Japan and European countries contradict Marxian law of increasing pauperization. However, Marxian philosophy of concentration of capital in few hands is available in case of both rich and poor countries.

(ii) According to Prof. Fellner in case of rich countries the ratio of capital to output has increased. This has not only promoted capital accumulation but the real wages of the labor have also gone up. Such all is against Marxian model.

iii) Mrs. Robinson also rejects the Marxian law of declining of rate of profit. She says that the technical progress can be capital saving which

would increase the productivity of labor. As a result, the rate of profit will increase, rather decreasing.

(iv) Marx failed to entertain that capitalism would be protected by democracy. It is the democracy which promoted social security, anti-monopoly laws and mixed economies. Such all contradicted Marxian philosophy of 'Self-Demise' of capitalism.

(v) According to Sehumpeter Marx model is based upon: (a) labor theory of value, (b) a modified version of subsistence wage theory. Both these are the instruments of constant situation. Thus, following Sehumpeter Marx model has been presented under constant circumstances. It fails to treat the matters dynamically.

(vi) According to Marx there exists a correlation between the growth of the average firm and increase in the degree of concentration. But this logic does not look appropriate. But, as far as unemployment is concerned it has increased both in UDCs and in DCs. Inspite of these flaws Marx model of economic growth is of greater significance, it analyzed the role of technical growth, inventions and innovations and capital accumulation. He attributed the growth of capitalism to rate of profit. He considers the trade cycles something inevitable. He says that more and less wages as compared with production may influence the process of economic growth.

3.10 SUMMARY AND CONCLUSIONS

This lesson throws light on the development of economic thought from the classical to Keynesian Static analysis and then to the dynamism introduced by Harrod and Domar. Finally, an attempt has also been made to just introduce the basic framework of the Neo-classical growth models and how they departed from the much publicized Harrod-Domar models. All these models highlighted the dual role of investment in raising the level of demand as well as supply. It has been propounded that under the constant

capital-labour ratios and fixed marginal and average propensities to save, that level of investment should be chosen at which the rise in demand is just equal to the rise in supply, or there is equality between the actual, desired (warranted) and natural growth rates. Any deviations from this line of equilibrium leads the economy towards chronic depression or secular inflation. Therefore, the economy must carefully select that level of investment so that it always moves on the self-sustained growth path. However, the neo-classicals pointed out that the problem of knife-edge balance occurs only if the capital labour ratios are kept constant while the variable capital-labour ratios always saves the economy from the knife edge balance and yet the steady state equilibrium can be achieved without much fluctuations.

3.11 GLOSSARY

(a) Ex-ante and Ex-post: In Latin ex-ante means 'before the event'. Therefore, ex-ante is used for anticipated or future value or trends in a certain variable in economic model. On the other hand, ex-post in Latin means 'after the fact' and therefore it can be defined as the realized or actual value of the variable in question.

(b) Full Employment: In simple terms full employment is defined as the state of the economy when all the factors that are willing to work/offer services at the prevailing factor prices get work in the factor market. In other words, this is the situation when the demand for all factors in the economy is just equal to their supplies at the prevailing level of factor prices.

(c) Knife-edge Balance: Knife edge balance is that state of equilibrium of any economy which is based on very strict assumptions and violation of any of those assumptions leads the economy farther away from the point of equilibrium.

(d) Stable Equilibrium: The equilibrium is stated to be stable if any deviation from the equilibrium point automatically leads the economy back to the position of equilibrium.

3.12 SHORT ANSWER TYPE QUESTIONS

Q 1. Discuss the assumptions of the Domar Model.

Ans. Domar Model is based on following set of assumptions:

(i) The economy is assumed to be in a full employment equilibrium state.

(ii) The economy is a closed one with no foreign trade.

(iii) The government does not interfere in the economic activities.

(iv) There is no time gap between investment and the increase in productive capacity.

(v) The marginal propensity to save is constant and is equal to the average propensity to save.

(vi) There is no depreciation of capital goods.

(vii) Saving and investment depend upon the income of the same time period.

(viii) Rate of interest is given and fixed.

(ix) Price level is fixed. It means that there is no difference between the money income and the real income.

(x) The capital and labour have a fixed proportion.

(xi) No distinction is made between variable and fixed capital.

(xii) The capital coefficient or the capital output ratio is constant.

Q 2. What do you mean by warranted growth rate?

Ans. Warranted growth rate is the minimum desired growth rate for the investors. It is the rate at which they are satisfied with their investment decisions. This is the rate of growth that ensures full utilization of the existing stock of capital.

Q 3. Discuss the dual role of investment as propounded by Harrod and Domar.

Ans. Harrod and Domar analyzed the 'dual' role of investment in their models. According to them, investment has a 'demand effect' as advocated by Keynes, as it is instrumental in raising the level of effective demand, income, output

employment etc. The other more important long run impact of investment is that it expands the productive capacity of the economy which is reflected in increased output. It is known as the 'supply side effect' of investment or the 'capacity effect'. The complete effect of the net investment in an economy can be comprehended fully if both the demand effect and capacity effect are taken into account. In case the net investment in the economy in any period of time is equal to saving in the economy, it produces the demand effect that removes the excess production from the market caused by savings. Thus, net investment brings a balance between aggregate demand and aggregate supply.

Q 4. Discuss the knife-edge balance in Harrod Model.

Ans. The economy grows at a steady rate in the long run if

$$G = G_w = G_n$$

This is known as the 'knife-edge equilibrium' as the actual, warranted and natural growth rates are equal. Any divergence between G and G_w, we have seen is self aggravating, that does not correct itself. The balance can not be restored because both the average propensity to save and the capital co-efficient (capital output ratio) are assumed to be fixed. If $G > G_w$, it will cause unlimited expansion but there is upper limit to it set by population, natural resources, technology etc. represented by G_n, however, this upper ceiling is itself variable. If $G_w > G_n$, then it will also be greater than G, the reason being that G_n is the upper limit of G, when $G_w > G_n$, then $c > C_r$. This is a situation when there is excess of capital stock and the labour power is not sufficient to support it. Obviously there will be excess capacity in the economy as the productive capacity is high in relation to demand. There is no incentive to invest and the economy heads towards depression. On the other hand, if $G_w < G_n$ then the warranted rate will fall below G, then $c < C_r$. It implies that the capital is scarce as compared to labour, the returns on capital will be high and it will induce the producers to invest more and the outcome will be rising inflationary gap.

Q 5. Discuss the similarities in Harrod and Domar Models of growth.

Ans. Harrod and Domar models are very similar, in fact so similar that they have been clubbed together. Both models stress on dual role of investment. Both look forward to find a unique rate of growth of investment that needs to be undertaken year by year so that the economy is in a steady state equilibrium over the long period of time. Both models are based upon the role of the capital, they assume average and marginal propensities to save to be fixed and equal. Same can be said about the constancy of capital coefficient or the capital output ratios.

According to Domar Model

$$\frac{\Delta I}{I} = \propto .\sigma \quad \text{(from equation 3)}$$

or,

$$\frac{\Delta I}{I} = \frac{\Delta S}{\Delta Y}.\frac{\Delta Y}{I} \qquad \left[\because \propto = \frac{\Delta S}{\Delta Y}, \sigma = \frac{\Delta Y}{I}\right]$$

or,

$$\Delta I = \Delta S$$

According to Harrod (from equation 5)

$$G.c = s$$

$$\frac{\Delta Y}{Y}.\frac{I}{\Delta Y} = \frac{S}{Y} \qquad \left[\because G = \frac{\Delta Y}{Y}, C = \frac{I}{\Delta Y}, S = \frac{S}{Y}\right]$$

$$I = S$$

Both models conclude that given the constancy and equality of average and marginal propensities to save, the balanced growth can be obtained through equality of saving and investment. Harrod's G_w is the same as Domar's α, σ

$$\sigma = \frac{\Delta Y}{I} \text{ or } \Delta Y = I.\sigma$$

$$\propto = \frac{S}{Y} \text{ or } \alpha.Y = S = I$$

Replacing '*I*' with α, Y in equation (10), we get

$$\Delta Y = I.\sigma = \alpha.Y.\sigma$$

or,

$$\frac{\Delta Y}{Y} = \alpha.\sigma$$

or,

$$G_w = \alpha.\sigma$$

$$\because G_w = \alpha.\sigma,$$

$$\text{also, } G_w.C_r = s \quad \text{or, } G_w = \frac{s}{C_r} = \alpha.\sigma$$

3.13 EXAMINATION ORIENTED QUESTIONS

1. Critically analyse Domar's model of growth.
2. Examine Harrod's model of economic growth and what are its shortcomings ?
3. Examine the similarities and dissimilarities in Harrod and Domar models. Discuss their applicability in underdeveloped economies.

3.14 SUGGESTED READINGS

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3.16 MODEL TEST PAPER

I. Answer the following in brief.

Q1. Discuss the assumptions of the Domar Model.

Q2. What do you mean by warranted growth rate?

Q3. Discuss the dual role of investment as propounded by Harrod and Domar.

Q4. Discuss the knife-edge balance in Harrod Model.

Q5. Discuss the similarities in Harrod and Domar Models of growth.

II. Answer the following in detail.

1. Critically analyse Domar's model of growth.
2. Examine Harrod's model of economic growth and what are its shortcomings ?
3. Examine the similarities and dissimilarities in Harrod and Domar models. Discuss their applicability in underdeveloped economies.
4. Critically examine the marxian model of growth and collapse.

NEO-CLASSICAL MODELS OF ECONOMIC GROWTH : SOLOW MODEL

4.1 INTRODUCTION

Harrod-Domar model was highly restrictive in nature because it had a very tight set of assumptions. The most unrealistic assumption being the production function that allowed labour and capital to be used in fixed proportions. The result of this assumption along with fixed saving rate is the knife-edge equilibrium even over the long period of time. The system is highly unstable with only possibility being the warranted growth rate equal to the natural rate. If the warranted rate happens to be different from the natural rate, the gap keeps on widening leading either to inflation or depression. The constancy of marginal propensity to save and capital output ratio does not allow the warranted rate of growth to adjust itself to the natural rate of growth. The Neo-classical models just let the capital output ratio to change and allow the warranted rate to adjust. Amartya Sen calls it the 'beautiful simplicity' of Neo-classical thinkers who make room for variable proportions in production function, thus exploring the possibility of regaining the equilibrium. The major contributors to the Neo-classical growth model are R. M. Solow, J. R. Hicks, J. E. Meade and T. W. Swan. Here in this lesson we shall discuss the Solow Model.

4.2 OBJECTIVES

This lesson has the following objectives:

1. To understand the basic framework of the Neo-classical growth models.
2. To examine the working of the Solow model of growth.
3. To analyse the possible growth patterns as suggested by Solow.
4. To show the superiority of Solow model over the Harrod-Domar model of growth.
5. To critically evaluate the working of Solow Model.
6. To understand the applicability of Solow model on underdeveloped economies.

4.3 SOLOW MODEL OF ECONOMIC GROWTH

The major departure of Solow model from the Harrod-Domar model is the variable capital-output ratio. The fixed proportion production function assumed

by Harrod and Domar is replaced by more realistic variable proportion production functions. The Solow model is based on the following assumptions:

4.3.1 Assumptions: Main assumptions of Solow's model of growth are given below:

1. This model is based on the production of a single composite commodity.
2. Labour and capital are the only factors of production.
3. Each factor is paid in accordance with its marginal productivity.
4. There is existence of constant returns to scale.
5. There is full employment of labour and capital.
6. The prices and the wage rates are fully flexible.
7. Capital and labour can be substituted for each other. In other words, the production function exhibits variable proportions.
8. Technical progress is assumed to be neutral.
9. The marginal propensity is assumed to be constant.

4.3.2 The Basic Framework: Given the fixed saving rate, it is the assumption of fixed capital output ratio which causes knife edge balance in Harrod-Domar's model and Solow dropped this assumption and the economy automatically tends towards equilibrium state. If the initial capital labour ratio is more than the equilibrium ratio, then the capital and output will grow slowly than the labour force and vice versa. Therefore, one may start with nay ratio, it will eventually converge with the equilibrium ratio.

Let us assume that the capital and labour both grow but the capital grows more quickly than the labour force. The capital labour ratio will increase which will result in fall in productivity of capital. The profit rates will decline, so will inducement to investment, the rate of capital formation will slow down till the economy attains equilibrium capital

labour ratio. The converse will happen if labour grows too quickly which will be followed by increasing rate of profit, high rate of capital formation and eventually settling at the equilibrium ratio. This model can be explained with the help of following equations.

Let Y(t) represent the level of output or the real income at the time period 't'. Some part of income (Y) is consumed and the rest is saved. Assuming that the average propensity to save is constant at 's', the aggregate saving will be equal to *s.Y*. The increase in capital stock $\overline{K}$ will be equal to the savings.

$$\overline{K} = s.Y \qquad \ldots(1)$$

The production function is assumed to be a function of labour 'L' and capital 'K' i.e.

$$Y = f(L, K) \qquad \ldots(2)$$

Putting this value of Y in equation (1), we get,

$$\overline{K} = s.f(L, K) \qquad \ldots(3)$$

In this equation, 'L', the supply of labour is exogenously determined and depends upon population growth which increases at a constant rate 'n'. So, it can be represented as:

$$L(t) = L_0 e^{nt} \qquad \ldots(4)$$

Here, '*n*' is Harrod's natural growth rate in the absence of technological progress, L_0 is the size of population in the base year. Given the value of L_0, and '*n*' being constant, the size of population can be calculated with the help of variable time period '*t*'. Further, on the assumption of full employment *L(t)* can replace '*L*' in equation (3). We have,

$$\overline{K} = s.f(L_0 e^{nt}, K) \qquad \ldots(5)$$

Equation (5) shows the path of capital accumulation over the periods of time that is essential to employ every unit of labour.

The supply of labour as shown by equation (4) is a vertical straight line which grows exponentially with time and keeps on shifting to right. The flexible real wage rate keeps the economy at full employment and the wage rate is determined by the marginal productivity of labour. Equation (5) gives us the time profile of the capital stock needed to ensure the full employment of the growing labour force. Once we know the growth of capital over the periods of time, we can determine the path of growth of output and the real wage rate determined by its marginal productivity. According to Solow, the equation (4) can be used to know the supply of labour at any given time period, the stock of capital can be determined through equation (5). The real returns to factor adjust to ensure full employment of labour and capital and the production function can be used to find the level of output. The propensity to save tells us how much will be saved and invested. Hence, we know the net accumulation of capital in the current period, which added to the previous stock of capital gives us the capital available for the next period and the whole process can be repeated.

4.3.3 Possible Growth Patterns: Solow's next quest is to find out whether there exists a path of capital accumulation with nay growth rate of labour force. he proceeds further by introducing a new variable to the given set. The variable r = K/L is the ratio of capital to labour,

or,

K= r.L

$$\Rightarrow K = r.L_0 e^{nt} \qquad \left[L(t) = L_0 e^{nt}\right]$$

Differentiating both sides with respect to 't', we get

$$\frac{dK}{dt} = n.r.L_0 e^{nt} + L_0 e^{nt}.\frac{dr}{dt}$$

Here, $\frac{dK}{dt}$ is nothing but rate of change of capital stock i.e. $\dot{K}$, therefore

equation (4) can be rewritten as

$$n.r.L_0e^{nt} + L_0e^{nt}.\frac{dr}{dt} = s.f\left(K, L_0e^{nt}\right)$$

or,

$$L_0e^{nt}\left[n.r + \frac{dr}{dt}\right] = s.f\left(K, L_0e^{nt}\right)$$

or,

$$n.r + \frac{dr}{dt} = s.f\left(\frac{K}{L_0e^{nt}}, 1\right) \qquad ...(6)$$

Now, $r = \frac{K}{L}$ or $= \frac{K}{L_0e^{nt}}$, then equation (6) can be written as

$$n.r + \frac{dr}{dt} = s.f\left(r, 1\right)$$

$$\frac{dr}{dt} = s.f\left(r, 1\right) - nr$$

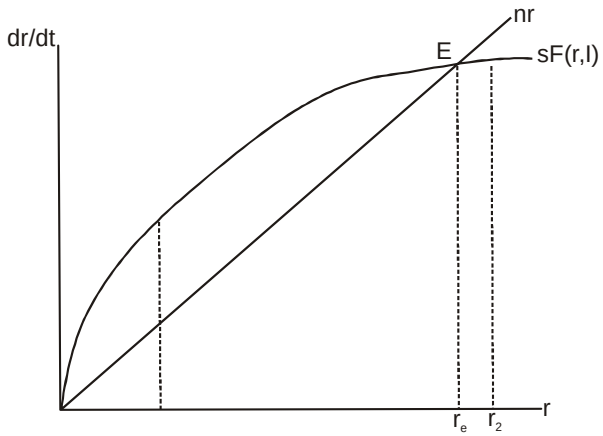
or,

$$\hat{r} = s.f\left(r, 1\right) - nr \qquad ...(7)$$

which is known as solow's fundamental equation

Where, $\hat{r} = \frac{dr}{dt}$ represents the rate of change of capital output ratio. The function *f(r, 1)* here represents the total output when varying amounts of capital labour ratio i.e. '*r*' are employed with one unit of labour. It can be simply stated that output per worker is a function of capital per worker. Equation (7) represents a simple fact that the rate of change of capital labour ratio i.e. $\hat{r}$ over time depends upon difference between two values, the first being the increment in capital and other being increment in labour.

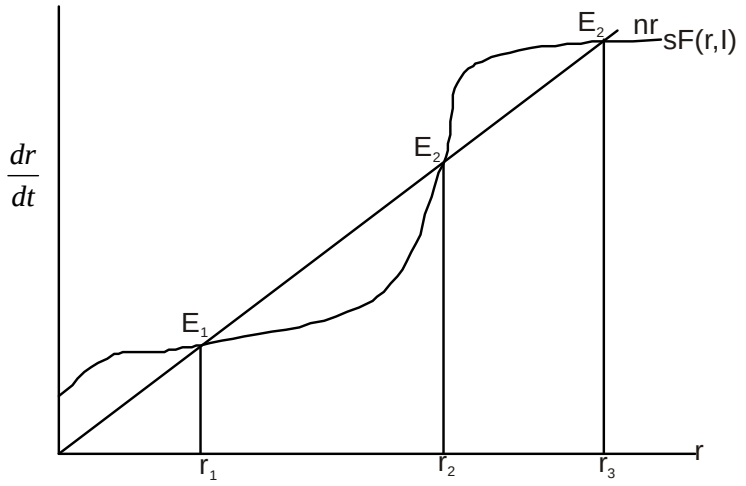
In the figure : 1, the capital labour ratio '*r*' is plotted along the horizontal axis while the change in capital labour ratio or $\hat{r}$ is measured along vertical axis. *n.r* is a straight line passing through origin rises proportionately with the value of '*r*', given the constant value of '*n*'. Curve *s.f(r, 1)*also passes through origin meaning that there will not be any output without any capital. The curve also represents the diminishing marginal productivity of capital. At the point of intersection $n.r = s.f(r, 1)$ or $n.r - s.f(r, 1) = 0$, i.e. $\hat{r} = \frac{dr}{dt} = 0$. It means that if capital output ratio corresponding to the point of equilibrium is established at r_e, then capital and labour will grow at same rate subsequently and there will be no change in capital labour ratio $\left(\hat{r} = 0\right)$.



Let us assume that capital labour ratio is r_1 which is less than the equilibrium ratio r_e i.e. $r_1 < r_e$. Here, $s.f(r,1) > n.r$, there will be tendency for capital-labour ratio to rise till it reaches r_e. If it happens to be greater than r_e then the capital-labour ratio will fall till it is equal to r_e. Solow remarks, "Whatever the initial value of capital labour ratio, the system will develop towards a state of balanced growth at the natural rate". If the initial capital stock is below the equilibrium ratio, then the

capital and output grow at a faster rate than the growth rate of labour force till the equilibrium is established. On the other side, if the initial capital labour ratio is above the equilibrium level then capital and output rise more slowly than the labour force, this will bring the capital-labour ratio down to the equilibrium level.

Solow, however, acknowledges that the highly stable steady state equilibrium is not the only possibility that prevails in the economy. This situation corresponds to production function that we have constructed in the figure which in reality is one of various kinds, with only one intersection point. There is a strong possibility of multiple intersection points as shown in figure 2.



Capital-Labour Ratio

Here, r_2 shows the capital-labour ratio with unstable equilibrium while r_1 and r_2 are stable ones. Let us assume that E_1 is the initial equilibrium point and we somehow move to right of it. Then $n.r > s.f\ (r,1)$, so that dr/dt or $\hat{r}$ becomes negative, the equilibrium will be regained at r_1. In case we are on the left side of r_1, the capital will grow at a quicker rate than population to reach at r_1. Same argument can be applied to E_3, where capital labour ratio is r_3. Any disequilibrium will disappear

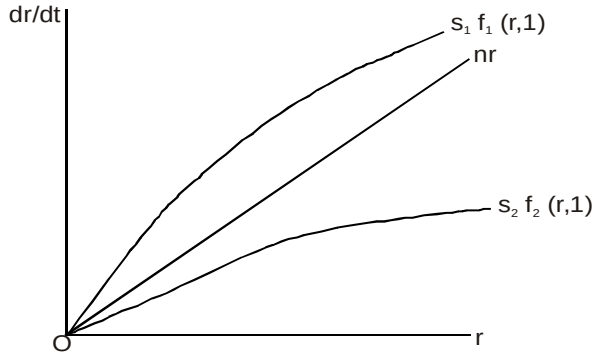
and the economy reverts to r_3. But the same does not apply to E_2 which is unstable equilibrium. Any deviation from r_2 will be magnified over the time and the economy never recovers to come back to r_2. Let us assume that the economy is operating at a level slightly lower than r_2. In this case population grows at a higher rate compared to capital and output i.e. $nr > s.\ f(r, 1)$. This implies that dr/dt or $\hat{r}$ will be negative and capital labour ratio will start to decline over a period of time when equilibrium is struck at r_1. Alternatively, if capital-labour ratio deviates to rise above r_2, $n.r < s.\ f\ (r, 1)$, then $\hat{r}$ will be positive as capital will rise at a rate higher than labour force, the capital labour ratio will rise further and further above r_2, till it reaches stable equilibrium at r_3. It is clear that once the equilibrium is disturbed at point r_2, it will revert to r_2, it will either be established at r_1 or r_3. If the capital-labour ratio exceeds r_2, then it will finally settle at r_3. Alternatively, if the capital labour ratio falls below r_2, it will eventually come down to r_1.

Solow model is basically designed on the experience of developed countries. The condition, challenges, institutions and attitudes in underdeveloped countries are quite different from the developed countries. As a result, the models like this being based on the experience of developed world have very limited applicability in the underdeveloped countries. But Solow model can be used quite effectively to demonstrate the economic dualism in underdeveloped countries.

Figure : 3 represents the problems of underdeveloped countries caused by the economic dualism. $n.r$ represents all those points where the natural and warranted growth rates are in equilibrium. The underdeveloped countries have two different sectors with different saving rates s_1 and s_2 and two different production functions $f_1(r, 1)$ and $f_2\ (r, 1)$. The curve $s_1 f_1(r,1)$ relates to the industrial sector which has a higher saving rate and makes use of more capital intensive techniques. The capital accumulation and the rate of growth of output is much higher than the

growth of population in the economy. There is full employment in the sector which indicates that capital-labour ratio keeps growing. The end result is that the growth in industrial sector never coincides with the natural growth rate.

Figure 3



The agricultural sector, on the other hand, is grappling with the problem of disguised unemployment due to immobility of labour. The techniques of production are primitive and highly labour intensive. The marginal productivity of labour is very low, consequently wages are very low and there is little possibility of savings. The condition of agriculture is reflected in the curve $s_2 f_2(r,1)$ which depicts that capital labour ratio is very low and it never rises enough to meet n.r. The only way out of the tricky situation is to mobilize the surplus labour in agriculture to utilize it in the industrial sector which is starved of labour. Both sectors in this situation witness diminishing marginal productivity but the aggregate supply is increasing because of increase in population and some net investment.

Prof. Solow concludes with the remark, "when production takes place under the usual neo-classical conditions of variable proportions and constant return to scale, no simple opposition between natural and warranted rate of growth is possible. There may not be any knife edge. The system can adjust to any growth of labour force and eventually approach a state of steady proportional expansion".

4.4 SUPERIORITY OF THE SOLOW MODEL

Harrod Domar model is based on a very narrow knife edge path where G_w, the warranted rate of growth must be equal to the natural growth rate G_n allowed by the growth rate of labour force and the given state of technology. The saving rate, the fixed capital-labour ratio and the growth rate of labour force are the most important determinants of the economy where the first two determine the warranted rate and the last one determines the natural rate. The Harrod-Domar model offers no scope for an alternative path of growth which at all costs must be equal to the natural rate if the economy is to grow at a steady state equilibrium rate for any divergence leads to extreme fluctuations.

The Solow model offers a simple solution by introducing a variable proportions production function implying that there is no possibility of such large fluctuations if the production function offers scope for substituting labour and capital. The production function advocated by Solow is known as the Neo-classical production function which retains some of the features of Harrod-Domar model i.e. the fixed saving rate and the constant growth of population. He just adds the possibility of substitution between labour and capital what makes the model more realistic and partly explains why the economic system are far more stable than what Harrod and Domar produced them to be. The reasons are not very difficult to fathom. Any departure of the warranted growth rate from the natural growth rate is cured by the flexible capital labour ratio. If natural growth rate is higher than the warranted rate, the quickly growing labour force will be absorbed by the extremely flexible production function which will immediately switch to labour intensive mode and the unemployment will disappear. Similarly, the production function will be on capital intensive mode when capital accumulates at a faster rate than the population. The extremely flexible production function is the strong point of Solow model.

4.5 LIMITATIONS OF THE SOLOW MODEL

The whole idea at work in the Solow model is to free Harrod Domar model of the knife-edge equilibrium. His whole emphasis is to provide a simple

solution to the intricate problem out of Harrod-Domar model which he does fairly successfully by introducing a variable proportion production function. But he does not fiddle with other unrealistic assumptions. Some limitations of this model are given below:

(i) Prof. Amartya Sen pointed out the emphasis of Solow model is to resolve the discrepancy between the natural growth rate G_n and warranted growth rate G_w. In the process he completely ignores the actual growth rate which is equally important to steady state equilibrium path. The actual growth rate G must be equal to G_n and G_w for the steady growth.

(ii) A major drawback of the Solow model is the way it ignores the investment function completely. Absence of investment functions make the model highly stable, in fact, more stable than the systems actually are. Investment is a highly volatile variable which depends upon the animal spirits of the investors guided by their expectations of the future. Once the investment function is introduced, then all the stability of the Solow model goes out of the window. The Neo-classical and the Neo-Keynesian views of the growth are not separated as much by the variable capital-output ratio or substitution of labour and capital, the greater differences can be found in the importance they attach to the expectations of the future and their impact on the investment.

(iii) The Solow model is based on the flexibility of prices, wage and interest rates. He forgets that the existence of the 'liquidity trap' does not allow interest rates to go beyond a certain minimum limit. The inability of interest rate to be fully flexible in downward direction restricts the capital-labour ratio to adjust fully in accordance with the changing conditions.

(iv) Solow's assumptions that all units of capital are equal is a huge over-simplification. Every economy consists of a large number of sectors.

It is very naïve to assume that all sectors have homogenous units of capital. secondly, different capital units belonging to different periods of time have different quality.

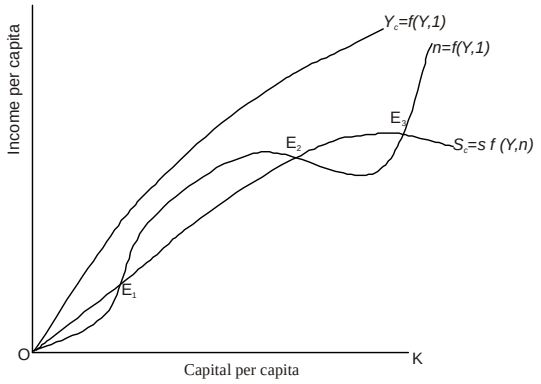
(v) Solow's viewpoint of technological progress and the factors affecting is quite incorrect. The technological progress is assumed to be dependent on exogenous factors and is assumed to be not affected by the endogenous factors. The endogenous factors of the model like investment or capital accumulation affect specialization, division of labour etc. significantly, which in turn play an important role in technological advancement.

