M.A. (ECONOMICS) PART-I **PAPER : ECO-104**
SEMESTER-I

ECONOMICS OF GROWTH AND DEVELOPMENT

SECTION- B

BOTH MEDIUM

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SECTION- B

2.1 : Domestic and External resources for development.
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M.A. (Economics) Part-I **ECO – 104**

Semester - I **Economics of Growth and Development**

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DOMESTIC AND EXTERNAL RESOURCES FOR DEVELOPMENT

Lesson Plan

2.1.1 Introduction

Most LDCs depend upon domestic resources for their development. However, even though labour may be abundant, the output of an LDC remains limited by a shortage of capital. LDCs must make efforts to mobilize and achieve effective use of their internal resources. However, domestic saving and investment for development has to be supplemented by various types of foreign resources inflows. It is also important that transfers to poor countries contribute to more employment and greater equality.

2.1.2 Objective of the lesson

The objective of the present lesson is to examine the various sources of domestic and external resources for development. The advantages and drawbacks of these resources will also be examined.

2.1.3 Domestic Resources for Development

Domestic resources are very important for the development of less developed countries (LDCs). In domestic resources, we shall chiefly be examining the role of monetary, inflationary, and fiscal policies in financing growth.

2.1.3.1 Role of Monetary Policy in Economic Growth

In LDCs, where savings and investment habits leave much to be desired, a well developed money market can efficiently allocate resources. It can establish equilibrium between demand for and supply of funds, ensure safety of financial assets, and also promote liquidity. A developed money market not only encourages financial mobility, but also plays a crucial role in implementing the monetary policy.

The problem in LDCs is that there is a dualism in money market, i.e. there is the presence of unorganized sector along with the organized sector. This presence of the unorganized sector leads to restricted use of cheques, growth of different types of instruments of credit, reduces bank credit, and restricts the volume of monetary transactions. This deprives the economy of financial assets which could have been saved and invested for raising the level of development.

Monetary expansion, thus, is needed to aid the growth of LDCs. Ghatak has listed some arguments as to how this can be done. First, money replaces barter transactions which are wasteful and time consuming, to strike the right balance between demand and supply. Second, money, as a medium of exchange, is capable of inducing specialization and increase productivity. Third, to match increasing output and the demand for money in a developing country, it is necessary to increase money supply. Fourth, real resources will be released if barter transactions are replaced by monetary transactions and this will promote growth. Increasing monetization requires growth of banking and credit institutions, which in turn promotes saving, investment and growth. Fifth, money is the store of value, and so the government can incur public debt and provide alternative channels to mobilize enough saving to achieve equality between the natural and the warranted rate of growth of capital.

Empirical evidence from some Latin American and Asian countries shows a positive and significant correlation between money supply and real output growth. For the LDCs, there exists evidence of a positive and significant relationship between the ratio of investment to income and growth of per capita income. Evidence also suggests that if saving is

treated as a function of income, then it is possible to find a positive and significant relationship.

Hence, there is a relationship between monetary expansion, saving, investment and economic growth. However, an expansionary monetary policy in LDCs could be inflationary beyond a certain level, given the supply inelasticities. We can now have a look at the impact of inflationary finance on growth.

2.1.3.2 Inflation and Economic Growth

Inflation can raise revenues, given certain assumptions regarding demand for money. LDCs can use inflation as a major tax to finance their public expenditure to promote economic development. This can be done when tax revenue as a proportion of GNP is low, and tax elasticity with respect to income is not always greater than unity. Also, by increasing profitability of industries, inflation can provide incentives to investment. There will then be less need for foreign resources. Inflationary financing can also promote growth of banks and other financial institutions, thereby encouraging public to hold more financial assets which in turn will release real resources for growth.

However, there is a negative side to inflation also. Inflation can distort efficient allocation of resources and reduce real growth. High inflation will reduce a country's competitive power in the export market. This will particularly be true in case of countries suffering from a chronic balance of payments deficit. Inflation can also lead to unequal distribution of income – in favour of profits rather than wages – and lead to public hostility. A high level of inflation can shake people's confidence in the currency of their country, and they might prefer holding physical assets rather than financial assets, which will be detrimental for growth. Ghatak thus argues for only a mild degree of inflation to promote economic growth.

Empirical evidence for LDCs has shown that although inflation has a positive effect on saving, but this impact is insignificant. The relation between inflation and investment appears to be positive and significant. However, inflation beyond a certain rate is bound to adversely affect investment, rate of exchange, balance of payments and unemployment.

Further, inflation tax is feasible in many LDCs, but inflation can have an adverse impact on allocation of resources in LDCs. The desirability of inflation thus depends on whether the effect of inflation on resources mobilization is greater than its impact on efficiency. A change in

financial structure of LDCs is thus an important factor in promoting economic growth. A realistic policy of financial reform is called for to promote real saving growth and employment in LDCs. Again, it should be kept in mind that financial liberalization can boost economic growth only if it is supported by appropriate and prudent macroeconomic stabilization policies and sound financial institutions.

Let us now turn to the role of fiscal policy for promoting economic growth.