4.6 SOLOW MODEL AND THE UNDERDEVELOPED COUNTRIES

The applicability of Solow model to the underdeveloped countries is limited by the conditions and problems of these countries which are quite different from the developed world. The economic, social and technological dualism is one such problem. The underdeveloped markets, especially the money and capital markets is another one. Even the idea of population growth which is true for the developed countries does not fit in with the underdeveloped countries. The population may grow exponentially at a constant rate in the developed world but in poor countries it is a function of per capita income. When per capita income is below the subsistence level, population may have a tendency to decline or so to say, the growth rate in population may be negative. But once, the per capita income crosses the subsistence level, then the population may start growing very quickly as the birth rate remain high but the death rate goes down. Once death rate stabilizes over a long period of time, the birth rate comes down. In figure : 4, curve S_c shows saving per capita which is shown as a function of income and '*n*' the population function. E_1 is subsistence level equilibrium and economy is caught in a low level trap. E_2 is the unstable equilibrium, any deviation from it will either take to E_1 or E_3 both being stable equilibriums. If we start from E_1 level assuming that the country is at low level equilibrium, the size of investment should be great enough to take it beyond E_2 level because it falls short of E_2, it will

automatically travel back to E_1 level. Once we go beyond E_2 it will set in to motion, the force that will lead to a higher stable equilibrium E_3.

Figure 4



4.7 SUMMARY AND CONCLUSIONS

The Neo-classical growth models challenged the assumption of constant capital labour ratio of Harrod-Domar model which leads to knife edge balance in the economies. Solow dropped this assumption and the economy automatically tends towards equilibrium state. If the initial capital labour ratio is more than the equilibrium ratio, then the capital and output will grow slowly than the labour force and vice versa. Therefore, one may start with nay ratio, it will eventually converge with the equilibrium ratio. Going further, this model also suggested several alternatives of the growth process in different economies with different economic structures. Solow model is basically designed on the experience of developed countries. The condition, challenges, institutions and attitudes in underdeveloped countries are quite different from the developed countries. As a result, the models like this being based on the experience of developed world have very limited applicability in the underdeveloped countries. But Solow model can be used quite effectively to demonstrate the economic dualism in underdeveloped countries.

4.8 GLOSSARY

(i) Depression: In economics, a depression is a sustained, long-term downturn

in economic activity in one or more economies. It is a more severe downturn than a recession, which is seen by some economists

(ii) Economic Dualism: Economic dualism refers to co-existence or two or more diversified economic structures with different levels of economic development, institutional, technological and occupational structure.

(iii) Exogenous Factor: In an economic model, an exogenous factor is one that comes from outside the model and is unexplained by the model.

(iv) Exponential Growth: Exponential growth is growth that increases at a consistent rate. It indicates the increase in number or size at a constantly growing rate.

(v) Variable Factor Proportions: If the ratio of two factors are allowed to change in a given production function, then it is termed as variable factor proportions. It indicates that the two factors can be substituted for each other.

4.9 SHORT ANSWER TYPE QUESTIONS

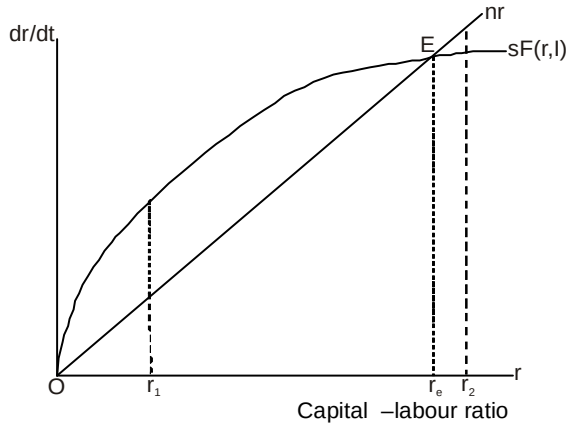
Q 1. Write down the basic assumptions of the Solow Model of growth.

Ans. Main assumptions of Solow's model of growth are given below:

1. This model is based on the production of a single composite commodity.
2. Labour and capital are the only factors of production.
3. Each factor is paid in accordance with its marginal productivity.
4. There is existence of constant returns to scale.
5. There is full employment of labour and capital.
6. The prices and the wage rates are fully flexible.
7. Capital and labour can be substituted for each other. In other words, the production function exhibits variable proportions.
8. Technical progress is assumed to be neutral.
9. The marginal propensity is assumed to be constant.

Q 2. Discuss stable equilibrium in Solow's Model.

Ans. The process of stable equilibrium in Solow's model can be examined through the figure given below. In the figure, the capital labour ratio '*r*' is plotted along the horizontal axis while the change in capital labour ratio or $\hat{r}$ is measured along vertical axis. *n.r* is a straight line passing through origin rises proportionately with the value of '*r*', given the constant value of '*n*'. Curve *s.f(r, 1)*also passes through origin meaning that there will not be any output without any capital. The curve also represents the diminishing marginal productivity of capital. At the point of intersection *n.r=s.f (r, 1)* or *n.r – s.f(r, 1) = 0*, i.e. $\hat{r} = \frac{dr}{dt} = 0$. It means that if capital output ratio corresponding to the point of equilibrium is established at r_e, then capital and labour will grow at same rate subsequently and there will be no change in capital labour ratio $\left(\hat{r} = 0\right)$.

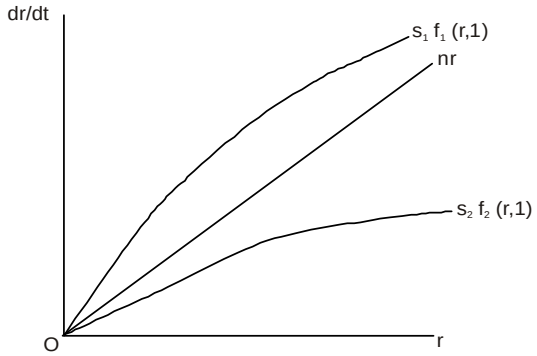


Let us assume that capital labour ratio is r_1 which is less than the equilibrium ratio r_e i.e. $r_1 < r_e$. Here, *s.f(r,1)>n.r,* there will be tendency for capital-labour ratio to rise till it reaches r_e. If it happens to be greater than r_e then the capital-labour ratio will fall till it is equal to r_e.

Q 3. Elaborate the case of poor agricultural economies and that of the industrial economies in Solow's frame work.

Ans. Solow model is basically designed on the experience of developed countries. The condition, challenges, institutions and attitudes in underdeveloped countries are

quite different from the developed countries. As a result, the models like this being based on the experience of developed world have very limited applicability in the underdeveloped countries. But Solow model can be used quite effectively to demonstrate the economic dualism in underdeveloped countries. We can try to understand it through the figure. The figure below represents the problems of underdeveloped countries caused by the economic dualism. *n.r* represents all those points where the natural and warranted growth rates are in equilibrium. The underdeveloped countries have two different sectors with different saving rates s_1 and s_2 and two different production functions $f_1(r, 1)$ and $f_2(r, 1)$. The curve $s_1 f_1(r,1)$ relates to the industrial sector which has a higher saving rate and makes use of more capital intensive techniques. The capital accumulation and the rate of growth of output is much higher than the growth of population in the economy. There is full employment in the sector which indicates that capital-labour ratio keeps growing. The end result is that the growth in industrial sector never coincides with the natural growth rate.



The agricultural sector, on the other hand, is grappling with the problem of disguised unemployment due to immobility of labour. The techniques of production are primitive and highly labour intensive. The marginal productivity of labour is very low, consequently wages are very low and there is little possibility of savings. The condition of agriculture is reflected in the curve $s_2 f_2(r,1)$ which depicts that capital labour ratio is very low and it never rises enough to meet n.r. The only way out of the tricky situation is to mobilize the surplus labour in agriculture to utilize it in the industrial sector which is starved

of labour. Both sectors in this situation witness diminishing marginal productivity but the aggregate supply is increasing because of increase in population and some net investment.

Q 4. Derive the fundamental equation in sdow Model ?

Ans. The inputs labour (L) and capital (K) are the variables that can used in substitutable mamer in the production function so that each combination (K, L) there corresponds a unique (Y).

Therefore, that production function is ----------

Y = f (K, L) ---------- (1) K, L > O

It is assumed here that 'Y' is a linear homogeneous function of degree 'I', i.e., subject to constant returns to scale. This Means

$$\lambda y = f(\lambda K, \lambda L) \qquad \text{---------} \quad (2)$$

But, Solow is not interested in 'Y' (total GDP). He is interested in per capital GDP (Y/L)

Thus, from (2), we have, the production function in per capital terms.

Lets $\lambda = \frac{1}{L}$ in equation (2), we have

$$Y / L = \int\left(\frac{1}{L}.k, \frac{1}{L}.L\right)$$

$$Y / L = \int\left(\frac{K}{L}.1\right)$$

$$y = f(k)$$

Where, Y = Y/L (a) Which is the per-capital output.

K = K/L (b) Which is the per-capital Capital stock.

Now, equation (4) indicates that per-capital is the function of capital-labour ratio.

K=K/L

Differentiating k.w.r.t.t, we have

$$\frac{dk}{dt} = \frac{d}{dt}\left[\frac{K}{L}\right]$$

$$\frac{dk}{dt} = \frac{L\overset{0}{K} - K\overset{0}{L}}{L^2}$$

$$\frac{dk}{dt} = \frac{L\overset{0}{K}}{L^2} - \frac{K\overset{0}{L}}{L^2}$$

$$\frac{dk}{dt} = \frac{\overset{0}{K}}{L} - \frac{K}{L}n \qquad \text{----------} \qquad \left[\therefore \frac{\overset{0}{L}}{L} = n\right]$$

$$\overset{0}{k} = s\frac{Y}{L} - -nk \qquad \text{----------} \qquad \left[\because \overset{0}{K} = s\frac{Y}{L}\, f\, \frac{K}{L} = k\right]$$

$$\overset{0}{k} = sf(k) - nk \qquad \text{----------} \qquad \left[\frac{Y}{L} = f(k)\right]$$

Which is the requried fundamental equation.

If $\overset{0}{k} = 0,$, then , $sf(k) - nk$, which gives us the time path of capital - labour ratio. This tells us that the time path is stable.

Q 5. Discuss the superiority of Solow model over the Harrod-Domar's model.

Ans. Harrod Domar model is based on a very narrow knife edge path where G_w, the warranted rate of growth must be equal to the natural growth rate G_n allowed by the growth rate of labour force and the given state of technology. The saving rate, the fixed capital-labour ratio and the growth rate of labour force are the most important determinants of the

economy where the first two determine the warranted rate and the last one determines the natural rate. The Harrod-Domar model offers no scope for an alternative path of growth which at all costs must be equal to the natural rate if the economy is to grow at a steady state equilibrium rate for any divergence leads to extreme fluctuations. The Solow model offers a simple solution by introducing a variable proportions production function implying that there is no possibility of such large fluctuations if the production function offers scope for substituting labour and capital. The production function advocated by Solow is known as the Neo-classical production function which retains some of the features of Harrod-Domar model i.e. the fixed saving rate and the constant growth of population. He just adds the possibility of substitution between labour and capital what makes the model more realistic and partly explains why the economic system are far more stable than what Harrod and Domar produced them to be. The reasons are not very difficult to fathom. Any departure of the warranted growth rate from the natural growth rate is cured by the flexible capital labour ratio. If natural growth rate is higher than the warranted rate, the quickly growing labour force will be absorbed by the extremely flexible production function which will immediately switch to labour intensive mode and the unemployment will disappear. Similarly, the production function will be on capital intensive mode when capital accumulates at a faster rate than the population. The extremely flexible production function is the strong point of Solow model.

Q 6. What are the limitations of Solow's model of growth?

Ans. Some of the limitations of Solow-model are given below:

(i) Prof. Amartya Sen pointed out the emphasis of Solow model is to resolve the discrepancy between the natural growth rate G_n and warranted growth rate G_w. In the process he completely ignores the actual growth rate which is equally important to steady state equilibrium path. The actual growth rate G must be equal to G_n and G_w for the steady growth.

(ii) A major drawback of the Solow model is the way it ignores the investment function completely. Absence of investment functions make the model highly stable, in fact, more stable than the systems actually are. Investment is a highly volatile variable which depends upon the animal spirits of the investors guided by their expectations of the future. Once the investment function is introduced, then all the stability of the Solow model goes out of the window. The Neo-classical and the Neo-Keynesian views of the growth are not separated as much by the variable capital-output ratio or substitution of labour and capital, the greater differences can be found in the importance they attach to the expectations of the future and their impact on the investment.

(iii) The Solow model is based on the flexibility of prices, wage and interest rates. He forgets that the existence of the 'liquidity trap' does not allow interest rates to go beyond a certain minimum limit. The inability of interest rate to be fully flexible in downward direction restricts the capital-labour ratio to adjust fully in accordance with the changing conditions.

(iv) Solow's assumptions that all units of capital are equal is a huge over-simplification. Every economy consists of a large number of sectors. It is very naïve to assume that all sectors have homogenous units of capital. Secondly, different capital units belonging to different periods of time have different quality.

(v) Solow's viewpoint of technological progress and the factors affecting is quite incorrect. The technological progress is assumed to be dependent on exogenous factors and is assumed to be not affected by the endogenous factors. The endogenous factors of the model like investment or capital accumulation affect specialization, division of labour etc. significantly, which in turn play an important role in technological advancement.

4.10 EXAMINATION ORIENTED QUESTIONS

1. Critically analyse Solow's Model of growth.

2. Elaborate the basic model of growth as given by Solow. Does equilibrium exist under all types of economic conditions?

3. What are the limitations of Solow's model? Discuss its applicability on underdeveloped economies.

4.11 SUGGESTED READINGS

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4.13 MODEL TEST PAPER

I. Answer the following in brief.

Q 1. Write down the basic assumptions of the Solow Model of growth.

Q 2. Discuss stable equilibrium in Solow's Model.

Q 3. Elaborate the case of poor agricultural economies and that of the industrial economies in Solow's frame work.

Q 4. Discuss the superiority of Solow model over the Harrod-Domar's model.

Q 5. What are the limitations of Solow's model of growth?

II. Answer the following in detail.

1. Critically analyse Solow's Model of growth.

2. Elaborate the basic model of growth as given by Solow. Does equilibrium exist under all types of economic conditions?

3. What are the limitations of Solow's model? Discuss its applicability on underdeveloped economies.

NEO-CLASSICAL MODELS OF ECONOMIC GROWTH : MEADE'S MODEL

5.1 INTRODUCTION

The model of economic growth by J. E. Meade is another important contribution in the Neo-classical growth models. Meade published his views in his book entitled 'A Neo-Classical Theory of Economic Growth'. He says about his model that, "it is designed to show the way in which the simplest form of economic system would behave during the process of equilibrium growth". Meade tries to find out how a simple traditional capitalist economy behaves during the growth process and how different variables income, capital, population and its growth, technological progress etc. affect the process of economic growth. Besides, analyzing the conditions which are central to the issue of economic growth, Meade's model tries to find out the relationship between the growth rate of population and growth rate of output. Meade identifies the three very important variables that are central to the issue of growth:

(a) The rate of accumulation of capital which depends upon the size of the savings out of present income.

(b) The expanding population which is vital for the increase in supply of labour force.

(c) The technological progress which allows the economy to produce more with the given supply of factors of production.

5.2 OBJECTIVES

This lesson has the following objectives:

1. To examine the determinants of economic growth.
2. To understand the working of Meade's model of growth.
3. To understand the idea of critical growth rate.
4. To critically evaluate the working of the Meade model of growth.

5.3 ASSUMPTIONS OF THE MODEL

Meade's model is based on following assumptions:

1. This model assumes laissez- faire and closed economy with the presence of perfect competition.
2. The production of commodities can be broadly divided into two sectors – the capital goods and the consumer's goods.
3. There are constant returns to scale in the production sector.
4. Machines are the only form of capital in the economy.
5. All the machines, that is, all units of capital are homogenous.
6. The consumer goods are assumed to have a constant money price.
7. The capital is assumed to be perfectly malleable i.e. the ratio of labour to capital can be changed not only in the long run but also in the short run.
8. There is full employment of land and labour.
9. There is perfect substitutability of production between the capital goods and consumer goods.
10. This model takes in to account the phenomenon of depreciation of machines. Some capital wears out in every production cycle which has to be replaced.

5.4 THE DETERMINANTS OF ECONOMIC GROWTH

Prof. Meade tries to analyse various determinant of economic growth in an economy where one consumer good and one capital good is produced and there is possibility of substitution between the two implying that more capital goods can be produced by reducing the production of consumer goods and vice versa. The level of production depends upon size of capital equipment, the amount of labour force, availability of natural resources including land and the technical progress over the period of time. It can be expressed in the following manner:

$$Y = f(K, L, N, t) \quad ...(1)$$

It indicates the simple fact that net national income 'Y' is a function of 'K', the stock of capital; 'N' the size of natural resources including land; 'L' the size of labour force i.e. supply of labour determined by size of population; 't' is the time period which is also a measure of technical progress.

Given the size of land and natural resources which are assumed to be fixed, the increase in net national income ΔY can be attributed to following three reasons:

Firstly, by an increase in capital stock (ΔK) which may occur because people save and invest some parts of their current incomes to augment the capital stock. The resultant increase in income depends partly on increase in capital stock multiplied by marginal productivity of capital 'V'. The increase in output will be V. ΔK.

Secondly, the increase in national income may occur due to increase in working population ΔL. Let 'W' be the marginal productivity of labour, then the increase in net national income caused by expanded working population will be W. ΔL.

Thirdly, the increase in national income may be due to technical progress which is bound to happen over a period. The technical progress increases the productivity of other factors of production which leads to increase in production even if all other factors remain fixed in quantity. Let it be denoted by $\Delta Y'$.

The increase in national income can be described with the help of following equation:

$$\Delta Y = V.\Delta K + W.\Delta L + \Delta Y' \qquad ...(2)$$

Dividing both the sides by Y, we get

$$\frac{\Delta Y}{Y} = \frac{V}{Y}.\Delta K + \frac{W}{Y}.\Delta L + \frac{\Delta Y'}{Y} \qquad ...(3)$$

or,

$$\frac{\Delta Y}{Y} = \frac{VK}{Y}.\frac{\Delta K}{K} + \frac{WL}{Y}.\frac{\Delta L}{L} + \frac{\Delta Y'}{Y} \qquad ...(4)$$

$\frac{\Delta Y}{Y}$ is the rate of change in national income represented by '*y*'; $\frac{\Delta K}{K}$ is denoted by '*k*' which is proportional growth of capital stock; $\frac{\Delta L}{L}$ denoted by '*l*' measures the proportional growth of labour force and $\frac{\Delta Y'}{Y}$ denoted by '*r*' is the measure of proportional growth rate of income due to technological progress.

VK/Y is the proportional marginal product of capital denoted by '*U*', while *WL/Y* is the proportional marginal product of labour denoted by '*Q*'. Now '*U*' is the part of national income accruing to capital (profits) and '*Q*' is the part of national income going to labour (wages). Equation (4) can be rewritten as

$$y = U.k + Q.l + r \qquad ...(5)$$

Equation (5) shows that the growth of national income '*y*' is sum of three growth rates, the growth rate of capital 'k' weighted by its share in national income (*U*), the growth rate of labour force '*l*' weighted by the share of wages '*Q*' in national income and the growth in income due to technological advancement '*r*'.

The growth in national income is accompanied by growth of population at rate 'l', so the real growth rate in national income is y-l. We can compute it by subtracting 'l' from both sides of equation (5) i.e.

$$y - l = U.k + Q.\ l + r - l$$

or,

$$y - l = U.k - (1 - Q).\ l + r \qquad ...(6)$$

This equation tells us that real growth rate of national income is the difference between growth rate of income and growth rate of population. For instance, if the national income grows at 10 per cent and the population grows at 4 per cent, the real growth in national income will be 10-4=6 per cent. Thus, the growth rate of national income per capita is determined by three factors – first, it is raised by growth rate of real capital '*k*' weighted by its proportional marginal product or by the proportion of the net national income which will be paid to profits in a competitive equilibrium; second, it is depressed by growth rate of working population '*l*' weighted by proportional marginal product of labour (*1-Q*); and third it is raised by the rate of technical progress '*r*'. The second of these factors namely, -(*1-Q*).*l* which tends to depress the growth rate of real income per head is of course, the familiar tendency for diminishing returns to labour to set in as more and more labour

is applied to any given amount of land and capital equipments. One of the most important determinants of growth rate of income per head is *Uk*, where *U= VK/Y*, '*k*' is great rate of capital, *ΔK/K*. '*ΔK*' depends on savings out of national income, therefore, it is equal to *S.Y* where '*S*' stands for the proportion of net national income that is saved, we get

$$\text{Uk} = \frac{\text{V.K}}{\text{Y}} . \frac{\Delta \text{K}}{\text{K}} = \frac{\text{V.K}}{\text{Y}} . \frac{\text{SY}}{\text{K}} = \text{V.S}$$

Thus, equation (6) can also be rewritten as

$$y - l = V.S - (1 - Q).l + r \qquad ...(7)$$

5.5 CHANGES IN GROWTH RATES

With the help of above equations Meade sets out to explore whether the growth will feed on itself to become more and more rapid or it will exhaust itself to slow down and down. Assuming that the technological growth measured by '*r*' and population growth '*l*' are exogenous factors given and constant, then the per capita growth of income depends on variables *V, S* and *Q*. if '*S*' the saving ratio goes up then '*V*' the marginal productivity of capital will decline but the decline would be slow if labour and capital can be substituted for each other. Secondly, the value of marginal productivity of capital may increase instead of falling if the rate of technical progress '*r*' is quite high.

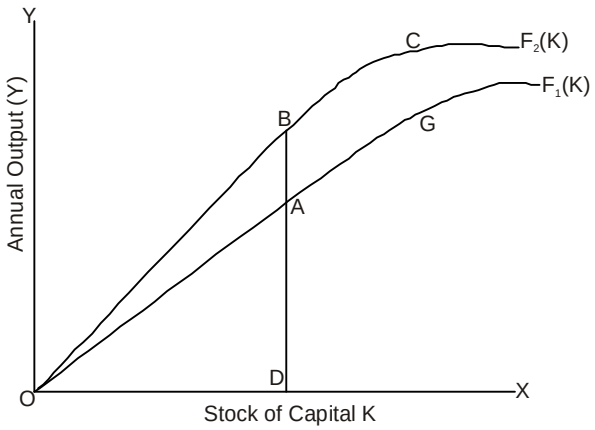
Let us assume that land, natural resources and population are constant i.e. '*l*', the growth rate of population is zero. The equation (7) becomes

$$y = VS + r \qquad ...(8)$$

Because of constant population, '*y*' the growth rate of income is not different from per capita growth of income. Assuming that the technological growth rate '*r*' is constant, then '*y*', the indicator of per capita growth rate of income or the standard of living depends entirely on the component *VS*. The increase in '*S*' tends to exert a downward pressure on '*V*' and '*r*' the technical progress tends to push '*V*' upwards. The rate of technical progress also influences the value of '*S*'. The

reason is that the technical progress increases the marginal productivity of capital which increases the share of profits in the national income. A big chunk of savings come from profits, therefore, the technical progress raises the size of savings.

Figure 1



In figure : 1, the national income 'Y' is measured on the vertical axis and the total capital stock 'K' is plotted along the horizontal axis. The curve $F_1(K)$ shows the possible levels of national output to be attained at different levels of capital stock. For example OD level of capital stock can produce the output level AD. The slope of $F_1(K)$ curve at point 'A' measures the marginal productivity of capital at OD stock of capital. The declining slope of function $F_1(K)$ shows the declining marginal productivity of capital for the given labour force and natural resources. After a period of time 't', the technological advancements will push the production function in an upward position, say to $F_2(K)$ in figure : 1. Technological advancement will help in producing more with the same amount of factors of production (here the capital stock). As we can notice in figure 1 that the capital stock OD, can produce BD amount of output which is greater than the previous level of output by the amount of AB. The slope at 'B' which is marginal productivity of capital is higher than the same at 'A'. The ratio AB/AD measures the rate of technical progress 'r'. In case the technical progress is neutral then the slope at 'B' will be greater than the slope at 'A' by the

same proportion as BD is greater than the output AD. The technical progress will be machine using if the difference between slope at B and A is greater than the proportionate difference between BD and AD and it will be machine saving if it is less than that. So, technical progress is neutral if it raises the marginal productivity of capital by AB/AD or rate of technical progress, if the increase is greater than '*r*' then it is machine using and if it is less than '*r*' it will be labour using.

Assuming that population and the saving rate can vary over a period of time, Meade analyzes the forces that can affect the rate of growth. Firstly, given $= U.k + Q.l + r$, anything that raises the rate of capital accumulation 'k' also raises the level of output. Given that $k = \frac{S.Y}{K}$, the growth rate of capital can be raised either by increase in saving ratio 'S' or by productivity of capital Y/K. Secondly, growing 'S' ensures that capital accumulation takes place at a faster pace, thereby raising growth rate of income. But 'S' can grow either due to increase in levels of income or changes in distribution. Thirdly, the degree of substitutability between factors of production plays an important role. A high degree means that the growth rate will be rising and lastly, the technical progress can raise the level of output.

5.6 THE STATE OF STEADY ECONOMIC GROWTH

While analysing the conditions of steady state rate of growth Meade drops the highly unrealistic assumption of constant population. Instead he moves to more realistic assumption that population grows at a constant rate. The technical progress rate is also assumed to be constant. The steady state growth requires that '*y*', the rate of change in output grows at a constant rate. With '*l*' the population growth rate also being constant, it eventually means that output per capita *y*-*l* grows at a constant rate. The steady state growth of income takes place under three conditions:

(a) The elasticities of substitution between various factors must be equal to unity.

(b) The technical progress is neutral.

(c) The proportion of savings out of profits, wages and rent are constant.

Let, S_u denote the rate of savings out of profits and S_Q and S_z represents the saving rates out of wages and rent respectively. If *U*, *Q* and *Z* are the proportions of national income going to profits, wages and rent respectively, then the total saving rate for the economy as a whole will be

$$S = S_u.U + S_Q.Q + S_z.Z \quad ...(9)$$

The saving ratio 'S' remains constant due to above mentioned three conditions. Condition (a) and (b) ensure that the proportion of national income accruing to wages – *Q*; Profits – *U* and Rent – *Z* remain unchanged and the condition (c) means S_u, S_Q and S_z are constant. The end result is that overall saving rate 'S' is constant.

Now consider the basic equation $y = U.k + Q.l + r$ in which *U* and *Q* are constant as discussed above, '*l*' the growth rate of population and 'r' the rate of technical progress are assumed to be constant. In this situation '*k*' the growth rate of capital is the only variable which can affect '*y*'. '*k*' itself is equal to $\frac{S.Y}{K}$ out of which 'S' is a constant. Therefore, 'k' will also be constant if *Y/K*, the ratio of income to capital remains constant which is only possible if '*Y*' and '*K*' grow at the same rate i.e. y=k. Thus, we can conclude that national income can grow at a steady rate only if the income and the capital stock grow at the same rate.

5.7 THE CRITICAL GROWTH RATE

The crux of the above analysis is that the national income can grow at a constant rate i.e. the economy can acquire the state of steady growth, the capital stock needs to grow at such a rate that the resultant increase in national income is equal to it. This rate of growth where the output and capital grow at the same rate is known as the 'critical rate' of growth. Let us denote the critical growth rate by '*a*' such that *y=k=a*.

The basic growth equation $y = U.k + Q.l + r$ can be written as

$$a = U.a + Q.l + r$$

or,

$a - U.a = Q.l + r$

or,

$a(1 - U) = Q.l + r$

or,

$$a = \frac{Q.l + r}{1 - U} \qquad ...(10)$$

Therefore, we can conclude that the national income as well as the capital stock must grow at the same critical rate i.e. $\frac{Q.l + r}{1 - U}$ to attain the steady state of economic growth. The possibility of divergence between 'k' the growth rate of capital stock given by $\frac{S.Y}{K}$ and the critical growth rate $\frac{Q.l + r}{1 - U}$ is not ruled out, but there are forces that set into restore the balance. If capital stock 'k' grows at a faster rate than the critical rate then $\frac{S.Y}{K} > \frac{Q.l + r}{1 - U}$ i.e. 'K' is growing at a faster rate than 'Y'. It means the ratio of income to capital Y/K will tend to decline. With 'S' being constant, the rate of growth of capital stock $\frac{S.Y}{K}$ will have a tendency to fall. As long as $\frac{S.Y}{K} > \frac{Q.l + r}{1 - U}$, the ratio Y/K will continue to fall until the two becomes equal.

Conversely, if rate of growth of capital is lower than the critical rate $\frac{S.Y}{K} < \frac{Q.l + r}{1 - U}$, it means 'Y' will be increasing at a faster rate than 'K' which implies that the ratios, Y/K and $\frac{S.Y}{K}$ will be rising till the two rates become equal. Based on the above arguments Prof. Meade concludes "If growth rate of population is constant, the three elasticities of substitution between three factors are unity, technical progress grows at a constant rate and neutral towards all factors and the

proportion of profits, of wages, and of rents saved are all constant, then the growth rate of real income and stock of machinery would both tend towards a constant level equal to $\frac{Q.l + r}{1 - U}$ ".

The whole process can be demonstrated with the help of figure : 2. The rate of growth of capital 'k' is plotted along the horizontal axis while the rate of growth of national income 'y' is measured along the vertical axis. OM depicts the 45° line which is the locus of all those points where the growth rate of income is equal to growth rate of capital stock. the line OCG passing through the origin with a constant slope measured by $\frac{CD}{OD} = \frac{GH}{OK} = U$ is the proportional marginal product of capital. The height of this curve at any level of growth rate of capital measures that part of growth of output which is due to growth of capital. So, line OCG is a locus of the component *Uk*. The other component *Ql+r* is a constant determined by *Q, l* and *r* which have been assumed to be given and constant. In this diagram, it is given by OE. The growth rate of income $y = U.k + Q.l + r$ is denoted by the line EAF which is parallel to line OCG that measures *Uk* and the two lines are separated by constant *Ql+r*. The total growth of output,say 'A' is sum of two parts, CD part of growth is due to growth of capital OD, while the 'AC' part is due to growth of population and technical progress. The equilibrium is at point 'F' where '*y*' the growth rate of output is equal to growth rate of capital i.e.

OH = FH = GH+FG

or,

$k = U.k + Q.l + r$

or,

$k - U.k = Q.l + r$

or,

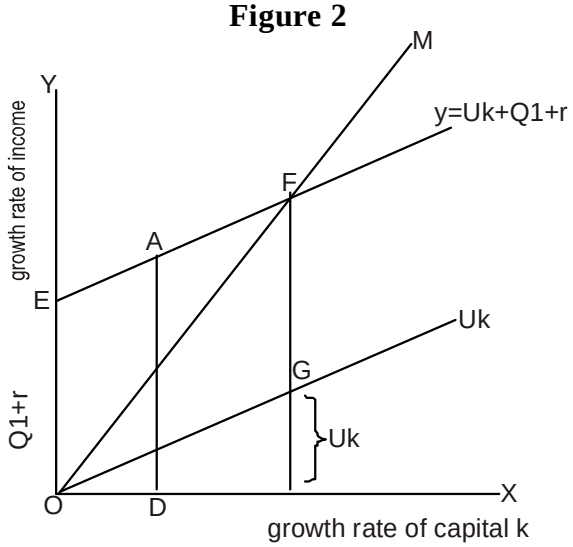
$k\ (1 - U) = Q.l + r$

or,

$$k = \frac{Q.l + r}{1 - U}$$

Thus, OH = $k = y = a$ is the critical rate of growth where the economy is growing at a steady rate. If the growth rate of capital is OD, then the growth rate of output is equal to AD. The growth rate of capital OD=AB is less than the growth of output as AB < AD i.e. $y > k$ or $\frac{Q.l + r}{1 - U} > \frac{S.Y}{K}$, as '$y$' is rising at a rate which is higher than 'k'. So, ratio Y/K will be increasing. The process will come to an end at point 'F' where 'y' and 'k' both grow at the critical rate 'a'.

Figure 2



5.8 CRITICAL APPRAISAL OF MEADE'S MODEL OF GROWTH

Meade's model is more realistic because it takes in to account the technical progress, changes in the population and the possibility of substitution between capital and labour. Though the steady state growth concept is

somewhat similar to Joan Robinson's Golden Age but it is better in some aspects because it is based upon relatively fewer assumptions. However, this model is not free from the shortcomings which are enlisted below:

(i) The assumptions of full employment, closed economy and constant returns to scale make it unrealistic. It ignores the imperfections of the market which are present in the developed as well as underdeveloped economies.

(ii) Being a mathematical model, it has many limitations as it analyses only those factors which are quantifiable. Many important economic and non-economic variables have to be ignored because they can not be expressed mathematically.

(iii) Economic development in underdeveloped countries is not merely an economic phenomenon. It involves many political, social and institutional factors which are being ignored by this model. These economies are trapped in vicious cycle of poverty, lacking social overhead capital where investment is a risky business. Therefore, a separate study is required to tackle the problem of underdevelopment.

(iv) Neo-classical models basically depend on the flexibility of prices, wages and interest rates that correct the disequilibrium. These variables in general, are not flexible in downward direction. The Keynesian liquidity trap shows that the interest rates do not fall beyond a certain point. The inability of interest rates to fall, may not allow the capital –labour ratio to adjust itself to keep the economy in steady state equilibrium growth path.

(v) The Neo-classical production function is faulty because of its conception of capital, the capital as conceived by neo-classicals can not work with any size of labour force. Of course, the capital-labour ratio can be viewed but there is a limit to it the upper as well as the lower limit. Due to these limits of variations in capital labour ratio, there will be limited chances of convergence.

(vi) Technical progress is not an exogenous factor as assumed by Meade. In fact, it is both endogenous as well as exogenous. Some technical progress does take place due to internal factors such as learning by doing, experience and specialisation. Technical progress to a large extent is an internal factor depending on the scale of investment.

(vii) These models lay too much emphasis on interplay of natural and warranted rate of growth. In the process they completely ignore the actual growth rate. It means that the investment function and the highly uncertain element like entrepreneurial expectations are not paid any attention.

5.9 SUMMARY AND CONCLUSIONS

J. E. Meade made an important contribution to the neo-classical school of thought on economic growth. Apart from the conditions which are central to the issue of economic growth, Meade's model tries to find out the relationship between the growth rate of population and growth rate of output. Meade identifies the three very important variables that are central to the issue of growth which are rate of accumulation of capital, expanding population and technological progress. This model propagated the idea that whereas the rate of capital accumulation and technical progress increase the growth of output in the economy, the growth of population tends to depress it. It has also been pointed out that the national income can grow at a steady rate only if the income and the capital stock grow at the same rate. This rate of growth where the output and capital grow at the same rate is known as the 'critical rate' of growth. Meade himself pointed out that if growth rate of population is constant, the three elasticities of substitution between three factors are unity, technical progress grows at a constant rate and neutral towards all factors and the proportion of profits, of wages, and of rents saved are all constant, then the growth rate of real income and stock of machinery would both tend towards a constant level. Thus, this model is based on many assumptions whose applicability challenges the validity of this model particularly in the context of the developing countries.

5.10 GLOSSARY

(i) Elasticity of Substitution: The elasticity of substitution measures the percentage change in factor proportions due to a change in marginal rate of technical substitution.

(ii) Neutral Technical Progress: By neutral technical progress we refer to such a technical progress which increases the productivity of all factors of production in the same proportion. Therefore, it is neither labour augmenting nor labour saving.

(iii) Perfect Malleability of Capital: Perfect malleability of capital refers to a situation in which the given capital can be used in any sector of the economy i.e. it can be easily switched from one sector of production to another. This term is also used for the possibility of substitution between labour and capital i.e. variable factor proportions within the same sector of the economy.

(iv) Technical Progress: In simple terms, technical progress refers to improvement in technology which leads to an increase in output for given set of the factors.

5.11 SHORT ANSWER TYPE QUESTIONS

Q 1. Discuss three important variables of growth identified by Meade.

Ans. Meade indentifies following three very important variables that are central to the issue of growth:

(a) The rate of accumulation of capital which depends upon the size of the savings out of present income.

(b) The expanding population which is vital for the increase in supply of labour force.

(c) The technological progress which allows the economy to produce more with the given supply of factors of production.

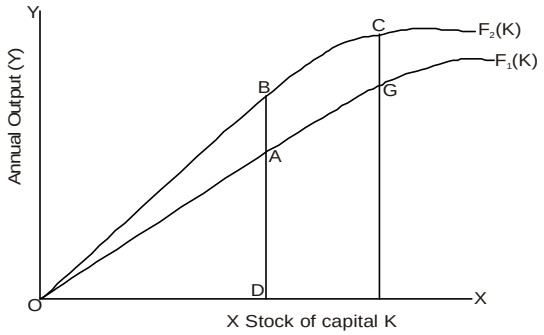
Q 2. What are the assumptions of the Meade's model of growth?

Ans. Meade's model is based on following assumptions:

1. This model assumes laissez- faire and closed economy with the presence of perfect competition.
2. The production of commodities can be broadly divided in to two sectors – the capital goods and the consumer's goods.
3. There are constant returns to scale in the production sector.
4. Machines are the only form of capital in the economy.
5. All the machines, that is, all units of capital are homogenous.
6. The consumer goods are assumed to have a constant money price.
7. The capital is assumed to be perfectly malleable i.e. the ratio of labour to capital can be changed not only in the long run but also in the short run.
8. There is full employment of land and labour.
9. There is perfect substitutability of production between the capital goods and consumer goods.
10. This model takes in to account the phenomenon of depreciation of machines. Some capital wears out in every production cycle which has to be replaced.

Q 3. Show the impact of technical progress on level of production as conceived by Meade.

Ans. The impact of technical progress on level of output can be shown through a diagram given below:



In this diagram, the national income 'Y' is measured on the vertical axis and the total capital stock 'K' is plotted along the horizontal axis. The curve $F_1(K)$ shows the possible levels of national output to be attained at different levels of capital stock. For example OD level of capital stock can produce the output level AD. The slope of $F_1(K)$ curve at point 'A' measures the marginal productivity of capital at OD stock of capital. The declining slope of function $F_1(K)$ shows the declining marginal productivity of capital for the given labour force and natural resources. After a period of time 't', the technological advancements will push the production function in an upward position, say to $F_2(K)$ in the diagram. Technological advancement will help in producing more with the same amount of factors of production (here the capital stock). As we can notice in figure 1 that the capital stock OD, can produce BD amount of output which is greater than the previous level of output by the amount of AB. The slope at 'B' which is marginal productivity of capital is higher than the same at 'A'. The ratio AB/AD measures the rate of technical progress 'r'. In case the technical progress is neutral then the slope at 'B' will be greater than the slope at 'A' by the same proportion as BD is greater than the output AD. The technical progress will be machine using if the difference between slope at B and A is greater than the proportionate difference between BD and AD and it will be machine saving if it is less than that. So, technical progress is neutral if it raises the marginal productivity of capital by AB/AD or rate of technical progress, if the increase is greater than '*r*' then it is machine using and if it is less than '*r*' it will be labour using.

Q 4. What do you mean by critical growth rate?

Ans. The idea of critical growth rate has been given by Meade. The crux of his analysis is that the national income can grow at a constant rate i.e. the economy can acquire the state of steady growth, if the capital stock grows at such a rate that the resultant increase in national income is equal to it. This rate of growth where the output and capital grow at the same rate is known as the 'critical rate' of growth. Let us denote the critical growth rate by '*a*' such that $y=k=a$. where, '*y*' growth of national income and '*k*', the growth of capital stock.

Q 5. Discuss the limitations of Meade's model of growth.

Ans. The limitations of Meade's model are given below:

(i) The assumptions of full employment, closed economy and constant returns to scale make it unrealistic. It ignores the imperfections of the market which are present in the developed as well as underdeveloped economies.

(ii) Being a mathematical model, it has many limitations as it analyses only those factors which are quantifiable. Many important economic and non-economic variables have to be ignored because they can not be expressed mathematically.

(iii) Economic development in underdeveloped countries is not merely an economic phenomenon. It involves many political, social and institutional factors which are being ignored by this model. These economies are trapped in vicious cycle of poverty, lacking social overhead capital where investment is a risky business. Therefore a separate study is required to tackle the problem of underdevelopment.

(iv) Neo-classical models basically depend on the flexibility of prices, wages and interest rates that correct the disequilibrium. These variables in general, are not flexible in downward direction. The Keynesian liquidity trap shows that the interest rates do not fall beyond a certain point. The inability of interest rates to fall, may not allow the capital –labour ratio to adjust itself to keep the economy in steady state equilibrium growth path.

(v) The Neo-classical production function is faulty because of its conception of capital, the capital as conceived by neo-classicals can not work with any size of labour force. Of course, the capital-labour ratio can be viewed but there is a limit to it the upper as well as the lower limit. Due to these limits of variations in capital labour ratio, there will be limited chances of convergence.

(vi) Technical progress is not an exogenous factor as assumed by Meade. In fact it is both endogenous as well as exogenous. Some technical

progress does take place due to internal factors such as learning by doing, experience and specialisation. Technical progress to a large extent is an internal factor depending on the scale of investment.

(vii) These models lay too much emphasis on interplay of natural and warranted rate of growth. In the process they completely ignore the actual growth rate. It means that the investment function and the highly uncertain element like entrepreneurial expectations are not paid any attention.

5.12 EXAMINATION ORIENTED QUESTIONS

1. Critically analyse Meade's model of growth.
2. Elaborate the main determinants of growth in Meade's model.
3. What do you mean by critical rate of growth? Give the main limitations of Meade's model of growth.

5.13 SUGGESTED READINGS

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5.15 MODEL TEST PAPER

I. Answer the following in brief.

1. Discuss three important variables of growth identified by Meade.
2. What are the assumptions of the Meade's model of growth?
3. Show the impact of technical progress on level of production as conceived by Meade.
4. What do you mean by critical growth rate?
5. Discuss the limitations of Meade's model of growth.

II. Answer the following in detail.

1. Critically analyse Meade's model of growth.
2. Elaborate the main determinants of growth in Meade's model.
3. What do you mean by critical rate of growth? Give the main limitations of Meade's model of growth.

M. A. ECONOMICS **LESSON NO. 6**

COURSE NO. : ECO 302 **SEMESTER III** **UNIT- II**

Cambridge Models of Economic Growth: Joan Robinson's Model of Capital Accumulation

6.1 INTRODUCTION

The Cambridge models of economic growth mainly include the views of Joan Robinson, Kaldor, Pasinetti and many more. Here, in this lesson we will discuss about Joan Robinson's model of capital accumulation. Mrs. Joan Robinson published her views in her book entitled 'The Accumulation of capital' that came in 1956. Later on she presented her views in more systematic, more forceful and much improved manner. Her model is based on the 'capitalistic rule of the game'. Instead of analyzing the automatic forces that are responsible for producing dynamic equilibrium in the economy, she is more interested in the features of economic growth. She concerns herself with the growth rate of population in the underdeveloped countries and its impact on growth of output and development; the relationship is partly due to relationship between rate of profit and capital accumulation and partly due to the effect of distribution of income on the savings. Mrs. Robinson's views were in verbal form and it was a clear cut attempt to do away with abstractions. Her models is based on her books 'The Accumulation of Capital' and the 'Essays in the Theory of Economic Growth'. The credit of constructing her model in mathematical form goes to Prof. K. K. Kurihara who published it in his book 'The Keynesian Theory of Economic Development'.

6.2 OBJECTIVES

The main objectives of this lesson are given below:

1. To discuss the basic framework of Joan Robinson's model of capital accumulation.
2. To examine the state of golden age.
3. To throw light on various types of golden and platinum ages.
4. To know about the views by Mrs. Joan Robinson about Harrod-Domar Model of growth.
5. To understand the applicability of Joan Robinson's model on underdeveloped economies.
6. To know about the limitations of the model by Mrs. Joan Robinson.

6.3 ASSUMPTIONS OF THE MODEL

The model by Mrs. Joan Robinson is based on following assumptions:

1. The economy is closed with with total absence of foreign trade.
2. There is no interference by the government in economic activities.
3. There are only two factors of production – labour and capital. Accordingly, the national income is divided in to wages and profits.
4. The entrepreneurs do not spend anything and save every thing. So, all the profits are saved.
5. The wage earners save nothing and spend all.
6. The prices are assumed to be constant.
7. The technical progress is assumed to be neutral.
8. The labour and capital can be used in a fixed proportion.

6.4 EXPLANATION OF THE MODEL

Robinson starts with the statement that national income can be divided into two parts i.e. wages and profits.

$$Y = w.N + p.K \qquad \ldots\ldots\ldots(1)$$

$w.N$ represents total wage bill where 'w' is the wage rate and 'N' is the size of the labour force. The share of profits is calculated by multiplying 'p' the profit per unit of capital and 'K' is the number of capital units employed.

Profit rate being central to the capital accumulation can be expressed as

$$p = \frac{Y - w.N}{K}$$

or,

$$p = \frac{\frac{Y}{N} - w}{\frac{K}{N}}$$

Let, Y/N = l and K/N = θ, we get

$$p = \frac{l - w}{\theta} \qquad \text{.....(2)}$$

Here, 'l' represents the productivity of labour and θ is the capital-labour ratio. We can conclude that 'p' the rate of profit is equal to the productivity of labour minus wage rate, divided by the capital labour ratio i.e. θ. Thus, the profit rate is directly related with productivity of labour 'l' which tends to raise it, and is inversely related with 'w' the wage rate and θ the capital-labour ratio.

Because the capitalists save and invest all their profits and the workers save nothing or consume all, therefore, all savings are invested and S=I.

Here, I=ΔK (as investment means net addition to capital stock)

$$\text{i.e. } S = \Delta K \qquad (I=S=p.K)$$

$$p.K = \Delta K$$

or,
$$p = \frac{\Delta K}{K} \qquad \text{.....(3)}$$

from equation (2) and (3)

$$\frac{\Delta K}{K} = \frac{l - w}{\theta}$$

The growth rate of capital $\frac{\Delta K}{K}$, varies directly with the net rate of return on capital given by factor l-w and inversely with capital labour ratio i.e. θ. The rate of growth of capital will be rising if net rate of return on capital (l-w) is rising at a faster rate than the capital labour ratio. If the technical conditions of production remain unchanged i.e. the productivity of labour 'l' and the capital-labour ratio 'θ' remain unchanged then the rate of growth of capital $\frac{\Delta K}{K}$ (which is also the rate of profit 'p') varies inversely with real wage rate 'w' i.e. an increase in the real

wage rate diminishes the rate of growth of capital and a fall in real wage rate increases it. In a way Joan Robinson reconnects with the Ricardian world with the conclusion that whatever affects profits also affects rate of capital accumulation and the determinants being productivity of labour, capital labour ratio and the real wage rate. At a constant capital labour ratio, the rate of profits will increase with increase in labour productivity or a fall in real wage rate.

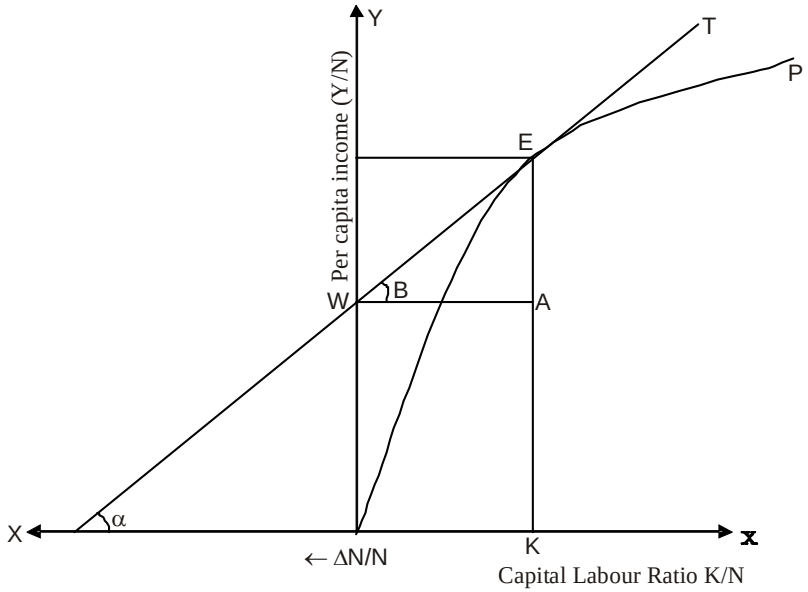
6.5 THE STATE OF GOLDEN AGE

The growth rate of capital accumulation obviously is an important component of economic growth at a steady rate but the growth rate of population $\Delta N/N$ is equally significant. Two factors vital to Joan Robinson's concept of 'Golden Age' are full employment of labour force and the full utilization of capital stock. In her own words, "when technical progress is neutral and proceeding steadily, without any changes in time pattern of production, the competitive mechanism working fully, the population growing at a steady rate and the accumulation going on fast enough to supply productive capacity for all available labour, the rate of profits tends to be constant and the level of real wages rise with the output per man. There are no internal contradictions to the system……the total annual output and the capital stock (value in terms of commodities) grow together at a constant proportionate rate compounded of the rate of growth of labour force and the rate of increase in the output per man. We may describe these conditions as 'golden age', thus indicating that it is a mythical state of affairs not likely to attain in an actual economy".

It is a state of bliss in the Harrodian sense when all actual, warranted and the natural rates of growth are equal. The consumption grows at a feasible rate which is just the rate required to maintain the growth. We have denoted earlier that $K/N = \theta$. As capital and labour increase in such a manner that it is consistent with full employment and full utilization of capital, therefore, $\Delta K/\Delta N = \theta$ or $\Delta N = \Delta K/\theta$, the growth of labour force will be

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

The steady state equilibrium growth is based on the condition that capital and labour grow in such a manner that the capital-labour ratio remains unchanged. The state of 'golden age' can be illustrated with the help of figure : 1.



Here capital-labour ratio θ (or K/N) is measured on the X-axis as we go to the right of the origin while the growth of the labour force is measured along left side of the origin. Per capita output Y/N is measured along the Y-axis. OP curve shows the production function where output per worker is a function of capital per worker. There is positive relationship between the two as output per worker increases with the capital per worker. In order to demonstrate the conditions of golden age, we draw a tangent NT at point E on production function which meets the Y-axis and X-axis on W and N respectively. At the equilibrium point 'E', the capital labour ratio is 'OK' and per capita output is 'EK' or 'OM'. Out of this per capita output 'OM', 'OW' is the wage rate and the residual 'WM' is the share of profits. Now,

$$\angle\alpha = \angle\beta$$

$\because \tan\alpha = \tan\beta$

$$\frac{OW}{ON} = \frac{EA}{AW}$$

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

The economy is in the golden age as both capital and labour are growing at the same rate. The economy may diverge from the golden age path but the forces at work in the economy interact to restore the balance.

Let us assume that $\frac{\Delta N}{N} > \frac{\Delta K}{K}$ i.e. population is growing at a faster rate than the capital stock or the capital stock is not expanding quickly enough to provide employment to the growing labour force. It means that there will be unemployment in the economy. Consequently, the money wage rate in the economy will decline. Assuming that prices remain constant, it will naturally mean that the share of profits will go up leading to higher rate of capital accumulation till the equilibrium is restored at $\frac{\Delta N}{N} = \frac{\Delta K}{K}$. This situation is not uncommon to the underdeveloped countries where the population grows at a higher rate than the rate of growth of capital. The resultant unemployment, we can see, will lead to lower real wage rates. Equation (2) tells us that if the real wage rate declines, it will lead to increase in the rate of profits. Higher rate of profits means higher rate of capital accumulation $\Delta K/K$ which narrows the gap between growth of population and growth of capital and the process continues till $\Delta K/K$ rises enough to equal $\Delta N/N$. There can be two deterrents to the process of equilibrium. The money wages, for instance, may not be flexible downwards, which may not allow the profits and capital accumulation to rise sufficiently to match $\Delta N/N$. Also, the prices may fall to keep the real wage rate high. Thus, unemployment in the economy may continue to exist. This situation is quite similar to Harrod's indefinite disequilibrium which arises out of fixed capital-labour ratio and fixed relative prices.

Alternatively, $\frac{\Delta K}{K} > \frac{\Delta N}{N}$ i.e. the rate of capital growth may exceed the growth rate of labour force, which is normally the case in developed countries. This situation is relatively easier to deal with. The attainment of 'golden age' is possible

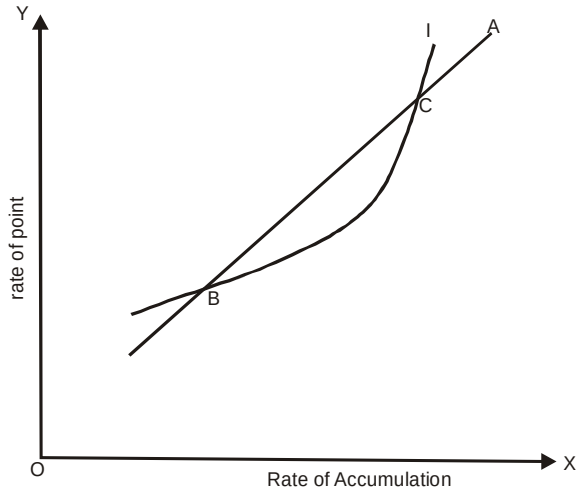
through the improvement in techniques. The economy can move on higher production possibility curve which is consistent with higher capital-labour ratio. There is an easy path back to equilibrium which operates via higher real wage rate, less profits and low rate of capital accumulation. But Joan Robinson prefers a path which keeps the real wage rate fixed but seeks the equilibrium through higher capital labour ratio and higher productivity of labour.

Joan Robinson is of the view that the economy is said to be in golden age when it grows in accordance with its 'potential growth ratio'. The 'potential growth ratio' may be defined as the maximum rate of growth of accumulation of capital that can be maintained at the constant rate of profit. It is equal to the sum of proportionate growth rate of population and the proportionate growth rate of output per head. The 'golden age' of Joan Robinson is associated with bliss, stability and tranquility. The 'golden age' requires a set of conditions that keeps the growth ratio to be steady all the time because frequent changes in the growth ratio might disturb the tranquility of golden age. But it needs to be pointed out that growth ratio is only one of the factors that can disturb it. Just for sake of argument, when the stock of capital becomes too high, the desire to accumulate further may lose stream. The stagnation may set and the economy may drift away from the golden path. The golden state is hardly the ideal state. A higher growth ratio may result in a new golden age where the proportion of productive capacity is higher and the consumption is lower. A lower growth ratio on the contrary, may either be manifested in unemployment or in increased consumption. A special case of golden age is the growth ratio being zero. The profit rate is also zero as the wages absorb the entire net output and the consumption rises. Joan Robinson terms it as a state of bliss as the consumption is at a higher level which can be maintained under some technical constraints.

The model is based on the assumption that the technical progress is neutral. When the accumulation is taking place at a rate that keeps the rate of profit constant, there is no perceptible change in capital employed per labour unit. The technical progress is dependent on forces of demand and supply in the market. It is defined as an increase in per capita output when the population is constant. If there is scope for higher profits, the producers quite naturally are

attracted by labour-saving techniques but such tendencies are prevalent even when there is huge unemployment in the market. According to Joan Robinson, the growth of knowledge gives rise to 'autonomous innovations', the increased competition to 'competitive innovations' and shortage of labour gives rise to 'induced innovations'. In the context of this model, the warranted or desired growth rate may fall short of the possible growth rate due to autonomous and competitive innovations. The desired rate of growth is that rate of growth that keeps the entrepreneurs happy. The desired growth rate depends upon the rate of profits resulting from rate of accumulation and the rate of accumulation caused by the rate of profit. It can be explained with the help of figure : 2. In this figure, the rate of capital accumulation is plotted along the X-axis and the rate of profit is measured along Y-axis. Curve 'A' shows the expected rate of profit as a function of rate of accumulation. The curve 'I' shows the rate of accumulation as the function of rate of profit. To the right of 'C', the expected rate of profit is below the rate of accumulation. The rate of accumulation tends to decrease because entrepreneurs do not expect the profits as high as they like to be. The rate of accumulation falls as a result till the system is in balance at 'C'. Between the interval 'B' and 'C', the expected rate of profit is higher than the rate of accumulation. Therefore, the rate of accumulation will increase till it reaches the desired rate at 'C'.

Figure 2



The possible growth rate depends upon the growth, technical know-how and the natural resources. The golden age is reached when the possible and the desired rates are in equilibrium. The real wage rate and per capita outputs are rising due to improvements in the techniques of production. The rate of profit is constant. The techniques of production are carefully chosen to keep the profit rate constant.

6.6 VARIOUS TYPES OF GOLDEN AGE

Having defined golden age as the situation when the economy grows so as to ensure full employment and the full utilization of capital. The capital accumulation is sufficient to employ the growing population so that capital labour ratio is constant. The rate of profit is constant as the productivity of labour and real wage rises at the same rate. There are some variants of golden age that can prevail. These are discussed below:

(i) A Limping Golden Age: A steady rate of capital accumulation takes place in the 'limping' age but below full employment. Stock of capital is sufficient to attain the desired growth but not sufficient to ensure full employment. The output is growing but less than the output and the level of employment is going down in the industrial sector. The output may be growing faster than the output per head meaning that the employment is increasing and the system is heading towards full employment if employment is growing faster than the increase in population. Otherwise, the proportion of non-working population may rise.

(ii) A Leaden Golden Age: A situation when capital accumulation is not sufficient and the unemployment rate is rising. The living standards may fall unless the increasing real wage is sufficient to compensate the unemployed members or there are sufficient opportunities for self-employment. Otherwise, the falling standards of living may act as a positive check which may reduce the growth rate of population. High ratio of unemployment may bring down the rate of population growth to the level of growth rate of output.

(iii) A Restrained Golden Age: If the desired rate of growth can not be achieved despite the sufficient stock of capital. There is full employment, the

population grows at a slower rate but the growth rate of output per head does not rise quickly enough. In the absence of sufficient labour force, the producers may compete hard to hire sufficient labour which will push up money wages and price levels. Here, investments have to be checked so that the demand for labour can be kept below the supply of labour. The equilibrium may be attained by placing the financial constraints on the investment but the investors may have a strong tendency to increase the scale of production by expanding the capital stock and labour force. Secondly, the producers may collaborate and refrain from bidding up the wages to attract workers from their competitors. As enough labour is not available they may not build up new plants. Thus, desired rate is downsized to match the natural rate. They may build up plants in anticipation but they will not be fully utilized and the rate of return on capital may fall. Steady growth is attained. When the expected rate of profit is such that accumulation rate is equal to the desired rate. The choice of technique depends on type of restraint. If there are financial constraints firms would opt for less mechanized techniques. If the producers opt for the second restraint firms would be using more mechanized techniques than the profits maximizing ones.

(iv) The Bastard Golden Age: This age is characterized by the inflexibility of the real wage rate in downward direction. The growth process will stop in the absence of technical progress. High real wage rates would create inflation and unemployment. The inability of wage rate to fall beyond a certain limit causes unemployment. The inflexibility of wages in the downward direction may be due to two reasons – firstly, one may be due to the pressures of the trade unions and secondly, the real wages are already too low to fall further down.

(v) The Galloping Platinum Age: In this stage, the rate of profits is high and the techniques are highly capital intensive. The result is high unemployment and low level of real wages. High profits lead to high accumulation, further reduction in real wage rates which acts as an incentive to labour intensive techniques and reduction in unemployment.

(vi) The Creeping Platinum Age: It is a situation when rate of capital accumulation is high. There is full employment, the profit rates are high and the techniques used are labour intensive. The profit rate starts to fall as a result of low capital intensive techniques. The rate of capital accumulation is below the desired rate. The entrepreneurs start using more capital intensive techniques. The mechanization increases with each new investment. The rate of capital accumulation rises to meet the growth rate of labour.

(vii) The Bastard Platinum Age: The rate of capital accumulation is rising very quickly. The real wage rate remains stagnant despite improved techniques. The capital accumulation takes place without any changes in price levels. This stage is highly suitable to underdeveloped countries which are labour abundant and the capital stock is not sufficient to employ the labour force.

We have observed that the 'golden ages' are different from the 'platinum ages' in the sense that in golden ages the initial situations are suitable for steady state equilibrium. In the platinum ages, the rate of accumulation is either going up or down.

6.7 JOAN ROBINSON'S VIEWS AND HARROD-DOMAR MODEL

Robinson used the standard equation

Y=w.N+p.K or, p= (Y-w.N)/K

Here, *Y-w.N* measures the share of profits in the economy. Because all the profits are saved, therefore,

$S = Y - w.N$

$$\because p = \frac{S}{K} \qquad \left[\because p = \frac{Y - w.N}{K} \, and \; S = Y - w.N \right]$$

or,

$$p = \frac{Y}{K}, \frac{S}{Y}$$

Here, $p = \frac{\Delta K}{K}\frac{Y}{K}$ is productivity of capital and is equal to 'σ' while $\frac{S}{Y}$ is the average propensity to save and is equal to 'α'.

$$\therefore \quad \frac{\Delta K}{K} = \sigma.\alpha$$

which is Domar's standard equation. It can also be converted into Harrod's equation by putting $\therefore \frac{\Delta K}{K} = G, \alpha$ = s and σ = 1/c,

hence, $G = \frac{s}{c}$

Above equations show that Mrs. Joan Robinson and Harrod- Domar reach similar conclusions that steady state growth depends on propensity to save and capital-output ratio. Both models are based on similar assumptions of technical growth being neutral and constant capital coefficients. The concept of warranted growth is very similar to desired growth rate as defined by Joan Robinson. That kind of similarity is present in Harrod's concept of natural growth rate and Robinson's possible growth rate. Mrs. Joan Robinson's golden age is based on the equality of possible and desired growth rates while the similar equality between warranted and natural growth rates is necessary to steady state growth in the Harrod-Domar models. However, there are important differences too. The Harrod-Domar models view the process of accumulation to be dependent upon the saving rate and the capital-output ratio. Mrs. Joan Robinson, however, argues that the process of capital accumulation depends upon how national income is distributed among wages and profits. Another difference is that Harrod-Domar model approaches it from the view point of capital whereas Joan Robinson approaches it from labour view point.

6.8 ROBINSON'S MODEL AND THE UNDERDEVELOPED COUNTRIES

One of the major problems of underdeveloped countries is the rapid growth of population which affects the process of capital accumulation and

economic growth. Joan Robinson's model becomes more relevant to the underdeveloped economies by laying stress on the population growth as an important variable that determines the path of economic growth. She takes account of the situation when the growth rate of population $\frac{\Delta N}{N}$ is greater than the growth rate of capital accumulation $\frac{\Delta K}{K}$. In a way she recognizes the need of government intervention or mixed economy in underdeveloped countries. She points out that the highly individualistic capitalism can grow only by keeping the real wage rates down as compared to productivity of labour and price of capital. According to Prof. Kurihara this can be her way of saying that the underdeveloped countries should stay away from the 'capitalistic rules of the game', instead they should opt for mixed economies where state formulates monetary and fiscal policies geared up to promote 'autonomous investment'. According to Prof. Kurihara, "Her model of laissez faire growth demonstrates even more convincingly than the Harrod-Domar models, how precarious, capricious and insecure it is to entrust private profit makers to the paramount task of achieving the stable growth of an economy consistent with the needs of the growing population and the possibilities of advancing technology. The concept of the 'potential growth rate' is very vital to Joan Robinson's model. The planned economies can formulate their policies on the growth rates of population and output per head. To tackle the problem of population growing more quickly than the rate of capital accumulation, government should make autonomous investments and chose appropriate technologies.

6.9 CRITICISM

Prof. Kurihara believes that the greatest contribution of Joan Robinson's model is to present a systematic model based on classical concepts of value and distribution and the Keynesian concepts of savings and investment. But the problem is that of targeting wage rate, labour productivity, capital-labour ratio and the rate of profit in the economies that are not fully planned. Some of the weaknesses are listed below:

(i) This model is based upon several unrealistic assumptions which restrict its adaptability to the real world. The assumptions of the closed economy, constant price level, non-intervention on the part of the government and technological neutrality are far moved from reality. The modern economies are very closely integrated into the world economy where foreign trade is very important component of growth.

(ii) Mrs. Joan Robinson's model proves that economic growth is a very tricky path which can not be obtained by relying on the 'capitalistic rules of the game'. To keep the balance between the growing population and growing stock of capital is essential to the golden age but market can not be entrusted to perform this task. Besides the techniques are needed to be chosen very carefully to maintain the balance. The entrepreneurs driven by profit maximization may not act according to social needs.

(iii) This model completely ignores the institutional factors that are so important to the development. Not just the institutional factors but a whole lot of non-economic factors are vital to growth. The political set up, the social structure, the psychological factors do not enter the model, making it partial and incomplete.

(iv) The assumption of fixed technical coefficients or the fixed capital-labour ratio is away from reality. The technical progress is rarely neutral. It is either capital intensive or labour intensive depending upon what fits the decision makers. Changing techniques also influence the possibility of substitution between labour and capital.

(v) The model just lays stress on physical capital without accounting for the human capital which the modern day economists think is equally important as the physical capital if not more. This model completely overlooks the importance of educated, skilled and progressive society that is adaptive to the changing conditions.

6.10 SUMMARY AND CONCLUSIONS

Joan Robinson's Model is a big leap forward from the Harrod-Domar

models as it places the issue of distribution at the centre of the development economics. Besides, it lays emphasis on the choice of technology that ensures full employment and proper utilization of machinery. Though, both the models put forth the idea of ensuring equality between the desired and the possible growth rates but Robinson's model put forth very important aspect of distribution of national income in wages and profits as important factor governing growth of the economy. As compared to Harrod-Domar model this model has greater relevance for the underdeveloped economies by laying stress on the population growth as an important variable that determines the path of economic growth. This model also recognizes the need of government intervention or mixed economy in underdeveloped countries. However, due to several unrealistic assumptions this model also has several limitations which affect its ability to be followed as an effective growth strategy.

6.11 GLOSSARY

(i) **Average Fixed Cost:** Average fixed cost is fixed cost divided by output, i.e. fixed cost per unit of output. It is inherently a short-run concept.

(ii) **Average Variable Cost:** Average variable cost is variable cost divided by output, i.e. variable cost per unit of output. It is inherently a short-run concept.

(iii) **Investment:** Refers to changes in the capital stock in a given time period.

(iv) **Gross investment:** is the sum of replacement investment and net invest ment in a time period.

(v) **Replacement investment:** is that amount of investment in a time period designed merely to replace the amount of capital that has deteriorated or been scrapped.

(vi) **Net investment:** refers to the net increment to the capital stock since the last time period and equals to total investment minus replacement investment.

6.12 SHORT ANSWER TYPE QUESTIONS

Q 1. What are the assumptions of Joan Robinson's model of growth?

Ans. The model by Mrs. Joan Robinson is based on following assumptions:

1. The economy is closed with with total absence of foreign trade.
2. There is no interference by the government in economic activities.
3. There are only two factors of production – labour and capital. Accordingly, the national income is divided in to wages and profits.
4. The entrepreneurs do not spend anything and save every thing. So, all the profits are saved.
5. The wage earners save nothing and spend all.
6. The prices are assumed to be constant.
7. The technical progress is assumed to be neutral.
8. The labour and capital can be used in a fixed proportion.

Q 2. Define Golden Age.

Ans. Golden age is the situation when the economy grows so as to ensure full employment and the full utilization of capital. The capital accumulation is sufficient to employ the growing population so that capital labour ratio is constant. The rate of profit is constant as the productivity of labour and real wage rises at the same rate.

Q 3. Define a restrained golden age.

Ans. A period would be termed as 'Restrained Golden Age' if the desired rate of growth can not be achieved despite the sufficient stock of capital. There is full employment, the population grows at a slower rate but the growth rate of output per head does not rise quickly enough. In the absence of sufficient labour force, the producers may compete hard to hire sufficient labour which will push up money wages and price levels. Here, investments have to be checked so that the demand for labour can be kept below the supply of labour. The equilibrium may be attained by placing the financial constraints on the investment but the investors may have a strong tendency to

increase the scale of production by expanding the capital stock and labour force. Secondly, the producers may collaborate and refrain from bidding up the wages to attract workers from their competitors. As enough labour is not available they may not build up new plants. Thus desired rate is downsized to match the natural rate. They may build up plants in anticipation but they will not be fully utilized and the rate of return on capital may fall. Steady growth is attained. When the expected rate of profit is such that accumulation rate is equal to the desired rate. The choice of technique depends on type of restraint. If there are financial constraints firms would opt for less mechanized techniques. If the producers opt for the second restraint firms would be using more mechanized techniques than the profits maximizing ones.

Q 4. What do you mean by the Galloping Platinum Age?

Ans. The Galloping Platinum Age is the stage in which the rate of profits is high and the techniques are highly capital intensive. The result is high unemployment and low level of real wages. High profits lead to high accumulation, further reduction in real wage rates which acts as an incentive to labour intensive techniques and reduction in unemployment.

Q 5. Discuss the limitations of Joan Robinson's Model of growth.

Ans. The main limitations of Joan Robinson's model of growth are given below:

(i) This model is based upon several unrealistic assumptions which restrict its adaptability to the real world. The assumptions of the closed economy, constant price level, non-intervention on the part of the government and technological neutrality are far moved from reality. The modern economies are very closely integrated in to the world economy where foreign trade is very important component of growth.

(ii) Mrs. Joan Robinson's model proves that economic growth is a very tricky path which can not be obtained by relying on the 'capitalistic rules of the game'. To keep the balance between the growing population and growing stock of capital is essential to the golden age but

market can not be entrusted to perform this task. Besides the techniques are needed to be chosen very carefully to maintain the balance. The entrepreneurs driven by profit maximization may not act according to social needs.

(iii) This model completely ignores the institutional factors that are so important to the development. Not just the institutional factors but a whole lot of non-economic factors are vital to growth. The political set up, the social structure, the psychological factors do not enter the model, making it partial and incomplete.

(iv) The assumption of fixed technical coefficients or the fixed capital-labour ratio is away from reality. The technical progress is rarely neutral. It is either capital intensive or labour intensive depending upon what fits the decision makers. Changing techniques also influence the possibility of substitution between labour and capital.

(v) The model just lays stress on physical capital without accounting for the human capital which the modern day economists think is equally important as the physical capital if not more. This model completely overlooks the importance of educated, skilled and progressive society that is adaptive to the changing conditions.

6.13 EXAMINATION ORIENTED QUESTIONS

1. Elaborate Joan Robinson's model of capital accumulation.
2. What do you mean by 'Golden Age'? Discuss different variants of 'Golden Age'.
3. Discuss the superiority of Joan Robinson's Model over Harrod-Domar model. What are its limitations?

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6.16 MODEL TEST PAPER

I. Answer the following in brief.

1. What are the assumptions of Joan Robinson's model of growth?
2. Define Golden Age.
3. Define a restrained golden age.
4. What do you mean by the Galloping Platinum Age?
5. Discuss the limitations of Joan Robinson's Model of growth.

II. Answer the following in detail.

1. Elaborate Joan Robinson's model of capital accumulation.
2. What do you mean by 'Golden Age'? Discuss different variants of 'Golden Age'.
3. Discuss the superiority of Joan Robinson's Model over Harrod-Domar model. What are its limitations?

KALDOR'S AND PASINETTI'S MODEL AND SAMUELSON AND MODIGLIANI ON PASINETTI'S PARADOX

7.1 INTRODUCATION

Cambridge economists have tried to solve the problem of discrepancy between the warranted rate and the natural rate through variation in the saving ratio. The Saving ratio is assumed to depend on the distribution of income between workers and capitalists. There is two Cambridge models—one is by Kaldor and

the other is by Pasinetti. In both the models it is assumed that the natural rate of growth is constant. It is also assumed that the marginal propensity to save of workers is less than the marginal propensity to save of capitalists. The overall marginal propensity to save is the weighted average of these two marginal propensities. By changing the distribution of income the overall saving ratio can be changed. Let us discuss the various cambridge models in detail below.

7.2 OBJECTIVES

This lesson will fulfil the following objectives.

i) To discuss the Kaldor's model of income distribution thoroughly.

ii) To explain the Pasinetti's model as a reformulated version of Kaldor.

iii) To throw light on the views of Samuelson and Modigliani on Pasinetti Paradox

iv) To know the difference between Kaldor's and Pasinetti's model.

7.3 KALDOR'S MODEL

The first Cambridge model of income distribution was provided by Kaldor. Hence it is better to start with the Kaldor model of distribution and growth. In Kaldor's model the capital-output ratio (v) is assumed to be a constant but the saving ratio (s) is a variable. The divergence between the warranted rate of growth $\left(\frac{s}{v}\right)$ and the natural rate of growth (n) is corrected through variation in s which depends on the distribution of income between wages and profits.

Kaldor's model of distribution is based on the assumpiton of full-employment. The basic difference between Kaldor's model and the neo-classical models is, that while in the former full employment is an assumption, in the latter full employment is a conclusion due to flexibility of input prices. In the neo-classical models input prices are determined by the marginal productivity theory. But Kaldor rejects the marginal productivity theory of distribution. The marginal broductivity theory is based on the assumption of perfect competition. This

assumption is also absent in Kaldor's model of income distribution. In the marginal productivity theory the share of profits and the share of wages in national income depend on the production function. But in Kaldor's model these two shares are independent of the production function.

Suppose that full employment level of national income (Y) is divided into two broad categories, wages (W) and profits (P) ; and total net saving is also divided into two categories : saving out of wge income (S_w) and saving out profit income (S_p). We then get the following two equations :

$$Y = W + P \quad \ldots. (1)$$

and $$S = S_w + S_p \quad \ldots(2)$$

Suppose now simple proportional saving functions : $S_w = s_w . W$ and $S_p = s_p . P$ where s_w and s_p are the propensities to save out of wage income and profit income respectively. It is assumed that both the saving propensities are greater than zero but less than unity. Further, it is assumed that the propensity to save out of profit income is greater than that out of wage income. This assumption is crucial to the analysis. Moreover, it is assumed that the amount of investment necessary to cope with population growth and technical progress is actually carried out. In other words investment is made as required for maintaining full employment. The condition under which the system will be in equilibrium is given by the equality of saving and invesment *ex-ante*, i.e.,

$$I = S \quad \ldots(3)$$

or,
$$\begin{aligned} I &= s_w W + s_p . P \\ &= s_w (Y - P) + s_p . P \\ &= s_w Y - s_w P + s_p . P \\ &= s_w Y + (s_p - s_w) P \end{aligned}$$

$$\therefore \quad (s_p - s_w)\, P = I - s_w . Y$$

$$\text{or, } P = \frac{I - s_{w.Y}}{s_p - s_w}.$$

$$\therefore \quad \frac{P}{V} \quad \frac{1}{s_p - s_w}.\frac{I}{Y} - \frac{s_w}{s_p - s_w} \quad \text{.....(4)}$$

$$\text{and } \frac{P}{K} = \quad \frac{1}{s_p - s_w}.\frac{I}{K} - \frac{s_w}{s_p - s_w}\frac{Y}{K} \quad \text{.....(5)}$$

Equation (4) determines the share of profits in national income while equation (5) determines the rate of profit. Equations (4) and (5) mean that there is a distribution of income and a rate of profit at which the equilibrium (3) remains through time.

There are two propositions in Kaldor's mode.

Proposition-1. *Corresponding to steady state there exists : a unique distribution of income between wages and profits such that it generates necessary amount of aggregate saving to support the full employment level of investment.*

Proposition-2 : *Corresponding to steady state there exists a unique rate of profit required to achieve the steady state.*

These two propositions can be proved as follows :

Proof of Proposition-1 : For steady we require $\frac{s}{\nu} = n$,

or $s = \nu n$

$$\text{or, } s_w \frac{W}{Y} + s_p.\frac{P}{Y} = \nu n$$

$$\text{or, } \quad s_w\left(1 - \frac{P}{Y}\right) + s_p.\frac{P}{Y} = \nu n$$

$$\text{or, } \left(s_p - s_w\right)\frac{P}{Y} = \nu n - s_w$$

$$\therefore \quad \frac{P}{Y} = \frac{\nu n - s_w}{s_p - s_w}$$

and $\frac{W}{Y} = 1 - \frac{P}{Y} = \frac{s_p - s_w - \nu n + s_w}{s_p - s_w} = \frac{s_p - \nu n}{s_p - s_w}.$

Thus corresponding to steady state there exists one $\frac{P}{Y}$ and one $\frac{W}{Y}$ i.e. a unique distribution of income.

Proof of Proposition-2 :

Since $\frac{P}{Y} = \frac{\nu n - s_w}{s_p - s_w}$

$$\therefore \quad \frac{P}{Y}.\frac{Y}{K} = \frac{\nu n - s_w}{s_p - s_w}.\frac{Y}{K}$$

or, $\frac{P}{K} = \frac{\nu_n - s_w}{s_p - s_w}.\frac{1}{\nu}$

$= \frac{n - \frac{s_w}{\nu}}{s_p - s_w}$ This gives the rate of profit required for steady state. $\frac{P}{K}$ can vary between 0 and $\frac{1}{\nu}$.

If $\frac{P}{K} = 0,$ then $\frac{s_w}{\nu} = n$

and if $\frac{P}{K} = \frac{1}{\nu}$ then $\frac{s_p}{\nu} = n$.

Note that $0 \leq P \leq Y$

$\therefore \ 0 \le \frac{P}{K} \le \frac{Y}{K}.$ or, $0 \le \frac{P}{K} \le \frac{1}{\nu}.$

This shows that $\frac{P}{K}$ varies between 0 and $\frac{1}{\nu}$.

Again if $\frac{P}{Y}$ = 0, then $n = \frac{s_w}{\nu}$ and when $\frac{P}{Y} = 1$, $n = \frac{s_p}{\nu}$.

It is obvious that $\frac{s_w}{\nu} \le n \le \frac{s_p}{\nu}$

i.e. $s_w \le n\nu \le s_p$

or, $s_w \le s \le s_p$

Thus in Kaldor's model the aggregate saving ratio varies between s_w and s_p. Equation (4) tells us that given s_p and s_w the share of profits varies directly with $\frac{1}{Y}$. But $\frac{I}{Y} = \frac{S}{Y} = s$, the aggregate saving ratio. Thus *s* is directly related to $\frac{P}{Y}$ and inversely related to $\frac{W}{Y}$. The aggregate saving ratio *s* can also be written as follows :

$s = \frac{s_w.W + s_p.P}{W + P}$. This shows that *s* is the weighted average of the two saving propensites s_w and s_p with *W* and *P* as weights. Now *s* is no longer a constant even if s_w and s_p are constants. Now *s* is a variable depending on the distribution of income. When W= 0, Y = P. Then $s = s_p$. On the other hand when P = 0, W = Y, $s = s_w$. $\therefore s_w \le s \le s_p$. This means that *s* is allowed to vary between s_w and s_p.

Consider the special case where s_w = 0. In this case equation (4) and (5) reduce to

$$\frac{P}{Y} = \frac{1}{s_p} \cdot \frac{I}{Y} \quad \text{.....(6)}$$

and $$\frac{P}{K} = \frac{1}{s_p} \cdot \frac{1}{K} \text{.....(7)}$$

Equations (6) and (7) show that the share of profits and the rate of profit vary inversely with s_p. This means that the more the capitalists spend (*i.e.* the less they save), the greater is their share in national income and the greater is the rate of profit. This is usually summarised in the following statement : "*Capitalists earn what they spend while workers spend what they earn*."

Let us now see the mechanism behind Kaldor's mode. This mechanism consists of movements in the level of prices relative to money wages whenever aggregate demand differs from aggregate supply and planned investment differs from planned saving. Thus with full employment, an excess of investment over sving *ex-ante* implies excess aggregate demand. This will raise prices and profit margins and therefore $\frac{P}{Y}$. Provided that $s_p > s_w$, this redistribution of income in favour of profits will increase aggregate real saving. Conversely, a shortfall of investment relative to saving implies a deficiency of aggregate demand, thereby causing a fall in prices relative to money wages and reducing $\frac{P}{Y}$. This reduces real savings. Thus the system is stable at full employment assuming flexible prices and profit margins. If however, s_p is less than s_w, the system will be unstable. In this case an excess of investment over saving at full employment will not be eliminated by wage-price flexiblity.

Note that in this model

$$\frac{S}{Y} = s_w \frac{W}{Y} + s_p \frac{P}{Y}$$

$$= s_w\left(1-\frac{P}{Y}\right)+s_p\frac{P}{Y}$$

$$= s_w + (s_p - s_w)\frac{P}{Y}.$$

This shows that so long as $s_p > s_w, (s_p - s_w) > 0$ and $\frac{S}{Y}$ increases as $\frac{P}{Y}$ increases. Thus if investment is greater than saving, profit share, $\frac{P}{Y}$, increases which increases saving and makes it equal to investment. But if $s_p < s_w$ then $(s_p - s_w) < 0$ and in that case the second term of the right hand side is negative. Here as $\frac{P}{Y}$ increases, $\frac{S}{Y}$ decreases and vice-versa. Here an excess of investment over saving increases the profit margin which reduces the saving ratio. Hence the gap between investment and saving widens rather than being narrowed down if $s_p < s_w$. Thus if $s_p > s_w$ there is always a mechanism which ensures the equality between saving and investment at full employment. The condition $s_p > s_w$ *can therefore be called as the stability condition of the system*.

Formally the stability condition can be derived as follows : We know that whenever there is a discrepancy between $\frac{I}{Y}$ and $\frac{S}{Y}$, this will be reflected in a change in the $\frac{P}{Y}$ ratio.

i.e. $\frac{d}{dx}(P/Y) = f\left(\frac{I}{Y}-\frac{S}{Y}\right)$ such that $f(0) = 0$ and $f'(0) > 0$.

When I = S *i.e.* $\frac{I}{Y}=\frac{S}{Y}$ then $\frac{P}{Y}$ remains unchanged. This value of $\frac{P}{Y}$ is denoted by $\frac{P}{Y}$. When $\frac{1}{Y}\to\frac{S}{Y}, \frac{P}{Y}\to\left(\frac{P}{Y}\right)^*$

Now following Taylor's series expanding this function, $f\left(\frac{I}{Y}-\frac{S}{Y}\right)$ around the equilibrium value and neglecting the terms of higher order than the first we get

$$\frac{d}{dt}\left[\frac{P}{Y}-\left(\frac{P}{Y}\right)^*\right]=f(0)+f'(0)\left[\frac{d\left(\frac{1}{Y}\right)}{d\left(\frac{P}{Y}\right)}-\frac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)}\right]_{\left(\frac{P}{Y}\right)^*}.\left[\frac{p}{Y}-\left(\frac{P}{Y}\right)^*\right]$$

Let $x = \frac{P}{Y}-\left(\frac{P}{Y}\right)^*$

and $m = \left[\frac{d\left(\frac{I}{Y}\right)}{d\left(\frac{P}{Y}\right)}-\frac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)}\right]_{\left(\frac{P}{Y}\right)^*}$ = constant

Then $\frac{dx}{dt}=f'.mx$

$\therefore \frac{dx}{x}=f'm.dt$

Integrating both sides

log x = f' $m.t$ + log A where log A is constant.

or, $\log\left(\frac{x}{A}\right)=\log e^{f'mt}$

$\therefore\left(\frac{x}{A}\right)=e^{f'mt}$

$\therefore x = Ae^{f'mt}$

on $\frac{P}{Y} - \left(\frac{P}{Y}\right)^* = Ae^{f'mt}$

Now steady state equilibrium is said to be stable if $\frac{P}{Y} - \left(\frac{P}{Y}\right)^* \to 0$ as $t \to \infty$.

This happens when $e^{f'mt} \to 0$ as $t \to \infty$.

But by assumption $f' > 0$ $\therefore$ $e^{f'mt} \to 0$ as $t \to \alpha$ if $m < 0$.

i.e. $\frac{d\left(\frac{I}{Y}\right)}{d\left(\frac{P}{Y}\right)} - \frac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)} < 0$

i.e. $\frac{d(I/Y)}{d(P/Y)} < \frac{d(S/Y)}{d(P/Y)}$

But $\frac{d(I/Y)}{d(P/Y)} = 0$ since $\frac{I}{Y}$ is predetermined for maintaining full employment. Hence stability requires

$\frac{d(S/Y)}{d(P/Y)} > 0.$

But $S/Y = s_w + (s_p - s_w)\frac{P}{Y}$

$\therefore$ $\frac{d(S/Y)}{d(P/Y)} = s_p - s_w$

$\therefore$ $\frac{d(S/Y)}{d(P/Y)} > 0$ when $s_p - s_w > 0$ or, when $s_p > s_w$. Therefore the steady state equilibrium will be stable when $s_p > s_w$.

To make this model of income determination yield economically meaninfgul results we should add two constraints with the Kaldor model :

$$s_p > \frac{I}{Y} > s_w \text{.....(8)}$$

The first inequality implies that $\frac{W}{Y} > 0$ while the second ensures that $\frac{P}{Y} > 0$.

Consider now the implication of this model of income distribution in the theory of growth. In the Harrod model the steady state equilibrium requires that $\frac{s}{\nu} = n$, or $s = \nu . n$. In Harrod's model s, ν and n are constants and there is no mechanism that will ensure the equality between s and νn. But now consider the Kaldor model of distribution. Here than n is independently given rate of growth of labour force. Suppose also that ν is constant. Hence $n\nu$ is constant. But s is variable depending on the distribution of income. Since $s = \frac{S}{Y} = s_w + (s_p - s_w)\frac{P}{Y}$ it shows that given s_p and s_w, s can be changed by changing $\frac{P}{Y}$. In other words, there is always a distribution of income which will generate a value of s that is required for being equal to $n\nu$. In other words, the warranted and the natural rates of growth are not independent of each other. Whenever the two are not equal, the former will move to the latter through a change in s.

More spcifically, consider a situation where $\frac{s}{\nu} > n$ *i.e.* warranted rate is greater than the natural rate. With fixed coefficients of production this mans that the actual rate of growth will be less than $\frac{s}{\nu}$ i.e. $g < \frac{s}{\nu}$ or, $\frac{\Delta Y}{Y} < \frac{s}{\nu}$ or $\nu . \Delta Y < sY$ i.e. I < S. Now an excess of saving over investment at full employment means that prices will fall relative to wages. The share of profits will therefore fall and the share of wages will rise. As a result of this redistribution of income, s will fall and

therefore $\frac{s}{\nu}$ will approach *n*. The exactly opposite will happen when $\frac{s}{\nu} < n$. Thus there is always a tendency for the economy, through variations in $\frac{P}{Y}$ to equalise the warranted rate of growth to the natural rate of growth.

In Kaldor's model for maintaining steady state *s* is allowed to vary between s_w and s_p. But in Harrod's model steady state is obtained for only one value of *s*, viz., when $s = \nu n$. Hence, the possibility of getting steady state in Kaldor's model is higher than the possibility of getting steady in Harrod's model. Hence, from the standpoint of getting steady state Kaldor's model is superior to Harrod's model.

Consider now the comparison between the Cambridge model and the neo-classical model. In the neo-classical model for maintaining steady state ν can take any value between zero and infinity i.e. $0 < \nu < \alpha$. This range is obviously larger than the range $\frac{s_w}{n} < \nu < \frac{s_p}{n}$ of the Kaldor's model. Hence from the point of view of possibility of steady state, neo-classical model is superior to Kaldor's model.

However, there are two situations when this mechanism will not work. Consider the two situations where the values of *n* and ν are such the $n\nu$ is either less than s_w or greater then s_p. In that case condition (8) will be violated and to maintain the equality between *s* and νn a negative share of profits or a negative share wages will be required. In these two cases the flexibility in *s* is incapable of maintaining the equality between *s* and νn.

Apart from these two cases we can impose three further restrictions on the working of the model :

$\omega \geq \bar{\omega}$ ..... (9) where $\bar{\omega}$ is the subsistence wage rate

$\frac{P}{K} \geq r$ .....(10) where *r* is the minimum rate of profit.

$\frac{P}{Y} \geq m$ .....(11) where m is the 'degree of monopoly' rate.

Condition (9) states that the real wage rate cannot fall below a certain subsistence minimum. Condition (9) also implies that the share of profit cannot exceed a certain level. i.e. $\frac{P}{Y} \leq \frac{Y - \bar{\omega}L}{Y}$. Conditions (10) and (11) describe alternative restrictions of which the higher will apply.

7.4 PASINETTI'S MODEL

The Pasinetti model is a reformulated version of the Kaldor model. The Kaldor saving function $S = s_w W + s_p P$ involves a distinction between saving coefficients which are essentially based on different classes of income. It does not necessarily imply that workers or wage earners receive any income from capital, but it does imply that the propensity to save from profits is the same whether received by workers or capitalists. Similarly it implies that the propensity to save out of wage income is the same over all income classes.

But what will happen if the saving propensities do differ, not according to classes of income but according to classes of persons ? What if the workers, even if they receive a part of income from capital, have a propsensity to save that differs from those who derive their income exclusively from capital ? Pasinetti has examined the consequences of such an assumption for the Cambridge model of distribution and growth. The Pasinetti saving function is written as $S = s_w (W + P_w) + s_c . P_c$, $0 < s_w < s_c < 1$. where Pw and P_c denote profits received by workers and capitalists respectively. On the implicit assumption that these two classes of income receivers are permanent. Pasinetti has shown that in the long run equilibrium growth $\frac{P}{K} = \frac{1}{s_C}\frac{1}{K}$ and $\frac{P}{Y} = \frac{1}{s_C}\frac{I}{Y}$ without assuming that $s_w = 0$. Note that these results are obtained in Kaldor's model on the assumption that $s_w = 0$. The novelty of Pasinetti's model is that these results are obtained irrespective of the value of s_w within the

limits imposed by $0 < s_w < s_c < 1$. Let us now see how Paisnetti arrives at this result.

Pasinetti argues that when an individual saves a part of income, he must be allowed to own it; otherwise he would not save at all. Since ownership of capital entitles the owner to a rate of interestt, if workers have saved – and thus owned a part of capital stock (directly or through loan to the capitalists) – then they will also receive a share of the total profits. Therefore, total profits themselves must be divided into two categories : profit which accure to the capitalists and profit which accrue to the workers. If all profits are attributed to the capitalists, it implies that workers savings are always transferred as gift to the capitalists. Clearly this is an absurd assumption. For this reason Pasinetti has reformulated the distribution theory earlier developed by Kaldor.

In the Pasinetti model.

$Y = W + P$ ... ... (1)

$S_w = S_w + S_c$ ... ... (2)

and $I = S$ ... ... (3)

Further $P = P_c + P_w$ ... ... (4) where P_c and P_w stand for profits which accrue to the capitalists and profits which accrue to the workers respectively. The saving functions now become

$S_w = s_w (W + P_w)$ ... (5) where $0 < s_w < 1$.

and $S_c = s_c \, . \, P_c$ ..... (6) where $0 < s_c < 1$.

Note that Pasinetti assumes that workers get income both from wage income and from profit income. But the capitalists do not earn any wage income. They receive their income exclusively from profits. The equilibrium conditions (3) can now be written as :

$$I = S$$

or, $$I = s_w (W + P_w) + s_c . P_c$$

$= s_w\ (Y - P_c - P_w + P_w) = s_c.\ P_c$

$= s_w\ Y + (s_c - s_w).\ P_c$ .....(7)

From (7) we get,

$$\frac{1}{Y} = s_w + (s_c - s_w).\frac{P_c}{Y}$$

or, $$\frac{P_c}{Y} = \frac{\frac{I}{Y} - s_w}{s_c - s_w}$$

$\therefore$ $$\frac{P_c}{Y} = \frac{1}{s_c - s_w}\frac{1}{Y} - \frac{s_w}{s_c - s_w} \quad \text{..... (8)}$$

and $$\frac{P_c}{K} = \frac{1}{s_c - s_w}.\frac{I}{K} - \frac{s_w}{s_c - s_w}.\frac{Y}{K} \quad \text{..... (9)}$$

The equations (8) and (9) are similar to those obtained in the Kaldor model except that the left hand sides refer to profits accruing to the capitalists and not to total profits. To obtain $\frac{P}{Y}$ and $\frac{P}{K}$ we have to find out expressions for

$$\frac{P}{Y} = \frac{P_c}{Y} + \frac{P_w}{Y} \text{ ... ... (10)}$$

and $$\frac{P}{K} = \frac{P_c}{K} + \frac{P_w}{K} \text{ ... ... (11)}$$

Let us now start with equations (11). We already know $\frac{P_c}{K}$ from equation (9). Thus writing K_w for the amount of capital that the workers own indirectly through loans to the capitalists and *r* for the rate of interest on these loans, we obtain

$$\frac{P}{K} = \frac{1}{s_c - s_w} \cdot \frac{1}{K} - \frac{s_w}{s_c - s_w} \cdot \frac{Y}{K} + \frac{r.K_w}{K} \quad \text{..... (12)}$$

An expression for $\frac{K_w}{K}$ can easily be found. In dynamic equilibrium

$$\frac{K_w}{K} = \frac{S_w}{S} = \frac{s_w(Y - P_c)}{I}$$

and $$\frac{s_w(Y - P_c)}{I} = s_w \cdot \frac{Y}{I} - s_w \frac{P_c}{Y} \cdot \frac{Y}{I}$$

$$= s_w \frac{Y}{I} - s_w \frac{Y}{I}\left(\frac{1}{s_c - s_w} \frac{1}{Y} - \frac{s_w}{s_c - s_w} \right)$$

$$= s_w \frac{Y}{I} - \frac{s_w}{s_c - s_w} + \frac{s^2 w}{s_c - s_w} \frac{Y}{I}$$

$$= \frac{s_w s_c - s^2 w + s^2 w}{s_c - s_w} \cdot \frac{Y}{I} - \frac{s_w}{s_c - s_w}$$

Put this value of $\frac{K_w}{K}$ in (12) to obtain

$$\frac{P}{K} = \frac{1}{s_c - s_w} \frac{I}{K} - \frac{s_w}{s_c - s_w} \frac{Y}{K} + r \left(\frac{s_w s_c}{s_c - s_w} \frac{Y}{I} - \frac{s_w}{s_c - s_w} \right) \text{.....(13)}$$

Multiplying both sides by $\frac{K}{Y}$ we can get an expression for $\frac{P}{Y}$ given by

$$\frac{P}{Y} = \frac{1}{s_c - s_w} \frac{I}{Y} - \frac{s_w}{s_c - s_w} + r \left(\frac{s_w s_c}{s_c - s_w} \frac{K}{I} - \frac{s_w}{s_c - s_w} \frac{K}{Y} \right) \text{ ..... (14)}$$

These are the two general equations that will have to be replaced for the corresponding equations of Kaldor.

In a long run equilibrium model, the rate of interest is equal to the rate of profit. If we put $r = \frac{P}{K}$ equation (13) is reduced to

$$\frac{P}{K}\left(1-\frac{s_w.s_c}{s_c-s_w}\frac{Y}{I}+\frac{s_w}{s_c-s_w}\right)=\frac{1}{s_c-s_w}\frac{I}{K}-\frac{s_w}{s_c-s_w}.\frac{Y}{K}$$

or
$$\frac{P}{K}\left[\frac{s_c-s_w-s_w.s_c\frac{Y}{I}+s_w}{s_c-s_w}\right]=\frac{1}{s_c-s_w}.\frac{1}{K}[1-s_wY]$$

or,
$$\frac{P}{K}s_c\left[\frac{1-s_w.\frac{Y}{I}}{s_c-s_w}\right]=\frac{1}{K}\left[\frac{I-s_w.Y}{s_c-s_w}\right]$$

or
$$\frac{P}{K}s_c\frac{(I-s_w.Y)}{I}=\frac{1}{K}(1-s_wY).$$

Provided that $I - s_w Y \neq 0$

$$\frac{P}{K}=\frac{s_c}{I}.\frac{1}{Y}$$

or,
$$\frac{P}{K}=\frac{1}{s_c}.\frac{I}{K} \quad \text{..... (15)}$$

Similarly,
$$\frac{P}{Y}=\frac{1}{s_c}.\frac{I}{Y} \quad \text{..... (16)}$$

Thus in the long run workers' propensity to save, though influencing the distribution of income between capitalists and workers – equation (8) –

does not influence the distribution of income between profits and wages – equation (16). In the long run the rate of profit is independent of the workers' propensity to save. Note that results (15) and (16) have been obtained without assuming $s_w = 0$. These results were obtained in Kaldor's model as a special case where $s_w = 0$. In Pasinetti's model they are not derived as special cases. Instead, they are derived from the long run equilibrium property of the model.

Pasinetti uses the following agrument to show this result in an alternative way. Assume that the workers and the capitalists earn the same rate of profit on their capital. Then $\frac{P_w}{K_w} = \frac{P_c}{K_c} = r$. Now in steady growth the ratio of saving to capital is constant over time and equals the natural rate of growth.

Hence, $\frac{S_c}{K_c} = \frac{S_w}{K_w} = n$ (= natural rate of growth)

Now, $\frac{S_w}{P_w} = \frac{S_w}{rK_w}$ and $\frac{S_c}{P_c} = \frac{S_c}{rK_c}$

Since in steady growth $\frac{S_c}{K_c} = \frac{S_w}{K_w}$,

therefore, $\frac{S_w}{P_w} = \frac{S_c}{P_c} = \frac{s_c.P_c}{P_c} = s_c$

$\therefore S_w = s_c.P_w$

Hence, $S = S_c + S_w = s_c.P_c + s_c.P_w = s_c\,(P_c + P_w) = s_c.P$

or $I = s_c.\ P$

or, $P = \frac{1}{s_c}.I$

or, $\frac{P}{K} = \frac{1}{s_c}.\frac{I}{K}$ which is the same result as we obtained earlier.

To understand the reason why the workers' propensity to save does not play a role in determining total profits we should remember that both the following conditions must be staisfied along the steady growth path in Pasinetti's model :

$$(a)\ I = s_w\ (W + P_w) = s_c.P_c$$

and $(b)\ I = s_c.P.$

Setting (a) and (b) equal to each other and recalling that $P = P_c + P_w$, we get.

$$s_w\ (W + P_w) + s_c.\ P_c = s_c.P_c + s_cP_w$$

$$\therefore\ s_w(W + P_w) = s_c.P_w\ .....(c)$$

$$\text{or, } s_w.W = (s_c - s_w).P_w .....(d)$$

Equation (c) implies that total saving of workers is equal to the amount which the capitalists would have saved out of workers' profits if these profits had gone to them. Equation (d) implies that $s_w.\ W$ is simply equal to the excess or what capitalists would have saved out of workers' profits had the latter gone to them instead of the workers. Thus when we consider total saving out of profits by the capitlists ($s_c.P$) we at once consider the saving of workers since $s_c.P$ has two components $s_c.P_c$ and $s_c.P_w$. The saving of workers is equal to $s_c.P_w$. Thus in considering $s_c.P$ we take into account the workers' saving also. This is the reason why s_w is not directly relevant in determining $\frac{P}{Y}$ or $\frac{P}{K}$.

Pasinetti has shown that his model is not dependent on the assumption of constant coefficients of production. Even if we introduce a neo-classical type of production function Y = F(K, L), we shall get the same result. From (15)

we get $I = P.s_c$. But $P = Y - W$

$$= F\ (K,\ L) - W$$

or, $s_c\ \{F(K,\ L) - W\} = 1$

Now let $k = \frac{K}{L}$, the capital-labour ratio. Then $K = k.L$

$$\therefore I = \frac{dK}{dt} = \frac{dk}{dt}L + k.\frac{dL}{dt}$$

$$= \; L\frac{dk}{dt} + nkL$$

$$\therefore s_c\{F(K,L) - W\} = L.\frac{dk}{dt} + nkL$$

But in a situation of steady state growth $\frac{dk}{dt} = 0$ so that equilibrium condition can be written as $s_c\{F(K,L) - W\} = nkL$ or, $s_c.P = n.\frac{K}{L}.L$

or $\frac{P}{K} = \frac{n}{s_c}$. This shows that on the steady state growth path the equilibrium rate of profit depends on the natural rate of growth and the propensity to save of the capitalists. Thus we get the same result that the rate of profit is indpendent of the workers' propensity to save even if we introduce a neo-classical production function in Paisinetti's model.

Pasinetti also considers the stability condition in his model. In the Kaldor model we have seen that wage-price flexibility and its consequent effect on the distribution of incme will generate a stable equilibrium position if $s_c > s_w$. Pasinetti calls this conditions only a short run conditon. According to Passinetti the system will be stable in the long run if $s_c > 0$. Let us now see how this result is arrived at. In both the models of Kaldor and Pasinetti we have assumed that the movement in the share of profit in national income depends on the difference between the share of investment and the share of saving in national income.

i.e. $\frac{d}{dt}\left(\frac{P}{Y}\right) = f\left(\frac{I}{Y} - \frac{S}{Y}\right)$ such that $f'0 = 0$ and $f' > \; = 0$.

This means that the share of profits increases, remains constant or decreases depending on whether investment is greater than, equal to or less than saving. Here

$\frac{P}{Y}$ will be in a stable equilibrium position if $\frac{d\left(\frac{I}{Y}\right)}{d\left(\frac{P}{Y}\right)} < \frac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)}$. Expanding the function by Taylor's series around the equilibrium level $\left(\frac{P}{Y}\right)^*$ and neglecting the terms of higher order than thge first, we obtain

$$\frac{d}{dt}\left[\frac{P}{Y}-\left(\frac{P}{Y}\right)^*\right] = f(0) + f'(0)\left[\frac{d\left(\frac{I}{Y}\right)}{d\left(\frac{P}{Y}\right)}-\frac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)_{\left(\frac{P}{Y}\right)^*}}\right]\cdot\left[\frac{P}{Y}-\left(\frac{P}{Y}\right)^*\right]$$

Let $\frac{P}{Y}-\left(\frac{P}{Y}\right)^* = x,$

and $\left[\frac{d\left(\frac{I}{Y}\right)}{d\left(\frac{P}{Y}\right)}-\frac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)}\right]_{\left(\frac{P}{Y}\right)^*} = m$

$\therefore \frac{dx}{dt} = f'mx$ or $\frac{dx}{x} = f'\,mdt$

Integrating, $\log x = f'mt + \log A$ where $\log A$ is a constant.

or, $\log\left(\frac{x}{A}\right) = \log e^{f'mt}$

or, $x = A.e^{f'\,mt}$

Now $\frac{P}{Y}-\left(\frac{P}{Y}\right)^{*}=A\,e^{f'mt}$.

Now steady state equilibrium is said to be stable if $\frac{P}{Y}-\left(\frac{P}{Y}\right)^{*}\rightarrow 0$ as $t\rightarrow\alpha$.

This happens when $e^{f'mt}\rightarrow 0$ as $t\rightarrow\alpha$. But by assumption $f'>0$. Therefore $e^{f'mt}\rightarrow 0$ as $t\rightarrow\infty$. if $m < 0$

i.e. $\frac{d(I/Y)}{d(P/Y)}-\frac{d(S/Y)}{d(P/Y)}<0$

i.e. $\frac{d(I/Y)}{d(P/Y)}<\frac{d(S/Y)}{d(P/Y)}$

Here $\frac{P}{Y}\rightarrow\left(\frac{P}{Y}\right)^{*}$ as $m < 0$ because $f'>0$.

But in the model we have assumed that investment is undertaken in such manner as to maintain full employment. This means that $\frac{1}{Y}$ is autonomously given and therefore $\frac{d\left(\frac{I}{Y}\right)}{d\left(\frac{P}{Y}\right)}=0.$ Therefore the stability condition requires that $\frac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)}>0.$

But $S = s_w\ (W = P_w) + s_c,\ P_c$

Hence $\frac{S}{Y}=s_w.\frac{W}{Y}+s_w.\frac{P_w}{Y}+s_c.\frac{P-P_w}{Y}$

$=s_w.\frac{W}{Y}+s_w\frac{P_w}{Y}+s_c\frac{P}{Y}-s_c.\frac{P_w}{Y}$

$$= s_w\left(1-\frac{P}{Y}\right)+ s_w.\frac{P_w}{Y}+ s_c.\frac{P}{Y}- s_c.\frac{P_w}{Y}$$

Now in the short run, the share of profits which accrue to the workers is fixed. Hence in this case $\dfrac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)}= -s_w + s_c > 0.$ This is the same condition as that given by Kaldor. But Pasinetti argues that this is only a short run conditoin. For, in the long run the share of workers' profits is no longer fixed and P_w adapts itself to a proportion of K_w equal to the proportion that P_c bears to K_c. This means that in the long run s_w. $W = (s_c - s_w)P_w$ *i.e.* $s_w \quad \dfrac{W}{Y}=\left(s_C - s_W\right).\dfrac{P_w}{Y}$.

Putting this value of $s_w\dfrac{W}{Y}$ we get

$$\frac{S}{Y}=(s_c - s_w)\frac{P_w}{Y}+ s_w.\frac{P_w}{Y}+ s_c\frac{P_w}{Y}= s_c\frac{P}{Y}.$$

Therefore $\dfrac{d\left(\frac{S}{Y}\right)}{d\left(\frac{P}{Y}\right)}= s_c > 0$ is the condition of stability in the long run.

Consider now the implications of Pasinetti's model. *In the first place*, the model shows that in the determination of the rate of profit and the share of profit in national income in the long run the workers propensity to save is irrelevant. There is, therefore, no need for any hypothesis about the aggregate saving behaviour of the workers. *Second*, the model shows the crucial importance of the propensity to save of the capialists in the economy. The importance of the capitalist class in the process of capital accumulation has long been emphasised by the

classical economists. Pasinetti's model throws new light on the importance of this capitalist class. More clearly, Pasinetti has pointed out that the relation between capitalists' savings and capital accumulation does not depend on the assumption of negligible saving of the workers. The relation holds independently of the saving behviour of the workers.

Third, consider the implications of the model in the case of a socialist economy. In a socialist economy all members of the community belong to the category of workers. There is no place for capitalists. The production process is carried out by the State. However, the State, as such cannot consume. This means that in a socialist economy $s_c = 1$. Then from (15) and (16) we get $\frac{P}{Y} = \frac{I}{Y}$ and $\frac{P}{K} = \frac{I}{K}$. This means that in equilibrium total profits are equal to total investment and the rate of profit is equal to the ratio of investment to capital (which is equal to the natural rate of growth). It follows that total wages are equal to total consumption and total profits are equal to total savings. This, however, does not mean that all wages are consumed and all profits are saved. Because, this result has been obtained without any assumption about individual decisions to save. Each individual may be left completely free to decide the proportion of his income that he likes to save, without affecting the conclusiojn that total consumtion is equal to total wages. The socialist state need not interefere in individual decisions to consume and to save.

7.5 SAMUELSON AND MODIGLIANI ON PASINETTI PARADOX

Samuelson and Modigliani claimed that Pasinetti's model was not truly general and demonstrated that there existed a point at which, if saving from wages income ($W + P_w$) became high enough so as no longer to satisfy the condition that $I - s_w Y \neq 0$, the workers' propensity to save becoems crucial and a dual regime takes over and is a mirror of that in which the capitalist had control. This case is called the Pasinetti dual case. In what follows we shall consider the Samuelson – Modigliani model and see how these results are arrived at.

In addition to the notations used in connexion with the Pasinetti model we use the following notations :

k = capital-labour ratio = $\frac{K}{L}, k_w = \frac{K_w}{L}$ = workers' capital per worker, k_c

$= \frac{K_c}{L}$ = capitalists' capital per worker.

$k = k_c + k_w$ .....(1)

The production function in per capita terms can be written as $\frac{Y}{L} = f(k)$

where $f'(k) > 0. f''(k) < 0.$

$f'(k)$ is the marginal productivity of capital or the rate of profit. As in the Solow model we shall get two dynamic equations representing k_c and k_w respectively. First of all let us consider the expression for k_c.

Total income received by the capitalists = $K_c . f'(k)$. A portion s_c of this income is saved so that total saving of the capitalists (S_c) = $s_c . K_c$

$f'(k) \therefore \frac{S_c}{K_c} = s_c f'(k).$

Here $\frac{S_c}{K_c}$ is the growth rate of capital owned by capitalists, $\left(\frac{K_c}{K_c}\right)$.

$\therefore \quad \frac{K_c}{K_c} - \frac{L}{L} = s_c f'(k) - n$

or, $\frac{k_c}{k_c} = s_c f'(k) - n$

$\therefore \quad k_c = \{s_c f'(k) - n\} k_c$ .....(2)

This equation gives us the time path of k_c. Similarly income received by the

workers = $Lf(k) - K_c f'(k)$. A fraction s_w of this income is saved so that total saving of workers $(S_w) = s_w[Lf(k) - K_c f'(k)] = L.s_w[f(k)] - k_c f'(k)]$

$$\therefore \frac{S_w}{K_w} = \frac{Ls_w\left[f(k) - k_c f'(k)\right]}{K_w}$$

or, $$\frac{\dot{K}_w}{K_w} = \frac{s_w\left[f(k) - k_c f'(k)\right]}{k_w}$$

or, $$\frac{\dot{K}_w}{K_w} - \frac{\dot{L}}{L} = \frac{s_w\left[f(k) - k_c f'(k)\right]}{k_w} - n$$

or, $$\frac{\dot{k}_w}{k_w} = \frac{s_w\left[f(k) - k_c f'(k)\right]}{k_w} - n$$

$\therefore$ $\dot{k}_w = s_w [f(k) - k_c f'(k)] - nk_w$ ....(3)

Equations (2) and (3) together with the accounting relation (1) completely describe the system.

In a situation of balanced growth $\dot{k}_c = 0$ and $\dot{k}_w = 0$

From (2) putting $\dot{k}_c = 0$ we get

sc. $f'(k) - n = 0$ provided $k_c \neq 0$.

or, $$f'(k) = \frac{n}{S_c} ...(4)$$

From (3) we get by putting $\dot{k}_w = 0$

$$s_w[f(k) - k_c f(k)] = nk_w$$

or, $$f(k) - k_c f(k) = \frac{n}{s_w} k_w$$

or, $f(k) = \frac{n}{s_w} k_w + k_c f'(k)$

$= \frac{n}{s_w} k_w + \frac{n}{s_c} k_c$ [from (4)]

or, $f(k) = n\left(\frac{k_w}{s_w} + \frac{k_c}{s_c}\right)$.....(5)

Solving (4) and (5) we can get the steady state values of k_w and k_c. Let us denote them by k_w^* and k_c^* respectively. Analogously denote $k_w^* + k_c^*$ by k^*. Equations (4) and (5) can therefore be written as follows : $f'(k^*) = \frac{n}{s_c}$... (4) and

$f(k_w^*) = n\left(\frac{k_w^*}{s_w} + \frac{k_c^*}{s_c}\right)$...(5)

Samuelson and Modigliani distinguish between two types of balanced grwoth cases :

(1) The "Pasinetti case" where there are pure capitalists who provide no labour service : $k_c^* > 0$.

(2) The "dual case" where there are no pure capitalists. All capital owners are workers : $k_c^* = 0$. Let us discuss the analytical properties of each of these two types of balanced growth path.

Case (1) : The Pasinetti Case :

In this case equation (4) gives us $f'(k^*) = \frac{n}{s_c}$. This shows that the rate of profit is determind by the capitalists' propensity to save. Here s_c together with the rate of growth of population (n) determines the stedy state capital labour ratio (k^*). It also determines the wage rate $f(k^*) - k^*$. $f'(k^*)$. The

workers' saving ration, s_w, apparently plays a limited role. Through equation (5) s_w participates in the determination of workers' share in capital $\frac{k_w^*}{k^*}$ and their share in income. Variations of s_w within limits would have no effect on the rate of profit or on the equilibrium capital labour ratio. Further since the production function does not enter into the detrmination of the rate of profit, the form of the production has no effect on the rate of profit.

Case (2) : The Dual Case

In the dual case $k_c^* = 0$. Here equation (4) becomes inoperative because when $k_c = 0$ equation (2) is an identity of the form 0 = 0. The over all capita-labour ratio is equal to workers' capital per worker, because $k^* = k_c^* + k_w^* = k_w^*$. Equation (5) now becomes $f(k_w^*) = \frac{n}{S_w} k_w^*$. In this model every economic magnitude is determined in the same way as in the Solow model except that s_w plays the role of *s*. The workers' saving ratio determiners all the important magnitudes and s_c plays no appartent role in the system. The form of the production function has no effect on the equilibrium output-capital ratio which is equal to $\frac{n}{s_w}$.

The Pasinetti case and the dual case can be explained with the help of the following diagram (figure 1).

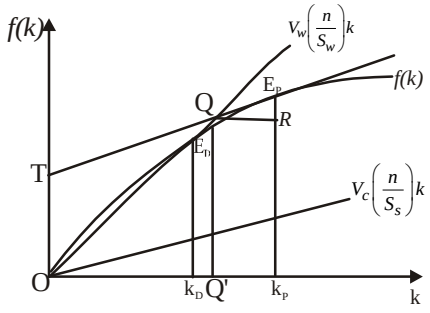

Fig. 7.1

In the above figure equation (4) is satisfied at point E_p,where the tangent to the $f(k)^{p'}$ curve is parallel to the ray OV_c. The point = E_p may therefore be called the Pasinetti equilibrium point. Ok_p is the over all capital labour ratio (k*). Suppose that the ray OV_w intersects the tangent TE_p at point Q. Drop a perpendicular QQ' from point Q on the horizontal axis. Then it can be seen that $OQ' = k^*_w$ and $Q'k_p = k^*_c$ such that $OQ' + Q'k_p = Ok_p = k^*_w + k^*_c = k^*$.

Note that $\frac{QQ'}{OQ'} = \frac{n}{s_w}$ so that $QQ' = \frac{n}{s_w}.OQ' = \frac{n}{s_w}.k^*_w$

Similarly $\frac{E_pR}{QR} = \frac{n}{s_c}$ and $E_pR = \frac{n}{s_c}.QR = \frac{n}{s_c}.k^*_c$

Now $E_pk_p = E_pR + Rk_p = E_pR + QQ'$

or, $f(k^*) = \left(\frac{n}{s_c}\right)k^*_c + \left(\frac{n}{s_w}\right)k^*_w$ which is nothing but equation (5).

Thus the point Q' determines the distribution of the over all capital-labour ratio between the two classes. The point E_p where the OV_w ray cuts the $f(k)$ curve satisfies the condition of equilibrium in the dual case. E_D may therefore be called the dual equilibrium point. The dual equilibrium point is however not applicable because k^*_c is not zero here. But suppose that s_w is somewhat higher than it used to be. Then OV_w must have a flatter slope. The value of k^*_w will increase at the expense of k^*_c. But should s_w be so large that OV_w becomes flat enough to pass through E_p or to its right, then k^*_c becomes zero and the dual case becomes operative. Thus if the values of n, s_c and s_w are such that E_p is to the left of E_p then the Pasinetti case is applicable. But if E_D is to the right of E_p then the dual case is applicable.

Alternatively we can say that in the Pasinetti case $\frac{n}{s_w} > \frac{f(k^*)}{k^*}$ and $f'(k^*) = \frac{n}{s_c}$.

This implies that $\frac{\frac{n}{s_w}}{\frac{n}{s_c}} > \frac{f(k^*)}{k^*.f'(k^*)}$

or, $\frac{s_w}{s_c} < \frac{k^* f'(k^*)}{f(k^*)}$

The right hand side represents the share of profits in national income. Thus we can say that the Pasinetti case emerges if and only if the ratio of the workers' saving propensity to that of the capitalists is less than the share of profits in national income.

In the dual case $\frac{f(k^*)}{k^*} = \frac{n}{s_w}$ and $\frac{n}{s_c} \geq f'(k^*)$. Therefore $\frac{s_w}{s_c} \geq \frac{f'(k^*)k^*}{f(k^*)}$. The dual case will therefore be applicable if the ratio of the two saving propensities is greater than or equal to the share of profits in national income.

In the Pasinetti case the capitalists' propensity to save is the crucial variable while in the dual case the workers' propensity to save is the crucial variable. Thus in a general model the conclusion of Pasinetti that the workers' propensity to save is irrelavant is not correct. It is correct only in the Pasinetti case that we have considered i.e. when $\frac{s_w}{s_c} < \frac{k^* f'(k^*)}{f(k^*)}$. But if this condition is not fulfilled then the opposite comes to be true and the capitalists' saving propensity becomes irrelevant. Thus Samuelson and Modigliani have proved that the Pasinetti model is only a special case of the general neo-classical model.

7.6 SUMMARY AND CONCLUSION

To conclude, it can say that Kaldor provided the first Cambridge Model of income distribution and Pasinetti presented the reformulated version of the Kaldor model. Pasinetti's results have intrigued several economists, notably Modigliani and Samuelson. Samuelson and Modigliani proved that the Pasinetti's model is only a special case of the general neo-classical model.

7.7 GLOSSARY

(i) Income Distribution : In economics, income distribution is how a nation's total GDP is distributed amongst its population. Its a central concern of economic theory and economic policy.

(ii) Capital-Labour Ratio : It is ratio of capital employed to labour employed i.e. the amount of capital per unit of work.

(iii) Marginal Productivity Theory : According to it, wages are paid at a level equal to the marginal revenue product of labour, MRP (the value of the mairginal product of labour), which is the increment to revenues caused by the increment to output produced by the last labourer employed.

7.8 EXAMINATION ORIENTED QUESTIONS

1. Prove that corresponding to steady state there exists a unique rate of profit required to achieve the steady state.
2. How Pasinetti model is different from Kaldor's model.
3. Describe the "Pasinetti Case" as given by Samuelson and Modigliani.
4. Explain the "Dual case" as described by Samuelson and Modigliani.

7.9 SUGGESTED READINGS

Sarkhel, Jaydev (2005). Growth Economics. Kolkata Book Syndicate.

Thirlwal, A.P., Growth and Development, Palgrane

7.10 REFERENCES

Kaldor, Nicholas (1963). Capital Accumulation and Economic Growth United Nations Educational Scientific and Cultural Organization.

Samuelson, P.A. and Modigliani, Franco (1966). The Pasinetti Paradox in Neoclassical and More General Models. The Review of Economic Studies, Vol. 33, No. 4, pp : 269-301

7.11 MODEL TEST PAPER

1. Comment on "Capitalists earn what they spend while workers spend what they earn."
2. What are the assumptions of Kaldor's model?
3. Extend the equation $\frac{P_W}{K_W} = \frac{P_C}{K_C} = r$ from Pasinetti Model.
4. How Samuelson and Modigliani proved that the Pasinetti model is only a special case of the general neo-classical model.

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M. A. ECONOMICS **LESSON NO. 8**

COURSE NO. : ECO 302 SEMESTER III UNIT- III

UZAWA'S TWO SECTOR MODEL OF GROWTH

8.1 INTRODUCTION

The two-sector model of economic growth given by Uzawa is basically a neo-classical model. This model states that every sector in the economy employs fixed co-efficient of the factors and there is initial stage of static equilibrium in the economy. The central result of the Uzawa (1961, 1963) two-sector growth model is that the uniqueness of factor market ("momentary") equilibria and the stability of the steady-state growth path depends crucially on the relative factor-intensities of the two sectors and attendant savings hypotheses. The most celebrated result is that we are only assured stability if the consumer goods sector is more capital-intensive than the investment goods sector. In Uzawa's model there are two productive inputs – the labour and capital which are substitutable to each other and freely transferable from one sector to the other. Thus, Uzawa introduced a two-sector and two-factor model in the neo-classical frame-work.

8.2 OBJECTIVES

This chapter has the following objectives:

1. To understand the economy in a two sector framework with two inputs.
2. To observe the basic assumption upon which this two-sector model is based.
3. To find out the stability conditions.
4. To observe the changes in factor prices and commodity prices in order to fulfil the stability conditions.
5. To examine the optimal growth path under the stable conditions and what happens if those conditions are not met.

8.3 ASSUMPTIONS

Before we analyse the working of this model, let us look at a few assumptions of this model. This model is based upon following assumptions:

1. There are two productive inputs – labour and capital which can be substituted for each other.

2. The factors are perfectly mobile across all sectors of the economy.

3. The capital depreciates at a constant rate.

4. The supply of labour is fixed at any point of time. The size of the labour force is exogenously determined.

5. At any point of time, the supply of capital is determined by its existing stock.

6. All the wages are spent on consumer goods and all the profits are reinvested.

8.4 THE BASIC MODEL

In a two-sector economy, two produced goods are consumer goods and the capital goods, produced by using both labour and capital. Thus this model assumes two inputs and two outputs. Moreover, one of the two outputs i.e. capital goods is also an input. Thus, introduction of two-sectors in the neo-classical framework raised a number of special problems for the possibility of steady growth and its stability. The basic set up of the model given by Uzawa is given below:

8.4.1 The Consumer Goods Sector

The production function of the consumer goods is

$Y_c = F_c (K_c, L_c)$,

Where, Y_c = output of consumer good; L_c = labour used in consumer good sector; K_c = capital used in consumer good sector; $F_c(ï½·)$ = is the consumer goods industry production function.

8.4.2 The Capital Goods Sector

The production function of the capital goods is

$Y_i = F_i (K_i, L_i)$

Where, Y_i = output of investment good; L_i = labour used in investment good sector; and K_i = capital used in investment good sector; $F_i(ï½·)$ = the investment goods industry production function.

Both production functions $F_c(ï½·)$ and $F_i(ï½·)$ are Neoclassical, in the sense of exhibiting constant returns to scale, continuous technical substitution, diminishing marginal productivities to the factors, etc.

8.4.3 Total Output of two sectors

$Y = Y_c + pY_i$

Y = total output of economy; p = price of investment good (in terms of consumer good).

8.4.4 Total Demand for Labour and Capital in two sectors

L = total supply of labour

$L_c + L_i = L$

K = total supply of capital

$K_c + K_i = K$

Since, $L_c + L_i$ are total demand for labour and $K_c + K_i$ are total demand for capital, above two equations show equilibrium in the labour and capital markets.

In the labour market, the wages are just equal to the marginal product of labour and are expressed as:

w = return to labour (wages)

$w = dY_c/dL_c = pï^{½}·(dY_i/dL_i)$

while in capital market, the rate of return is just equal to the marginal product of capital

r = return to capital (profit/interest)

$r = dY_c/dK_c = pï^{½}·(dY_i/dK_i)$

Further, labour supply is assumed to grow exogenously at the exponential rate n, thus the growth rate of labour is

$g_L = (dL/dt)/L = n$, where 'n' is the natural rate of growth of population;

Finally, as the investment goods industry produces all the *new* capital goods in the economy, then, ignoring depreciation, we can define the change in the total stock of capital as that sector's output, i.e. $dK/dt = Y_i$, so growth rate of capital is

$$g_K = (dK/dt)/K = Y_i/K,$$

each sector of the economy will have its own optimal capital and labour ratio which will be K_c/L_c for the consumer goods industry and K_i/L_i for the capital goods industry. Under the conditions of full employment, the overall capital-labour ratio for the economy will be:

$$\frac{K}{L} = \frac{K_c + K_i}{L_c + L_i} = \frac{K_c}{L_c + L_i} + \frac{K_i}{L_c + L_i}$$

$$\frac{K}{L} = \frac{K_c + K_i}{L_c + L_i} = \frac{L_c}{L_c + L_i}.\frac{K_c}{L_c} + \frac{L_i}{L_c + L_i}.\frac{K_i}{L_i}$$

$$= \frac{L_c}{L_c + L_i}.\frac{K_c}{L_c} + \left(1 - \frac{L_c}{L_c + L_i}\right)\frac{K_i}{L_i}$$

This shows that the capital labour ratio in the economy is the weighted average of the capital labour ratio of two sectors of the economy. Uzawa further states that the allocation of labour and capital in each sector of the economy would depend upon the relative factor price ratios i.e. w/r which further determine the ratio of prices of two commodities i.e. consumer goods and that of the capital goods i.e. P_c/P_i. Both industries male optimal adjustments and these yield unit costs; competition that sets the price ratio P_c/P_i for the two commodities equal to the ratio of unit costs. Thus any w/r determines an equilibrium P_c/P_i.

8.5 THE CONDITIONS FOR STABILITY

In the two-sector model by Uzawa, for stable equilibrium of the economy, with given wage-profit ratio (w/r) and capital-labour ratio (K/L) and given the outputs Y_c and Y_i, the following conditions must be met:

$$\frac{wL}{rK} = \frac{P_c Y_c}{P_i Y_i}$$

This stability proposition further states that even in the growing economy, the capital labour ratio remains constant. This is possible only if the growth of capital is just equal to the growth of labour force. The labour supply grows geometrically at rate λ and is defined as $\Delta L/L = \lambda$. In order to find the growth of capital stock, we must calculate ΔK which is given as under:

$\Delta K = r.(K/Pi) - \mu.K$, where μ is depreciation of capital

The stability proposition states that under conditions of equilibrium the rate of change in capital labour ratio ($k = K/L$) should be zero i.e.

$\Delta k/k = (\Delta K/K) - (\Delta L/L)$ = (change in capital labour ratio in capital goods sector) $- \lambda - \mu = 0$

i.e. $f'(k_i) - \lambda - \mu = 0$

or $f'(k_i) - (\lambda + \mu) = 0$

here, the marginal product function i.e. $f'(k_i)$ is a decreasing function of k_i and as k_i increases, $f'(k_i)$ falls and ultimately, it becomes equal to $\lambda + \mu$.

Finally, another important condition of stability, which is related with above two conditions is that the consumption goods sector is more capital intensive than the capital goods sector. With these conditions in view, we can analyse the working of this model through diagrams.

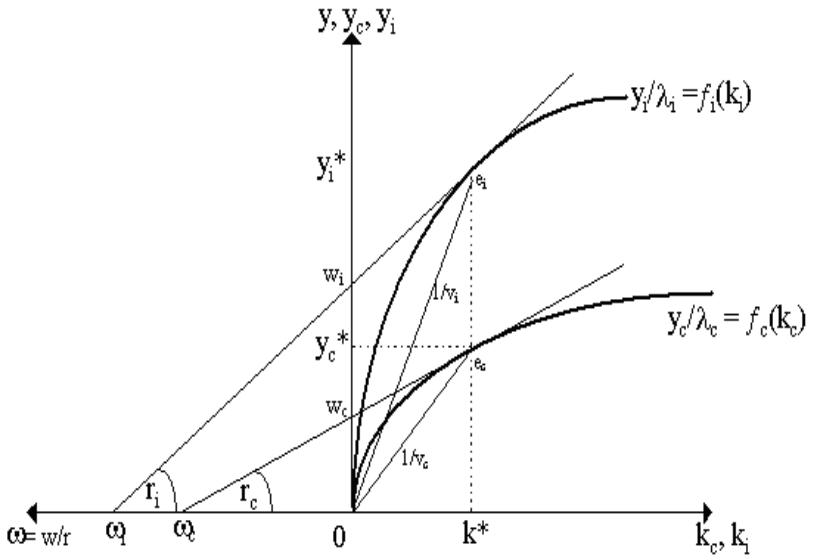
8.6 DIAGRAMMATIC EXPLANATION

Above discussion has shown that the stable equilibrium in the economy depends upon the relationship between the factor intensities of the two sectors. The factor intensities in the two sectors can be understood with help of the following figure (figure 1). In figure 1, we have taken intensive production functions of the two sectors of the economy. Here, intensive production functions are the same production functions as already defined in the basic model but are expressed

in per capita or per labour unit terms e.g. in intensive production function, following notations are used

$y_c = Y_c/L$; $\lambda_c = L_c/L$; $k_c = K_c/L_c$; $f_c(k_c) = F_c(K_c, L_c)/L_c$; $y_i = Y_i/L$; $\lambda_i = L_i/L$; $k_i = K_i/L_i$; $f_i(k_i) = F_i(K_i, L_i)/L_i$; $y = Y/L$; $k = K/L$

Figure 1: Two-Sector Model (for given k*)



In this figure y_c and y_i are the production functions of the consumer goods and capital goods sector, respectively. On X-axis, on the right side, we take capital labour ratio i.e. k =K/L and on the left side, we have taken wage-interest ratio or factor price ratio, represented as $\omega = w/r$ while the Y-axis show the per capita out of the economy as a whole (y); per capita output in capital goods sector (yi) and in consumer goods sector (y_c). Let us begin with a given capital-labour ratio, k*. Suppose we wish to specialize completely in the production of consumer goods, i.e. suppose $y_i = 0$ so that $y = y_c = y_c/\lambda_c$, where $\lambda_c = 1$ (all labour allocated to consumer goods sector) and $k_c = k^*$ (so all capital allocated to consumer goods sector). We see immediately that our entire economy is governed by the intensive production function $f_c(k_c)$. So, with k*, we produce y_c^* as our aggregate output.

The slope of the ray tangent to the production function is f_c' (= r_c), the marginal product of capital, the point where that ray intersects the vertical axis, (= w_c), the marginal product of labour. Most importantly, the point where the tangent ray intersects the horizontal axis is $\omega_c = w_c/r_c$, the ratio of marginal products. If we specialize in producing consumer goods, then the ratio ω_c can be seen as the resulting equilibrium factor price ratio, i.e. the factor prices that clear the capital and labour markets, where the initial supply of capital and labour is captured by the given capital-labour ratio k*.

On the other hand, if we specialize completely in investment goods production, $y_c = 0$, and so $y = pï½·y_i = pï½·y_i/\lambda_i$ as $\lambda_i = 1$ (all labor to investment goods production) and $k_i = k^*$ (all capital to investment goods). Thus, aggregate per capita output is governed by the intensive production function $f_i(k_i)$ depicted in Figure 1. With the given k*, notice, we will produce $y = pï½·y_i^*$ which (although this depends on p) seems to be *more* than y_c^*. This should alert us to the fact that the investment goods industry is less capital-intensive than the consumer goods industry.

Through this figure, we can also observe the relative factor price intensities which are measured as the slope of a ray from the origin to the relevant point on an intensive production which is 1/v, the reciprocal of the capital-output ratio, v. Thus, letting v_c and v_i denote the capital-output ratios in the consumer goods and investment goods industries respectively, we can see in Figure 1 by the rays connecting 0 to e_c and e_i, that $1/v_i > 1/v_c$, so that $v_c > v_i$, in other words, you need more capital per unit of output in the consumer goods industry than in the investment goods industry. Relatively speaking, consumer goods are capital-intensive and investment goods are labour-intensive. Of course, we could have drawn this differently so that the factor-intensities were reversed.

We can further observe in the figure that a tangent line with slope intersects the horizontal axis at $\omega_i = w_i/r_i$, the equilibrium factor price ratio. We can easily notice that $\omega_i > \omega_c$, which is another indication that the

consumer goods industry is relatively capital-intensive. Specifically, note that relative factor shares can be denoted $k/\omega = rK/wL$. The higher this k/ω ratio, the greater the capital-intensity. In terms of Figure 1, holding $k = k^*$ constant, we see that as $\omega_i > \omega_c$, then $k^*/\omega_i < k^*/\omega_c$, indicating, once again, that the investment goods sector is relatively capital intensive.

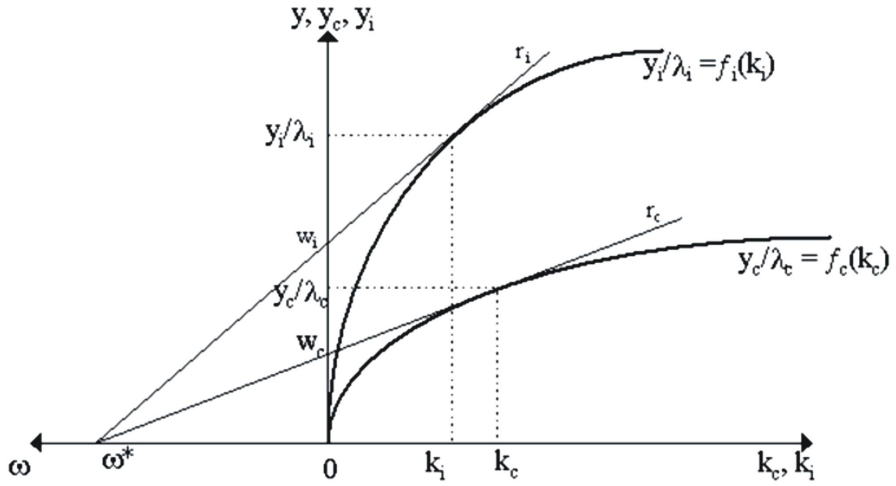
Thus, for a given k, the resulting equilibrium factor-price ratio will depend on the allocation of two factors between the two sectors of the economy. Specifically, if all the factors are allocated to the consumer goods sector, the equilibrium will be ω_c; and on the other hand if all factors are allocated to the investment goods sector, the equilibrium will be ω_i. The assumption of strict concavity of production functions guarantees this uniqueness. If we do not know the sectoral composition of output, we cannot determine what the actual equilibrium factor-price ratio ω is: it can range from a minimum of ω_c (complete specialization in consumer goods) to a maximum of ω_i (complete specialization in investment goods), i.e. for a given k,

$$\omega_{min} \leq \omega \leq \omega_{max}$$

where $\omega_{min} = \omega_c$ and $\omega_{max} = w_i$.

Similarly, we can also find a solution with given value of ω i.e. the factor price ratio. This can be observed from figure 2. In this figure the given factor-price ratio ω^* will set a point on the horizontal axis from which emanate two rays, one with slope r_c and another with slope r_i, corresponding to the marginal products of capital for the consumer goods and investment goods industries. These rays form tangencies with the intensive production functions of both the consumer goods and capital goods industries at points e_c and e_i respectively, which translate into resulting capital-labour ratios k_c and k_i. Thus, this indicates the relationships $k_c(\omega)$ and $k_i(\omega)$ such that $k_c > k_i$, which is another indicator of the relative factor intensity of the sectors and we can also notice that $k_c/\omega^* > k_i/\omega^*$.

Figure 2: Two Sector Model (for given ω*)

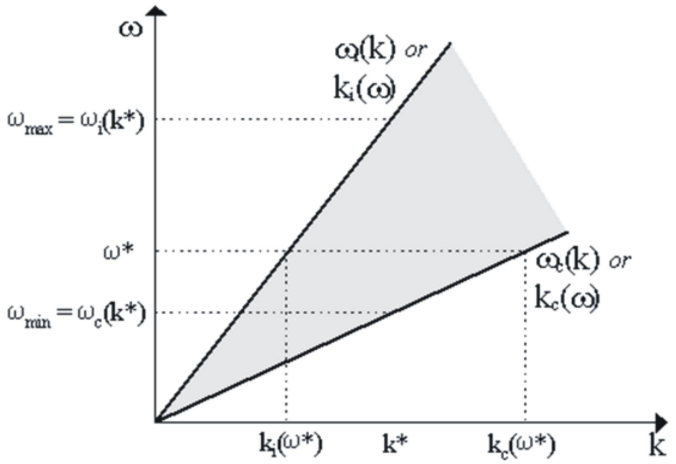


We can also notice in Figure 2 that although the factor-price ratio is the same for both sectors, so $\omega^* = r_i/w_i = r_c/w_c$, we have it that $r_i \neq r_c$ and $w_i \neq w_c$, so it seems that the rates of return to capital and wages are not equal across sectors. But we must also keep in mind the price of investment goods, p. Specifically, p will be such that pï½·$r_i = r_c$ and pï½·$w_i = w_c$. Finally, that the amount that will be produced when factor prices are ω* can be determined from y_c/λ_c and y_i/λ_i on the vertical axes. Since, both industries have positive output per capita (y_c, $y_i > 0$), so we are not specializing exclusively in either of them. Both sectors are allowed to operate and the particular amounts they produce will be dictated by the equilibrium factor price ratio i.e.ω*.

The feasible solutions in each of the cases mentioned above that is in case of given k* and ω* and then varying their levels can be observed from the figure 3. It should be noticed that varying the given k, these upper and lower boundaries for equilibrium factor prices will vary. If we observe the Figure 1, we can say if k is increased above k*, then both ω_c and ω_i will increase. We depict the resulting boundaries in Figure 3 as the upward-sloping curves $\omega_c(k)$ and $\omega_i(k)$. We draw them as straight lines, but this is not necessarily the case. The only things that are posited are (i) that the relationship between k and ω_c and ω_i is unique and monotonically increasing (by assumptions

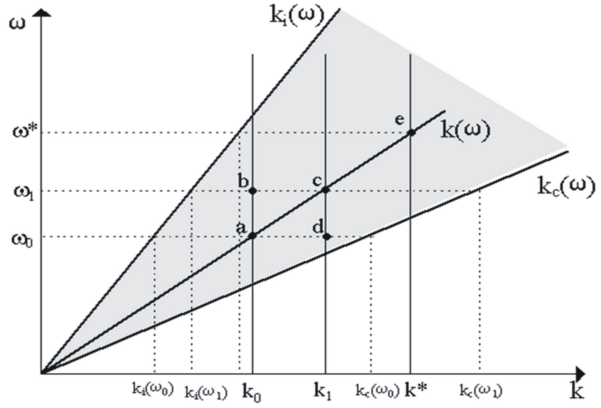
of strict concavity and constant returns to scale for the production function) and (ii) that the investment goods boundary $\omega_i(k)$ will always lies above the consumer goods boundary $\omega_c(k)$ (from the assumption that consumer goods industry is more capital-intensive than the investment goods industry). Naturally, if we change the assumption of factor-intensity, so that investment goods are more capital-intensive than consumer goods, then $\omega_c(k)$ would lie everywhere above $\omega_i(k)$.

Figure 3: Factor Prices and Quantities



Now, we can easily have a look at the locus of factor market equilibrium in figure 4.

Figure 4: Factor Market Equilibrium Locus



In figure 4, suppose we are given an initial aggregate capital-labor ratio k_0. As we say nothing about allocation between sectors, then there is a whole range of equilibrium factor prices 'w' Which are consistent with that allocation (within some maximum/minimum range). Picking one of these factor price ratios which will then determine a sectoral allocation of $k_c(\omega)$ and $k_i(\omega)$. But this may not be necessarily market-clearing, i.e. it may be that $\lambda_c k_c(\omega) + \lambda_i k_i(\omega) \neq k_0$, so that our demands for factors are not equal to our initial supplies of the factor, which implies that the factor price ratio we have chosen is not appropriate. So, for the initial k_0, we must search for a market-clearing factor price ratio that makes demands equal to supplies.

The line $k(\omega)$ in Figure 4 maps out the locus of equilibrium factor prices for every aggregate capital-labor ratio. The fact that this is upward-sloping everywhere and lies between the boundaries is important. Suppose we begin at k_0. The locus $k(\omega)$ tells us that ω_0 is the market-clearing factor price ratio. Thus, the corresponding sectoral allocations $k_c(W_0)$ and $k_i(W_0)$ are equilibrium allocations, i.e. $\lambda_c k_c(\omega_0) + \lambda_i k_i(\omega_0) = k_0$. In contrast, for initial capital stock k0, the wage-profit ratio ω_1 *is not* market clearing, so $\lambda_c k_c(\omega_1) + \lambda_i k_i(\omega_1) \neq K_0$. However, for initial capital stock k_1, ω_1 is the market-clearing wage-profit ratio (i.e.$\lambda_c k_c(W_1) + \lambda_i k_i(\omega_1) = k_1$). So positions a and c represent factor market equilibrium, while positions such as b and d are factor market disequilibrium. The curve $k(\omega)$ is merely the locus of equilibrium positions.

Thus, this model also proposes the solutions if both the ω^* and k^* can be varied but in each case we find that the consumption goods sector is more capital intensive than the investment sector. We have observed that for any factor price ratio, since consumption goods sector is more capital intensive than the investment goods sector, then $rK_c/wL_c > rK_i/wL_i$. Under constant returns to scale and perfect competition, it is generally the case that when the factor price

ratio i.e. w/r increases, the price ratio $\frac{P_C}{P_i}$ will increase or rise according to the share of wages in the consumer goods sector being greater or smaller than that of the investment good sector. Accordingly, this model states that as P_c/P_i falls, w/r rises and vice versa. Also, we can derive from the equation, $\frac{wL}{rK} = \frac{P_c Y_c}{P_i Y_i}$ that K/L = (w/r) (Pi.Yi/Pc.Yc).

An increase in w/r raises P_i/P_c, then K/L must rise unless Y_i/Y_c falls. But if Y_i/Y_c falls, there is a shift of output in favour of consumer goods which are more capital intensive commodities leading to a rise in overall K/ L. Thus, k_i and k must move together under the stability proposition. However, the stability condition of the consumer goods sector being more capital intensive than the investment goods sector is a sufficient condition for stability but not necessary as the stability may also occur even if this condition is violated. Uzawa states that in Cobb-Douglas type production function with elasticities α_i and $1-\alpha_i$ for K_i and L_i and α_c and $1-\alpha_c$ for K_c and L_c, under full employment, the equation for demand and supply for investment goods is $rK = \alpha_i.P_i.Y_i + \alpha_c.P_c.Y_c$

But we also know that $rK = P_i Y_i$

Therefore, we can easily note that

$P_i Y_i = \alpha_i.P_i.Y_i + \alpha_c.P_c.Y_c$

i.e. $P_i Y_i - \alpha_i.P_i.Y_i = \alpha_c.P_c.Y_c$

$(1-\alpha_i).P_i Y_i = \alpha_c.P_c.Y_c$

$P_i Y_i / P_c.Y_c = \alpha_c/(1-\alpha_i)$

But, we have also seen that $\frac{wL}{rK} = \frac{P_c Y_c}{P_i Y_i}$ i.e. $P_i Y_i / P_c.Y_c = rK/wL$

Therefore, $rK/wL = \alpha c/(1-\alpha i)$

Since, the elasticities in each sector of the economy are constant, the right hand side of this equation will also be constant showing that rK/wL will always remain constant. Hence, whenever r/w falls (so K_i rises), K/L must rise. This implies that k_c and k_i move together and stability occurs regardless of which sector is more capital intensive. However, one strong assumption regarding the stability of the system is that it occurs only if all the wages are spent on consumption and all the profits on investment goods. Robert Solow and Frank Hahn severely criticised these basic assumptions of Uzawa's model for stable growth. Solow states that its weak an assumption for such as important result for stable equilibrium growth path. Frank Hahn went further and called the assumptions regarding capital intensity and savings as 'terrible assumption' which probably never or rarely hold true in the real world. It is thus reasonable to conclude from this exercise that, if anything, these models have taught us that the real world is a bit more complicated than one-sector models let on. Rather than the smooth convergence to a single steady-state path we find in the Uzawa two-sector model indicates that we ought to expect a good amount of indeterminacy, instability and cyclical behaviour in growth paths.

8.7 SUMMARY AND CONCLUSION

In contrast to many one-sector models which are based on the assumptions of similar production function for whole of the economy, Uzawa put forth the idea of two-sector model with different factor intensities. This immediately raises a number of special problems for the possibility of steady growth. This model is based upon two strong stability conditions – firstly, all the wages are consumed and all the profits are reinvested; and secondly, the consumption goods sector is more capital intensive than the investment goods sector. However, this model has proposed a range of options for optimal growth path under the given factor price ratios, factor input ratios and commodity price ratios. It also traces the possible solutions if any of the conditions are violated.

8.8 GLOSSARY

(i) Constant Returns to Scale : Under constant returns to scale output increases by the same proportional change as all inputs change.

(ii) Exogenous Variable : Independent variable that affects a model without being affected by it, and whose qualitative characteristics and method of generation are not specified by the model builder. An exogenous variable is used for setting arbitrary external conditions, and not in achieving more realistic model behaviour. For example, the level of government expenditure is exogenous to the theory of income determination.

(iii) Production Function : The production function shows the functional relationship between inputs and output. For a given state of technology and managerial practices, the relationship between the physical inputs and the physical outputs of a firm is generally referred to as the production function.

(iv) Steady State : The dictionary meaning of a steady state is an unvarying condition in a physical process. From the economic perspective, the possibility of a steady state economy comes down to balance: economies may grow or contract, but ultimately fight back to equilibrium.

8.9 SAQ/CYP

Q 1. Discuss the main assumption of the 'Two-Sector Model' by Uzawa

Ans. The 'Two-Sector Model' by Uzawa is based on the following assumptions:

1. There are two productive inputs – labour and capital which can be substituted for each other.
2. The factors are perfectly mobile across all sectors of the economy.
3. The capital depreciates at a constant rate.
4. The supply of labour is fixed at any point of time. The size of the labour force is exogenously determined.
5. At any point of time, the supply of capital is determined by its existing stock.
6. All the wages are spent on consumer goods and all the profits are reinvested.

Q 2. Discuss the stability condition of Uzawa Model

Ans. In the two-sector model by Uzawa, for stable equilibrium of the economy, with given wage-profit ratio (w/r) and capital-labour ratio (K/L) and given the outputs Y_c and Y_i, the following condition must be met :

$$\frac{wL}{rK} = \frac{P_c Y_c}{P_i Y_i}$$

Q 3. Do you agree that the condition of consumer goods sector being more capital intensive than the capital goods sector is necessarily required for stable equilibrium?

Ans. The stability condition of the consumer goods sector being more capital intensive than the investment goods sector is a sufficient condition for stability but not necessary as the stability may also occur even if this condition is violated. Uzawa states that in Cobb-Douglas type production function with elasticities α_i and $1-\alpha_i$ for K_i and L_i and α_c and $1-\alpha_c$ for K_c and L_c, under full employment, the equation for demand and supply for investment goods is $rK = \alpha_i.P_i.Y_i + \alpha_c.P_c.Y_c$

But we also know that $rK = P_i Y_i$

Therefore, we can easily note that

$P_i Y_i = \alpha_i.P_i.Y_i + \alpha_c.P_c.Y_c$

i.e. $P_i Y_i - \alpha_i.P_i.Y_i = \alpha_c.P_c.Y_c$

$(1-\alpha_i).P_i Y_i = \alpha_c.P_c.Y_c$

$P_i Y_i / P_c.Y_c = \alpha_c/(1-\alpha_i)$

But, we have also seen that $\frac{wL}{rK} = \frac{P_c Y_c}{P_i Y_i}$ i.e. $P_i Y_i / P_c.Y_c = rK/wL$

Therefore, $rK/wL = \alpha_c/(1-\alpha_i)$

Since, the elasticities in each sector of the economy are constant, the right hand side of this equation will also be constant showing that rK/wL will always remain constant. Hence, whenever r/w falls (so K_i rises), K/L must rise. This implies that K_c and K_i move together and stability occurs regardless of which sector is more capital intensive.

8.11 EXANIMATION ORIENTED QUESTION

1. Critically analyse Uzawa's Two sector model.

2. What are the main conditions of stability? Examine the growth path in a two-sector economy with the given conditions.

8.11 SUGGESTED READINGS

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H. Uzawa (1963) "On a Two-Sector Model of Economic Growth, II", Review of Economic Studies, Vol. 30, p.105-18.

8.13 MODEL TEST PAPER

1. Give the assumptions of Uzawa's Two-Sector model.

2. Discuss the basic model of growth given by Uzawa.

3. What do you mean by intensive function? Show the basic model given by Uzawa as intensive functions.

4. Critically analyse Uzawa's Two-Sector model

5. What are the main conditions of stability? Examine the growth path in a two-sector economy with the given conditions.

MONEY AND ECONOMIC GROWTH

STRUCTURE

9.1 INTRODUCTION

In neo-classical framework, the equilibrium marginal productivity of capital and rate of interest are determined by technology and saving behavior

and it is assumed that whatever is earned as profits is saved and then invested. Such propositions automatically assume that the warranted growth rate is just equal to the natural growth rate of the economy. However, if there is divergence between the two, the unattractively low rates of return may create a problem for availability of investible resources. This can be rationalized if there are other competing alternatives where people may wish to supply their savings if the economy is not providing sufficient returns. James Tobin states that most of the models are non-monetary in nature and take only one destination of the savings by the people and that is investment. However, in any economy there can be a number of other portfolio choices in which people can invest their money. Hence different questions or issues of equilibrium growth path arise when monetary assets are available to compete with ownership of real goods.

9.2 OBJECTIVES

This chapter has the following objectives:

1. To find the different capital intensities and marginal productivity of capital under the classical or non-monetary frame work.
2. To examine the need of introducing the monetary factors in the analysis of stable growth path.
3. To observe the properties of the monetary assets.
4. To examine the effect of the monetary assets and how they lead the economy towards the stable growth.

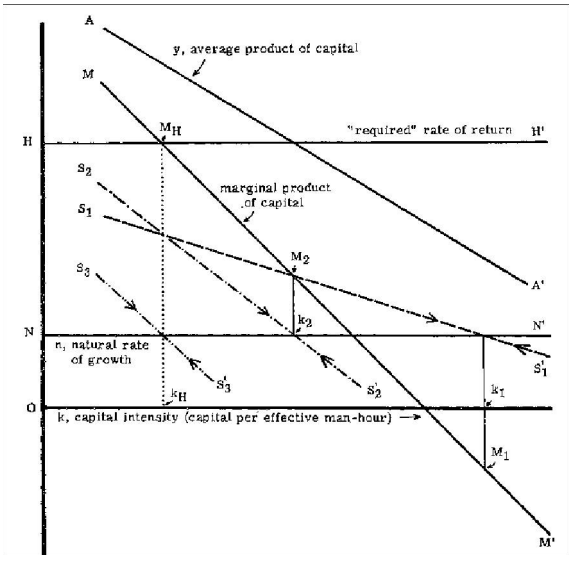
9.3 ECONOMIC GROWTH – THE NON-MONETARY FRAMEWORK

In a non-monetary model of economic growth, savings are always equal to investment and this process goes on and on until savings and investment augment the capital stock faster than the effective supplies of other factors. Under the conditions of diminishing marginal productivity of capital, an increase in capital stock leads the returns on capital to zero or below. At low or negative yields people reduce or discontinue their savings or even to consume capital. The responsiveness of savings to rate of interest actually determines the

upper limit to capital deepening and a lower bound to the rate of return on capital. But lower savings in the classical framework do not lead to a situation of under employment in the economy as fall in savings means increase in consumption expenditure which automatically stimulates investment and the economy is back on the track. This can be illustrated with the help of the figure 1. In this figure, on horizontal axis, capital intensity i.e. k, which is defined as the quantity of capital per effective manhour of labour. Here the term 'effective manhour' actually takes in to account the improvements in the quality of labour inputs due to labour augmenting technological progress. The vertical axis measure rates of growth, rate of return etc. In the figure, AA´ represents 'y' the average annual product of capital. As the units of capital increase, the average product per unit of capital increases, therefore, this curve is downward sloping. It is also the reciprocal of capital-output ratio. The curve MM´ represents the marginal product of capital. Since, we assume the diminishing marginal productivity of capital, this curve is also downward sloping and becomes zero and even negative for more intense use of capital. Both the average and marginal product curves here are shown in net terms i.e. net of constant rate of depreciation δ. The curve $S_1S_1´$ reflects saving behavior. It shows net savings and investment per unit of the existing capital stock. This tells about the speed of growth of the capital stock. In Harrodian frame work it may be stated as 'warranted rate of growth' of capital stock. The effective labour force grows at a constant rate 'n' independent of the capital intensity and since the 'natural growth rate' of the economy depends on the natural increase in the labour force, this will be represented by a horizontal line NN´. If the rate of growth of capital is just equal to 'n', there will be no change in capital intensity. If the warranted rate of growth of capital exceeds the 'natural' growth of labour 'n', then capital deepening will occur. If capital grows more slowly than labour, 'k' will decline. These facts are indicated in the diagram by the arrows in curve $S_1S_1´$ where, the equilibrium capital intensity is k_1 to which the corresponding marginal product is M_1 which is negative in this diagram. If we assume a constant propensity to save and consume, we could have remained on the curve $S_1S_1´$ but if we consider the change in

propensity to consume and save, this behavior will be depicted by S_2S_2'. Here, the ratio of net investment to output declines with 'k'. This may happen due to a number of facts such as due to lower yield on savings, the propensity to consume increases and savings falls. Tobin says, this may also happen as the capital deepening also implies an increase in wealth relative to current income as a result the savings as a proportion to average income fall. In the figure, with the saving behavior S_2S_2', the equilibrium capital intensity is k_2 and marginal product is M_2. This is how the classical model in non-monetary framework works.

Figure 1



Source: Tobin (1965).

9.4 INTRODUCING THE MONETARY FACTORS

Some growth models assume a lower limit on the marginal product of capital e.g. Harrod argues that investors will not simply invest unless they do not receive a certain minimum rate of return but the savers are not discouraged from trying to save when yields fall to or below this minimum. In Keynesian

framework such situation may lead to deficient demand and unemployment while Harrod says that the difficulties arise when the warranted rate of growth at the minimum required rate of profit exceeds the natural rate. The rate of savings from full employment output would cause capital to accumulate faster than the labour force is growing. As a result, the marginal product of the capital would fall and push the rate of return on investment below the required minimum. In figure HH´ is the required minimum. Then the kH is the maximum capital intensity investors will tolerate. Yet both the saving behaviors $S_1S_1´$ and $S_2S_2´$ show that the economy will be pushed towards marginal products M_1 or M_2 and the capital intensities k_1 or k_2. It is this excess of ex ante savings over investment which gives rise to the Keynesian difficulties. The opposite problem would arise if the warranted rate of growth falls short of the natural growth rate, in that case higher return on investment would raise the demand for investment goods well above savings. This impasse will lead to 'inflationary gap' in the economy whose main consequence is an increase in general price level. The increase in prices is another form of forced savings which reallocates the income from low savers to the high savers and ultimately, the discrepancy in savings and investments is removed. But it is nearly impossible to talk about inflation in a non-monetary model. Moreover, a minimal rate of return on capital can not exist in isolation, it must reflect the competition of other channels for the placement of savings. Therefore, may consider other alternatives of store of value i.e. monetary assets. It is their yield that set limits on the acceptable rates of return on real capital and on acceptable degree of capital intensity. Therefore, it is essential to introduce the monetary assets. Tobin takes the case of a single monetary asset with the following properties:

1. It is supplied by the central government. This means that it represents neither a commodity produced by the economy nor the debts of private individuals or institutions.

2. It is the mean of payment, the medium of exchange and a store of value by reason of its general acceptability in the discharge of public and private transactions.

3. Its own yield is fixed by the government arbitrarily. This may even be zero.

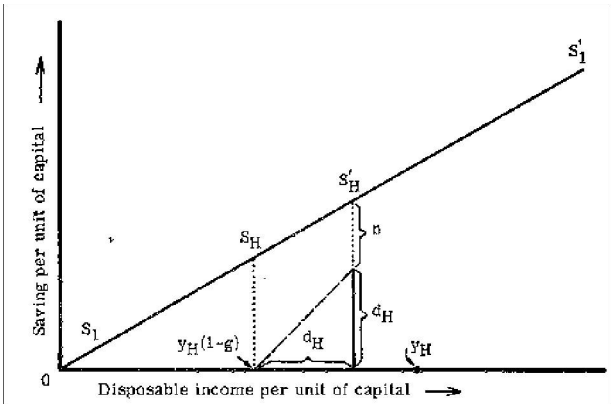
9.4.1 Assumptions: The introduction of monetary assets in the growth model needs certain assumptions. These are discussed below:

1. The value of money in terms of goods is fixed.
2. All the individuals make rational choices.
3. There is perfect information about the returns on available alternatives of store of value.
4. The community's wealth has two components – the real goods and paper goods.
5. The monetary assets can be easily converted into physical assets and vice versa.

9.4.2 The Explanation of the Model: For a rational individual, in case of two alternative portfolios, the wealth owners will wish to place all of their wealth in the assets with the higher yield. If they are the same, the wealth owners do not care in what proportion they divide their wealth between the two assets. If there are positive supplies of the both assets, they will hold their portfolios in such a way that the two yields are equal. This is only through this behavior that we can understand how the institutionally determined rate of interest on money controls the yield of capital. In particular, it is this rate of interest which is the minimal rate of profit that leads to the deflationary impasse. Now by introducing the central government assets, the government can avoid this impasse in two ways. Returning to figure 1, if we take HH´ as the yield on money, it will be the minimal yield acceptable to the owners of capital. The corresponding capital intensity is k_H. One measure the government could take it to reduce the yield on money, say to M_1. Alternatively, the government could channel part of the community's excessive thrift into increased holdings of money. The Harrod impasse occurs if the saving

behavior is S_1S_1' but if only part of it goes to capital accumulation, then the rate of increase in capital stock can be lowered to S_3S_3' then there will be no problem as at this curve, the equilibrium capital intensity will be k_H, consistent with maintaining the marginal product of capital at the required level HH′. This can be done if the government provides new money to absorb the saving represented by the difference between S_1S_1' and S_3S_3'. The only way for the government to achieve this is through continuously running deficit finance by issue of new money. But we also have to find the optimal size of this deficit. This can be observed from figure 2.

Figure 2



Source: Tobin (1965).

In figure 2 the vertical axis shows the savings and the horizontal axis shows the income. Both of these variables are shown in terms of per unit of capital. y_H is the output per unit of capital corresponding to the required equilibrium in capital intensity k_H. The government purchases of goods and services are assumed to be a fraction 'g' of output. Consequently, $y_H(1 - g)$ is output available for private use and is also the disposable income of the population. Taking S_1S_1' as the saving function, S_H is the amount of private saving (relative to capital stock) when the budget is balanced. However, this much of the investment

causes the warranted rate of growth to exceed the natural rate. Now 'n' is the natural rate of growth, it is therefore, the right amount of investment. A deficit of d_H will probably do the trick. It will increase the disposable income from $y_H(1\text{-}g)$ to $y_H(1\text{-}g) + d_H$, and this raises total savings to S_H'. But out of this d_H is the acquisition of government debt, leaving only 'n' for new tangible investment. This can also be expressed mathematically, the total savings would depend upon the propensity to save i.e. 's' out of this increased disposable income and can be written as:

$$\mathbf{S = s[y(1-g)+d] = d+n} \qquad ...(1)$$

It can also be written as

$$\frac{d}{y} = \frac{s(1-g) - n/y}{1-s} \qquad ...(2)$$

Since 'd' stands for deficit, the equation (2) gives the required deficit as a fraction of income. This shows that the absolute size of the government debt is immaterial, it can be of any size and it should be a given proportion corresponding to the given level of income.

Similarly, we can also discuss the case of inflationary impasse, in which contrary to the above case, the government will adopt the surplus policy. In this case, a balanced budget policy would leave the yield on capital so high that no one wants to hold money. To get public to hold money, it is necessary to increase the capital intensity and lower the marginal product of capital. But a higher capital intensity takes more investment relative to output. To achieve a higher investment ratio, the resources that savers make available for capital formation must be supplemented by a government budget surplus. This process can be seen in the figure 2 itself but by reading it in reverse manner.

Above discussion shows that the economy will remain at the equilibrium level. Under such an equilibrium, the shares of money and capital in total wealth must be constant so that their yields can remain constant. To

maintain the fixed relations between the stocks, money and capital must grow at the same rate i.e. new savings must be divided in the same ratio of the portfolios as the old savings. For further elaboration, let m(k, r) be the required amount of money per unit of capital when the capital intensity is 'k' and the yield of the money is 'r'. Since, 'm' is an increasing function of 'r'; more money will be demanded when its yield is higher. If we take 'r' as fixed, 'm' will be increasing function of 'k' because an increase in'k' lowers the yield of capital, it also lowers 'y' and therefore the transaction demand. Let 'w' be the warranted rate of growth of the capital stock, and let 'd' is deficit per unit of existing capital as already defined in equation (1) and (2). The constancy of amount of money per unit of capital at m(k.r) requires that d = m(k,r)w. Assuming as before that savings are constant proportion of disposable income, the basic identity in equation (1) can be rewritten as

S = s[y(1-g)+d] = d+w

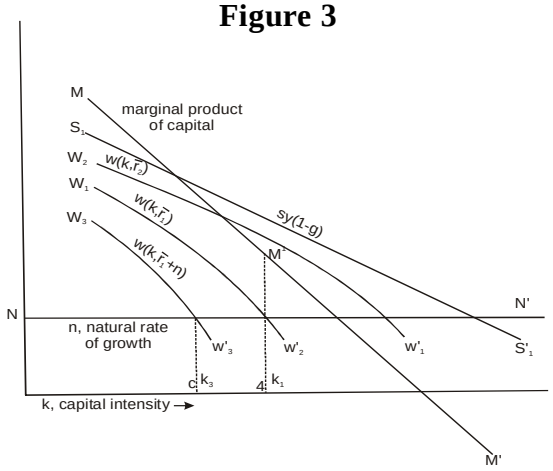
And taking d = m(k,r)w; the equation (2) becomes

$$w(k,r)=\frac{sy(k)(1-g)}{1+(1-s)m(k,r)} \qquad ...(3)$$

In equilibrium, w = n, the equilibrium degree of capital intensity is the value of 'k' that equates w(k,r) in above equation with 'n'. In this equation 'w', 'm' and 'y' are written as functions of 'k'. Since, 'y' is decreasing and 'm' is an increasing function of 'k', it is but natural that 'w' declines with 'k'. Moreover, the amount by which 'w' in (3) falls short of the hypothetical 'w' for m=0; s.y (1-g) increases with 'k'. This may be analysed in figure 3. Like in figure 1, in this figure also, we have S_1S_1' as a saving function where savings are a constant fraction of disposable income. This would be warranted rate of growth if m=0. If we assume that the stock of money is adjusted to the capital intensity by deficit financing, the W_1W_2' represents the warranted rate of growth of capital for every capital intensity. The intersection of W_1W_2' with natural growth rate curve i.e. NN', the equilibrium capital intensity will

be k_1 with marginal product M´. This yield, however, is not necessarily equal to the yield on money $\bar{r}_1$. The curve W_1W_2' is drawn for a particular yield on money $\bar{r}_1$ lowering the yield on money, say to $\bar{r}_2$ would shift the curve to the right to W_2W_1' increasing equilibrium capital intensity and lowering the equilibrium rate of return on capital.

Figure 3



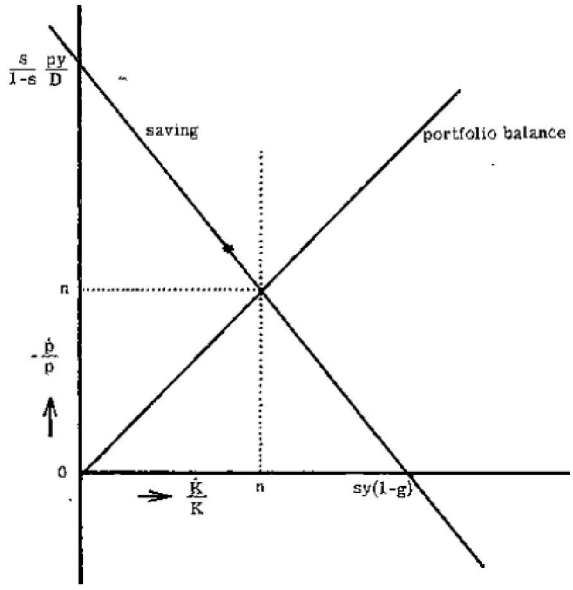
Source: Tobin (1965).

Going a step further, let us now suppose that the value of money in terms of goods is variable. This will have two important consequences – the real value of the monetary component of wealth is not under the direct control of the government but also depend upon the price level; and the real return on a unit of money will consist not only its own yield but also the change in its real value. Thus, under the conditions of deflation, even if the nominal stock of money remains constant, the increase in real value of the money stock will play the same role as in case of deficit financing as it will increase the real disposable income and it will absorb part of the propensity to save. However, in the equilibrium, the real stock of money must be increasing as fast as the capital stock, namely at the natural rate 'n'. in the present case, this can happen only if the price level falls at rate 'n' and the real return on money 'r' is not simply the nominal yield $\bar{r}$ but $\bar{r}$ + n. Consequently,

the demand for money will be larger than if the prices were expected to remain stable. Equilibrium will require a greater stock of money per unit of capital and a lower capital intensity if deflation is substituted for money creation. This can be observed from figure 3 where W_3W_3' is the curve corresponding to a yield on money 'n' points higher than the yield in case of W_1W_2'.

9.4.3 Equilibrium Path and its Stability: Now it is important to discuss the stability of the equilibrium growth path when the community is thrown out of portfolio balance due to irregularity in technological progress, labour force growth, saving behavior, change in yield expectations, or portfolio preferences. If people have too much capital and too little money for its tastes, goods etc. the prices will fall faster or rise more slowly than before. In the opposite case, the public will try to buy capital with money and will push the prices up faster or fall slowly. Under such conditions, the issue of stability has been addressed in figure 4.

Figure 4



Source: Tobin (1965).

In this figure, the vertical axis measures the price deflation i.e. $-\frac{\hat{P}}{p}$ and the horizontal axis measures the rate of capital accumulation i.e. $\hat{K}/K$. On each axis the natural rate of growth i.e. 'n' has been shown. On the horizontal axis, a rate of accumulation larger than 'n' means capital deepening and a decline in yield, while opposite will be the case if capital accumulation is at a slower rate than 'n'. The 45° line from the origin, labeled 'portfolio balance' shows the combinations of price deflation and capital formation that will preserve portfolio balances at the existing rates of return. The negatively sloped line labeled savings shows the combinations of $-\hat{P}$/p and $\hat{K}$/K that exhausts the savings, assuming the same saving behavior as assumed in figure 2. On the horizontal axis, s.y(1-g) is the rate of capital growth if all savings go into capital. On the vertical axis $\frac{s}{1-s}.\frac{p.y}{D}$ measures a rate of price deflation at which the entire propensity to save would be satisfied by capital gains on monetary assets, here D is the nominal stock of money per unit of capital. The saving line crosses the portfolio balance line at the point (n, n). At this point, new savings will be divided so as to maintain both portfolio balance and capital intensity. But if deflation exceeds 'n', the division of saving will move to the north-west along the saving line. This means that the yield on money will be higher but the portfolio behavior will not adjust it immediately and will take time until the new rate of deflation is registered in the expectations of the wealth owners to make adjustments according to new expectations. Meanwhile, the yield on capital will be rising because capital accumulation is falling short of the natural rate. Further, as the ratio of income to money stock (py/D) is declines, the vertical intercept of the saving line moves down; the rate of deflation that would divert all savings away from capital formation becomes smaller and smaller. So the yield on money

declines, the yield on capital rises, while the relative supplies will move in the opposite direction. Eventually, the rate of deflation will fall to 'n' and the economy will be on balanced growth path. However, a great hindrance to achieve this path can be the downward rigidity of the money wages which may prevent the reallocation of the portfolios that move towards the balanced growth.

9.5 SUMMARY AND CONCLUSION

In the classical theory the interest rates and the the capital intensity of the economy are determined by the interaction of the technology and the saving propensities both in the short as well as the long run. Keynes gave reasons why in the short run monetary factors and portfolio decisions modify, and in some circumstances dominate, the determination of the interest rate and process of capital accumulation which influence the growth path of the economy. James Tobin suggested that similar proposition is true even in the long run. The equilibrium interest rate and the process of capital accumulation may in general be affected by monetary supplies and portfolio behavior as well as by technology and savings. Tobin states that if under the conditions of low returns, people are averse to invest, there can be other alternatives that have the capacity to plug this gap. He proposed monetary debt of the government as one alternative store of value and show how enough savings may be channeled into this form to bring the warranted rate of growth of capital down to natural rate. The equilibrium capital intensity and interest rates are then determined by portfolio behavior and monetary factors as well as saving behavior and technology. In such an equilibrium, the real monetary debt grows at the natural rate, either by deficit spending or by deflation leading the economy to a stable equilibrium.

9.6 GLOSSARY

Capital Deepening: Capital deepening is a situation where the capital per worker is increasing in the economy. This is also referred to as increase in the capital intensity. Capital deepening is often measured by the capital stock per labour hour.

(i) Inflationary Gap: The inflationary gap is condition that refers to increase in income, output and employment above the full employment level. This is indicated by the difference in country's real gross domestic product and the level of GDP with full employment. It is called inflationary gap because after all the resources are fully employed any rise in demand will only cause rise in their prices without any increase in output.

(ii) Natural Growth Rate: It is the maximum possible growth rate, which is allowed by existing stock of capital, natural, labour force and state of technology. In the long run, growth rate of output depends upon the supply of labour. This is the maximum growth rate achievable, or the social optimum growth rate.

(iii) Warranted Growth Rate: Warranted growth rate is the minimum desired growth rate at which the investors/producers will be ready to invest or sell their commodities. Thus, this is the growth rate at which the economy will neither expand unsustainably nor go into the recession. It is equal to the saving rate of the economy divided by its capital-output ratio.

9.7 SHORT ANSWER TYPE QUESTIONS

Q 1. Discuss the basic difference in neo-classical and Tobin's framework of growth model.

Ans. In neo-classical framework, the equilibrium marginal productivity of capital and rate of interest are determined by technology and saving behavior and it is assumed that whatever is earned as profits is saved and then invested. Such propositions automatically assume that the warranted growth rate is just equal to the natural growth rate of the economy. However, if there is divergence between the two, the unattractively low rates of return may create a problem for availability of investible resources. This can be rationalized if there are other competing alternatives where people may wish to supply their savings if the economy is not providing sufficient returns. James Tobin states that most of the models are non-monetary in nature and take only one destination of the savings by the people and that is investment. However, in any economy there

can be a number of other portfolio choices in which people can invest their money. Hence different questions or issues of equilibrium growth path arise when monetary assets are available to compete with ownership of real goods. Thus, it is the introduction of the monetary factors that place Tobin's theory differently from other models of growth.

Q 2. What are the main properties of the monetary assets in Tobin's model of Money and Economic Growth?

Ans. Tobin takes the case of a single monetary asset with the following properties:

1. It is supplied by the central government. This means that it represents neither a commodity produced by the economy nor the debts of private individuals or institutions.
2. It is the mean of payment, the medium of exchange and a store of value by reason of its general acceptability in the discharge of public and private transactions.
3. Its own yield is fixed by the government arbitrarily. This may even be zero.

Q 3. Discuss main assumptions of Tobin's model of Money and Economic Growth.

Ans. Tobin's model of Money and Economic Growth is based on the following assumptions:

1. The value of money in terms of goods is fixed.
2. All the individuals make rational choices.
3. There is perfect information about the returns on available alternatives of store of value.
4. The community's wealth has two components – the real goods and paper goods.
5. The monetary assets can be easily converted in to physical assets and vice versa.

9.8 EXAMINATION ORIENTED QUESTIONS

1. Critically analyse Tobin's Model of Money and Economic Growth.
2. Examine the introduction of monetary factors as a tool of stable economic growth if the economy moves away from the path of equilibrium.

9.9 SUGGESTED READINGS

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Mankiw, N. Gregory. *Macro Economics*. Seventh Edition. New York: Worth Publishers.

Thirlwal, A. P., *Growth and Development,* Palgrave

9.10 REFERENCES

Tobin, James (1961). Money and Growth. *Econometrica. 33* (4), 671-684.

Tobin, J. and D. Hester (eds.) (1967). *Studies of Portfolio Behavior,* Cowles Foundation Monograph No.20, New York: J. Wiley & Sons.

9.11 MODEL TEST PAPER

1. What do you mean by capital intensity?
2. Define Warranted rate of growth.
3. Define natural rate of growth.
4. Give various properties of monetary asset in Tobin's model of Money and Economic Growth.
5. Critically analyse Tobin's Model of Money and Economic Growth.
6. Examine the introduction of monetary factors as a tool of stable economic growth if the economy moves away from the path of equilibrium.

OPTIMAL GROWTH MODELS
RAMSEY'S THEORY OF SAVINGS

STRUCTURE

10.1 INTRODUCTION

Any growth model in the neo-classical framework starts from the usual statements of single sector economy where, the inputs of labour and capital

are transformed in output through a given production function which exhibits the constant returns to scale. But it may not reach the optimal solutions as it is being felt that people may be myopic in their saving decisions as Pigou has stated that people underestimate their future utility and therefore they do not make proper provision for their future wants and thus personally save less than they would have wished had they made the calculation correctly. In other words, due to this behaviour, the savings, as a whole, are less than what is "optimal". Yet in order to confirm that the rate of savings thrown up by a market system with myopic agents was indeed suboptimal, one must first determine what the optimal savings rate might be. This type of exercise was done by the Cambridge philosopher Frank P. Ramsey (1928) who tried to derive the "optimal rate of savings" for a society. He proposed an inter-temporal social welfare function and then tried to obtain the optimal rate of savings as the rate which maximized social utility subject to some economic constraints. In the Ramsey model there is a finite number of agents with an infinite time horizon; further, these agents are completely alike. The Ramsey model is thus also called a representative agent model.

10.2 OBJECTIVES

This lesson has the following objectives:

1. To determine the point of bliss for society as a whole and that of the individual members.
2. To find an optimal solution of division of income in consumption spending and savings.
3. To find this solution in case of individual who lives in a finite time.
4. To find the future utilities and disutilities at a discounted rate of time.

10.3 ASSUMPTIONS

Ramsey's model is based on the following assumptions

1. One infinitely-lived household that maximizes intertemporal utility.

2. Enjoyments and sacrifices at different times can be calculated independently and added.

3. The household receives wage income in exchange for its labour services and interest income for its accumulated assets.

4. The income acquired is directed in purchasing goods for consumption and in savings through the accumulation of additional assets.

5. Change in technology has no impact upon the savings of the households.

6. The distribution of income across the society remains constant.

7. Population growth rate is constant (equal to *n*) and it grows exponentially.

8. The economy consists of a large number of identical firms producing a homogeneous consumption good y.

9. The goods as well as the factor market is homogeneous in character.

10. Each firm uses a production technology $Y = F(K, L)$ that satisfies the neoclassical properties, and pays wages and rent in exchange for labour and capital services respectively.

11. *R* is the rental price for a unit of capital and '*r*' the net rate of return to capital equals $R-\delta = r$, with δ denoting the capital depreciation rate, because 'r' is the interest rate on loans to other households, which are perfect substitutes with capital.

12. Normal economic conditions under which the saving behaviour of the society remains constant.

10.4 THE MODEL

Taking $x(t)$ and $\delta(t)$ the total rates of consumption and labour of the community and $c(t)$ its capital at time 't'. Since, income is function of labour and capital, it can be written as $f(\alpha, c)$. Income at any point of time is equal to consumption plus savings, therefore,

$$\frac{dc}{dt} + x = f(a, c) \qquad ...(1)$$

Now, if total utility from consumption is denoted as U (x) and the disutility from labour as V(α) then the marginal utility and disutility will be u(x) and v(α) and are denoted as :

$$\mu(x) = \frac{dU(x)}{dx}$$

$$\upsilon(\alpha) = \frac{dV(\alpha)}{d\alpha}$$

Here, we must note that $u(x)$ is never increasing and $v(\alpha)$ is never diminishing. The net utility for a society is $U(x) - V(\alpha)$ which is an increasing function of 'c' up to a point as with more capital we can obtain more enjoyment. But after some time, it will stop increasing as the increment of capital may not enable the society to increase the income or leisure or the society has already reached the maximum conceivable rate of enjoyment. In either case a certain amount of capital leads the economy to a point of bliss. Therefore, enough must be saved to reach the point of bliss. To find this amount of savings, we must formulate a set of equations. First, the marginal disutility of labour at any time must be equal to the product of marginal efficiency of labour $\left(\frac{\partial f}{\partial a}\right)$ and marginal utility of consumption i.e. $u(x)$ at that time

i.e. $$\upsilon(\alpha) = \frac{\partial f}{\partial \alpha}\mu(x) \qquad ...(2)$$

Second, the advantage of consuming today must be equal to that of postponed consumption (or saving today) in future time period. If we take $\frac{\partial f}{\partial c}$ as the rate of interest (i.e. the marginal product of capital) it will increase consumption in future time period ($t+\Delta t$). The inter-temporal distribution of consumption requires that the utility today must be equal to the utility to be gained in future.

Hence,

$$\mu\{x(t)\} = \left\{1 + \frac{\partial f}{\partial c}\Delta t\right\}\mu\{x(t+\Delta t)\}$$

But as we know that the marginal utility from consumption always decline, therefore,

$$\frac{d}{dt}\mu(x(t)) = -\frac{\partial f}{\partial c}.\mu(x(t)) \qquad ...(3)$$

This equation shows that the marginal utility of consumption falls at a proportionate rate given by the rate of interest. Consequently, x continually increases until $\frac{\partial f}{\partial c}$ vanishes.

On the basis of these equations, it is easy to find the optimum point, provided we know the amount of capital at the time of origin (i.e. t=0). To solve these equations, we can proceed as follows :

$$\frac{d}{dx}\{\mu(x).f(a,c)\} = \frac{d\mu}{dx}.f(a,c) + \mu(x)\frac{\partial f}{\partial a}\frac{da}{dx} + \mu(x)\frac{\partial f}{\partial c}\frac{dc}{dt}\frac{dt}{dx}$$

$$= \frac{d\mu}{dx}f(a,c) + \upsilon(a)\frac{da}{dx} - \frac{d\mu(x)}{dt}\{f(a,c) - x\}\frac{dt}{dx}$$

Using equations (1), (2) and (3)

$$\frac{d}{dx}\{\mu(x).f(a,c)\} = x\frac{d\mu}{dx} + \upsilon(a)\frac{da}{dx}$$

Further, integrating by parts, we get

$\mu(x).f(a, c) = x\mu(x) - U(x) + V(a)$ + a constant K,

or $$\frac{dc}{dt} = f(a,c) - x = \frac{K - \{U(x) - V(a)\}}{\mu(x)} \qquad ...(4)$$

We know that the point of bliss (B) is defined here as the maximum obtainable net utility and is therefore the difference of utility from consumption and the disutility from labour. In simple terms, it may be written as

B = U(X) – V(a)

and, B – {U(X) – V(α)} measures the distance from the attainable point of bliss for any society. If we integrate it over time, then the target of any society is to minimise this distance with change in savings (or amount of capital) over the period of time.

i.e. minimise

$$\int_{c_0}^{\infty} \frac{B - U(x) + V(a)}{dc/dt} dc$$

Or

$$\int_{c_0}^{\infty} \frac{B - U(x) + V(a)}{f(a,c) - x} dc$$

Now, in order to get the minimum value of this distance function, its partial derivatives with respect to consumption i.e. '*x*' must be equal to zero. Therefore,

$$\frac{-\mu(x)}{f(a,c) - x} + \frac{B - U(x) + V(a)}{\{f(a,c) - x\}^2} = 0$$

Or

$$f(a,c) - x = \frac{B - (U(x) - V(a))}{\mu(x)} \qquad ...(5)$$

$\mu((x)\ \{f(a, c) - x\} = B - \{U(x) - V(a)\}$

In other words, the rate of savings multiplied by the utility of consumption should always equal bliss minus actual rate of utility enjoyed.

Now coming to the production sector, it has been assumed that returns to capital and labour are constant and independent. Thus, taking '*p*' as rate of wages and '*r*' as rate of interest,

$$f(a, c) = pa + rc$$

Further, here '*pa*' can be termed as earned income and '*rc*' as unearned income.

Since, '*p*' the rate of wages must be equal to the marginal productivity of labour i.e. $\frac{\partial f}{\partial a}$, equation (2) becomes

$$\nu(a) = \rho\mu(x)$$

which takes '*a*' as a function of '*x*' only. But the unearned income may also be used for consumption. The difference of actual consumption and that of the earned income may be termed as the part of the unearned income spent on consumption, here denoted as '*y*', hence,

$$y = x - pa = \text{consumption} - \text{earned income}$$

The marginal utility of consumption from unearned income (denoted as *w(y)*) can therefore be simply the difference of marginal utility from consumption and marginal disutility from labour i.e. $w(y) = u(x) - v(a)$ and the total utility from the consumption from unearned income (*W(y)*) is

$$W(y) = \int w(y)\,dy = \int \{\mu(x)\,dx - \nu(a).da\}.dy = U(x) - V(a)$$

However, the difference of total unearned income i.e. '*rc*' and the part of it used for consumption i.e. '*y*' is equal to total savings. Hence,

$$rc - y = f(a, c) - x$$

Adjusting the equation (5) as utility from consumption from the unearned income, we can derive the following relationship

$$rc - y = f(a, c) - x = \frac{B - W(y)}{w(y)} \qquad ...(6)$$

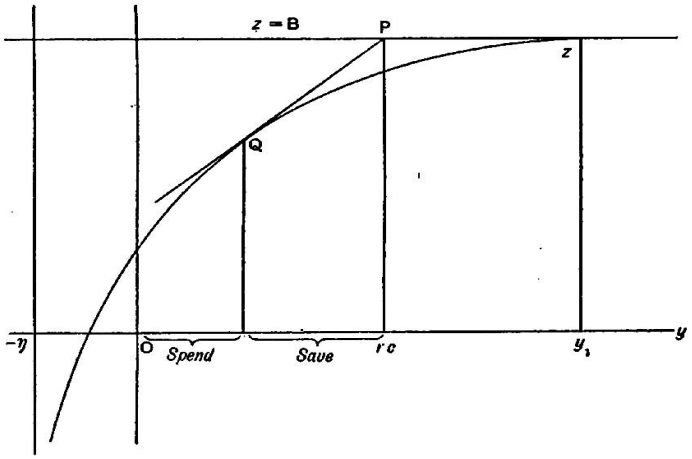
Or

$$B - W(y) = \frac{dW}{dy}(rc - y)$$

In this equation, *w(y)* has been substituted with $\frac{dw}{dy}$.

In order to determine how much of a given unearned income '*rc*' should be saved, let us look at the figure 1.

Figure 1



Source: Ramsey (1928).

In this figure, Z is the total utility curve from consumption from unearned income. At the point of bliss, where Z=B, the point P shows (*rc, B*), drawing a tangent line from point 'P' on curve 'z' which shows how much of the unearned should be spent and how much of it can be saved. We can observe that a certain proportion of this curve also falls in negative axis which shows that not

only whole of the unearned income is saved but a part of earned income also goes in to savings. By drawing a tangent we can easily find how much of a given amount of income should be saved, but it does not tell us what our income will amount to after a lapse of time. This can be obtained from equation (3) which may be rewritten as

$$\frac{d}{dt}w(y) = -rw(y)$$

Or

$$w(y) = Ae^{-rt} \qquad ...(7)$$

Where, $A = w(y_0)$ and y_0 is the value of y for t=0. Now, in order to find the time taken in accumulating a capital 'c' from initial capital c_0, we have to know about all the values at the time of origin i.e. P_0 and rc_0 and if we have taken the values at 'P' as (rc, B) then values at P_0 will be (rc_0, B); w(y) is the slope of tangent from 'P' then $w(y_0)$ will be the slope of tangent from the point 'P_0'. The time taken to accumulate the required amount of capital will be

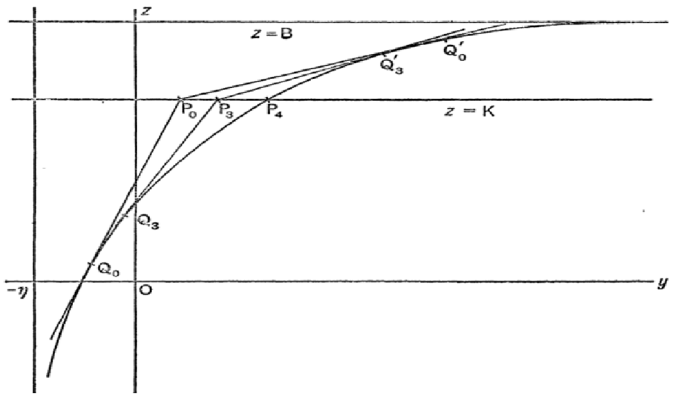
$$\frac{1}{r}\log_e \frac{w(y_0)}{w(y)} = \frac{1}{r}\log_e \frac{\text{slope of tangent from } P_0}{\text{slope of tangent from P}}$$

Similarly, we can also find the solution for an individual who lives for a finite time period in contrast to the society which lives forever. For this purpose, let us rewrite equation (4) in terms of utility from consumption from unearned income.

$$rc - y = \frac{K - W(y)}{w(y)} \qquad ...(8)$$

In case of the individual, the maximum attainable utility i.e. K can not be simply taken as equal to B, rather its optimal value has to be determined in case of an individual. This can be understood with help of figure 2.

Figure 2



Source: Ramsey (1928).

In the figure, the society's total utility curve Z, finds its point of bliss at Z=B, while the individual with a definite life time, finds himself/herself at line Z=K. Let us assume that the individual in question starts from P_0 with rc_0 unearned income and ends at P_3 with unearned income rc_3. However, the line Z=K meets the 'Z' curve at P_4. From these points we can draw tangents both in the upward as well as downward direction which will give us various combinations of savings and consumption from the unearned income for different stocks of capital. The figure shows if $c_3>c_0$ (taken as the abscissa on K), the value of y_0 will be greater than y_3, as shown by the upper tangent, which is impossible as 'y' continually increases. Therefore, we can take only the lower tangent of P_0. Ramsey further states as the individual moves from, P_0 to P_3 then it moves from Q_0 to Q_3 and there will be savings all the time. This happens if 'T', i.e. the perceived life span of an individual is small but if 'T' is very large, the individual may move from P_0 to P_4, then may shift back to P_3 indicating that there will be savings first and then splashing. Further, in order to determine the value of 'K' following ratio must be used. This ratio will not only determine the value of 'K' but also that which particular tangent – the lower or the upper one should be used?

$$\frac{\text{slope of tangent taken from } P_0}{\text{slope of tangent taken } P_3} = \frac{w(y_0)}{w(y_3)} = e^{rT}$$

10.5 DISCOUNTING THE FUTURE UTILITIES

It is but normal that people assign greater value to present than future. This time preference requires that the future utilities and disutilities must be discounted at a given rate and should not be considered equal to present ones. The time rate of discount on utility is taken here as less than the rate of interest. If we take a constant rate of discount as ρ and rate of interest as '*r*', the equation (3) becomes

$$\frac{d}{dt}\mu(x) = -\mu(x)\left\{\frac{\partial f}{\partial c} - \rho\right\}$$

$$= -\mu(x)\,(r - \rho) \qquad \ldots(9)$$

Similarly, equation (7) can also be rewritten as

$$w(y) = \mu(x) = Ae^{-(r-p)t} \qquad \ldots(9a)$$

While the equation $rc - y = \frac{dc}{dt}$ which shows the increment in savings, can also be rewritten as

$$rc - y = \frac{dc}{dt} = \frac{dc}{dw}.\frac{dw}{dt} = -(r-\rho)\,w\frac{dc}{dw}$$

Or $rc - y = -(r-\rho).w.\frac{dc}{dw}$

i.e. $\frac{dc}{dw} = -\frac{rc - y}{(r-p)w} = \frac{-rc}{(r-p)w} + \frac{y}{(r-p)w}$

$$\frac{dc}{dw} + \frac{rc}{(r-p)w} = \frac{y}{(r-p)w}$$

Equation (8) can also be rewritten in terms of discounted marginal utility and by substituting total utility *W(y)* as sum of (i.e. integral) of marginal utilities [i.e. *w(y)*] discounted at give rate of discount. Therefore, equation (8) becomes

$$rc - y = \frac{K - \int_b^y w^{r/(r-\rho)}(y)\,dy}{w^{r/(r-\rho)(y)}} \qquad ...(10)$$

Thus, in this equation we have the modified utility of an individual, which is discounted at the given time rate of discount and a given rate of interest. This indicated by taking marginal utility to the power $r/r-\rho$. This has the effect of accelerating the decline in marginal utility and declining effect of high incomes. Thus the discounting of future also becomes the same thing as discounting of high incomes. The rate at which this is done depends upon the values of 'ρ' and '*r*'. In this equation 'K' is the 'modified bliss' of an individual. 'K' is also the maximum value of modified utility i.e. $\int_b^y \frac{r}{w^{r-p}}(y)dy$. Thus, in above equation 'y' increases until bliss is reached and therefore *dc/dt* i.e. *rc-y* is never negative. The solution of this equation will give us the optimal rate of savings for an individual with finite life time. Here, we have assumed that '*r*' is greater than 'ρ' but if '*r*' is less than 'ρ', then the marginal utility of consumption will rise at a rate 'ρ-*r*', and the consumption will fall towards the barest subsistence level at which the marginal utility may be taken as infinite. During this process, since '*r*' is lower than 'ρ', all capital will be exhausted and debts incurred to the extent to which credit can be obtained.

10.6 DETERMINATION OF RATE OF INTEREST

For finding equilibrium rate of interest, we can consider three separate cases. Firstly, let us assume that every one discounts its utility at a constant rate 'ρ' for themselves as well as their heirs, then in state of equilibrium there will be no savings and change in consumption is equal to the change in savings i.e.

$$\frac{dx}{dt} = \frac{dc}{dt} = 0$$

And x = f(a, c)

The marginal disutility from labour is just equal to the marginal utility from consumption multiplied by marginal productivity of labour i.e.

$$\nu(a) = \frac{\partial f}{\partial a}\mu(x)$$

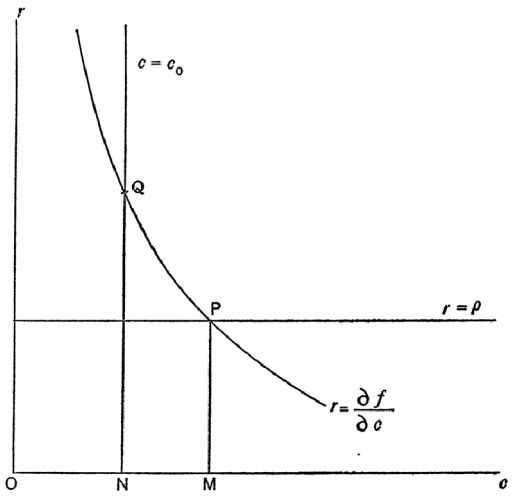
Further, the marginal productivity of capital must be equal to the time rate of discount i.e.

$$\frac{\partial f}{\partial c} = \rho$$

Now for solving these equations we need to determine the values of '*x*', '*a*' and '*c*'.

If rate of interest is taken as a determinant of demand for capital as well as the supply of savings, in figure 3, we can show the demand curve as $r = \frac{\partial f}{\partial c}$ while two types of supply curves can be taken. Firstly, the short period supply curve or the supply of capital at a given point of time is determined by the availability of capital at that point of time. This is shown by the curve $C=C_0$, termed as temporary supply curve by Ramsey. In long period people discount the future rates at ρ and weigh the rate of interest with the rate of discount. Therefore in the long run savings will by supplied only if $r= \rho$. Hence, the ultimate supply curve is shown by $r= \rho$. It is clear that at any point of time, the rate of interest is determined directly by the interaction of the demand curve and the temporary supply curve at QN but ultimately it settles at PM on the long run supply curve at which $r= \rho$.

Figure 3



Source: Ramsey (1928).

Secondly, we can also take the case when different people discount future utility at different rates, and do not take into account the utility of future generations i.e. their heirs. They take care of their own current and future utility and consume whole of their savings throughout their life time. Under such conditions, rate of interest will ofcourse be equal to the demand price as well as the supply price of capital. If we assume a constant rate of interest equal to '*r*', then the individuals will save more when young for whom $r > \rho$, in order to provide for loss of earning power in old age and they will spend these savings in later years of their life. If people perceive $p > r$, they will have the tendency to borrow when young and pay it back in old age. We can obtain the total supply curve of capital by adding together the supplies of each category of the individuals and can obtain a definite supply price to be equated with its demand price.

Lastly, taking the case of families rather than individuals where the families would be living forever as compared to the individuals who have a

definite life time. The families may discount their future utilities at a constant rate but this rate of discount may differ from family to family. Assuming labour supply to be fixed, total output of the economy can be considered as a function of capital only i.e. *f(c)* and rate of interest as *f´(c)*. Further, assuming that an individual can attain maximum conceivable utility with a finite income x_1 and that no one can support life on income less than x_2. In such a case, the families in the society can be obtained by dividing the society in to two classes, the thrifty enjoying the bliss and the spendthrift at the subsistence level. If we take 'n' as total number of families, the former category, let us take *m(r)* in number, will have a total income equal to *m(r)*. x_1 while the other category '*n-m(r)*' in number would be at subsistence and its total income will be [*n-m(r)*]. $x_{2.}$

Hence, total income in the society will be

$$f(c) = m(r)x_1 + \{n - m(r)\}x_2$$

$$n.x_2 + m(r)\{x_1 - x_2\},$$

which, together with *r= f´(c)* will determine equilibrium rate of interest '*r*' as well as the amount of capital '*c*' at the equilibrium level.

10.7 SUMMARY AND CONCLUSIONS

In this chapter we have discussed the Ramsey's model of optimal growth which aims at achieving the optimal point of bliss for the society as a whole. The achievement of the point of bliss depends upon the marginal utility of consumption and marginal disutility of labour. The process of growth depends upon the availability of savings i.e. how people allocate their income between consumption and spending. This allocation and the long run availability of capital is not a decision of a single point of time rather, it is an inter-temporal decision which would further depend upon the time rate of discount in relation to the prevailing rate of interest. Thus, the optimal growth rate seeks to find

the solution for equilibrium values of output, consumption, savings, their respective marginal utilities, the rate of interest and time rate of discount as well as the point of bliss of the individuals. Thus, this model aims at deriving the inter-temporal conditions that are satisfied on the optimal consumption path to be chosen by a central planner.

10.8 GLOSSARY

(i) **Abscissa**: (in a system of coordinates) the distance from a point to the vertical or *y* -axis, measured parallel to the horizontal or *x* -axis; the *x* -coordinate.

(ii) **Disutility:** In simple terms, the disutility can be understood as harmful effects associated with a particular activity or process. This may also be understood in terms of sacrifices made or sufferings borne for that activity or the process.

(iii) **Splashing**: In this lecture splashing refers to spending on goods lavishly or extravagantly.

(iv) **Utility:** In simple terms utility is the use value of a commodity or a set of commodities or other variables in question.

10.9 SHORT ANSWER TYPE QUESTION

Q 1. Give a brief idea of Ramsey's Model of Optimal Growth.

Ans. Ramsey's model of Optimal Growth aims at achieving the optimal point of bliss for the society as a whole. The achievement of the point of bliss depends upon the marginal utility of consumption and marginal disutility of labour. The process of growth depends upon the availability of savings i.e. how people allocate their income between consumption and spending. This allocation and the long run availability of capital is not a decision of a single point of time rather, it is an inter-temporal decision which would further depend upon the time rate of discount in relation to the prevailing rate of interest. Thus, the optimal growth rate seeks to find the solution for equilibrium values of output,

consumption, savings, their respective marginal utilities, the rate of interest and time rate of discount as well as the point of bliss of the individuals.

Q 2. What are the main assumptions of Ramsey's Model?

Ans. Ramsey's model is based on the following assumptions

1. One infinitely-lived household that maximizes intertemporal utility.
2. Enjoyments and sacrifices at different times can be calculated independentlyand added.
3. The household receives wage income in exchange for its labour services and interest income for its accumulated assets.
4. The income acquired is directed in purchasing goods for consumption and in savings through the accumulation of additional assets.
5. Change in technology has no impact upon the savings of the households.
6. The distribution of income across the society remains constant.
7. Population growth rate is constant (equal to n) and it grows exponentially.
8. The economy consists of a large number of identical firms producing a homogeneous consumption good Y.
9. The goods as well as the factor market is homogeneous in character.
10. Each firm uses a production technology $Y = F(K, L)$ that satisfies the neoclassical properties, and pays wages and rent in exchange for labour and capital services respectively.
11. R is the rental price for a unit of capital and 'r' the net rate of return to capital equals $R-\delta = r$, with δ denoting the capital depreciation rate, because 'r' is the interest rate on loans to other households, which are perfect substitutes with capital.
12. Normal economic conditions under which the saving behaviour of the society remains constant.

Q 3. What do you mean by point of Bliss?

Ans. The point of bliss (B) is defined here as the maximum obtainable net utility and is therefore the difference of utility from consumption and the disutility from labour. In simple terms, it may be written as

$$B = U(X) - V(a)$$

Here, '*x*' refers to consumption and '*a*' stands for labour inputs.

Q 4. What do you mean by earned income and unearned income in Ramsey's Model?

Ans. In Ramsey's Model, the earned income refers to income from labour while the unearned income refers to income earned from capital. Total income in the economy can be divided in to earned income and unearned income.

Taking '*p*' as rate of wages and '*r*' as rate of interest,

$$f(a, c) = pa + rc$$

Here '*pa*' can be termed as earned income and '*rc*' as unearned income.

10.10 EXAMINATION ORIENTED QUESTION

1. Critically analyse Ramset's Model of optimal growth.
2. Compare the determination of point of bliss for a society with infinite life time and the individuals with finite life time.
3. Discuss determination of rate of interest by taking into account various categories of individuals with different type of responses to time rate of discount.

10.11 SUGGESTED READINGS

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10.13 MODEL TEST PAPER

I. Answer the following in brief.

1. Give a brief idea of Ramsey's Model of Optimal Growth.
2. What are the main assumptions of Ramsey's Model?
3. What do you mean by point of Bliss?
4. What do you mean by earned income and unearned income in Ramsey's Model?
5. What do you mean by time rate of discount? Show the discounted utility of individuals as well as the society as a whole.

II. Answer the following in detail

1. Critically analyse Ramsey's Model of optimal growth.
2. Compare the determination of point of bliss fo r a society with infinite life time and the individuals with finite life time.
3. Discuss determination of rate of interest by taking in to account various categories of individuals with different type of responses to time rate of discount.