2.1.3.3 Fiscal Policy and Growth

In LDCs, the major goals of fiscal policy are:

(i) to raise revenue for the government;
(ii) to stabilize prices;
(iii) to promote economic growth by mobilizing surplus;
(iv) to promote foreign investment;
(v) to change the pattern of income distribution in accordance with social objectives;
(vi) to minimize adverse effects on resource allocation.

To achieve the above goals, the governments resort to taxation, expenditure and deficit finance. In the classical period, it was believed that the best principle of government finance was to tax little and spend little. This view has altered with the development of balanced budget multiplier (BBM) which states that if the tax and expenditure by the governments rise, national income will also rise by the same amount. The BBM theory has its limitations in that it assumes a constant marginal propensity to consume, and bottlenecks on the supply side poses a problem for a one-to-one correspondence between changes in taxes and expenditure and changes in income. Even within these limitations, however, the BBM theory implies that without a budget deficit, income could be expanded only if the budget size is large enough.

Turning to **deficit financing**, it is tempting for LDCs to adopt it, given the inability to the governments to mobilize adequate resources for growth, unreliability of foreign investment and lack of tax elasticity. For deficit financing to be effective, the supply of output must be elastic with respect to demand, otherwise inflation can occur. To realize the benefit of deficit financing, it is necessary to examine the costs of inflation vis-a-vis the possible gains in resources mobilization. The costs include: (a) distortions in real rates of return; (b) inefficiency in allocation; (c) inequalities in income distribution; and (d) increase in imports and

unemployment. On the other hand, the possible gains are: (a) stimulus to profitability and investment; (b) greater utilization of capacity because of increased demand and (c) consequent lowering of the costs of production; (d) larger investment provided that private investment was not forthcoming. It is also argued in favour of deficit financing that if an increase in money supply can stimulate growth, then deficit financing can be tolerated. Also, if income distribution becomes more unequal because of deficit financing, then a rise in profit share will stimulate investment. But growth is likely to suffer in case the profits are not reinvested. In addition, government can resort to deficit financing for generating savings in the absence of private savings.

Thus, deficit financing, generating a moderate rate of inflation, may help to promote growth.

So far as **taxes** are concerned, the tax structures of most LDCs are narrowly based, inelastic with respect to changes in income and greatly dependent upon indirect rather than direct taxes. In such a case, if fiscal policy is to play a role to promote revenue, growth and stability, it is necessary that the tax base should be broadened, that the tax revenue should be more elastic with respect to income (for example, a one per cent increase in income should lead to a more than one per cent rise in taxes) and that there should be relative expansion of the role of direct taxes in comparison with indirect taxes.

The major direct taxes in LDCs consist of income tax, corporation tax, wealth tax and property tax. The proportion of direct taxes in total tax is much lower than that of indirect taxes in LDCs. To widen the tax base, Kaldor had suggested the imposition of expenditure tax in addition to wealth tax, gift tax and property tax. Expenditure tax implies a tax on spending (income minus saving).

Indirect taxes in LDCs usually consist of sales taxes, excise taxes and custom duties. In addition, there are tariffs on imports, value added tax and payroll taxes. Indirect taxes are generally borne by consumers. LDCs heavily depend on indirect taxes because, as compared to direct taxes, the revenue that could be raised by indirect taxes is likely to be greater. Also, indirect taxes are less difficult to collect and easy to administer. Although indirect taxes do not always satisfy the principle of equity or ability, most LDCs continue to bank upon them.

The VAT (value added tax) has been advocated as a more desirable indirect tax than sales tax. It is argued that VAT is superior to other

forms of sales tax because it is neutral among different types of organization of production and distribution whereas sales tax applies to every stage of sale of the product and could thus increase vertical integration among firms. Also, while sales tax discriminates in favour of imports compared with home produced goods, VAT has a neutral effect on imports and home production. If LDCs strongly desire import substitution via large scale import of capital goods, then the case for VAT becomes stronger. Thus, if LDCs have to rely on indirect taxes for earning revenue, then VAT merits consideration.

Apart from domestic resources, foreign resources and trade also play an important role in financing economic development of LDCs. Let us now examine the role of external/foreign resources.

2.1.4 External/Foreign resources for development

It is generally argued that foreign resources can play a vital role in promoting economic development in the LDCs. Foreign capital has played a significant role even in today's advanced countries like Japan and the United States.

To examine the role of foreign resources in economic development, we will study the concept of foreign resources, the criteria for distribution of foreign resources and then the different types of foreign resources and their role.

2.1.4.1 Concept of foreign resources

The flow of foreign resources can be of many types:

There are institutions which provide **grants** to countries to overcome the after-affects of natural calamities such as floods, famines or earthquakes. These grants are non repayable and carry no rate of interest. Such grants are aids in the true sense of the term. Second, there are **loans** given by international lending agencies such as the World Bank. These loans carry a low interest rate. Where such loans are granted to LDCs at concessional rates for a very long periods of time, the inflow of foreign resources takes on the character of genuine foreign aid. Third, there is **foreign private investments** in LDCs, which carry commercial rates of interest. These form a significant proportion of the total flow of foreign resources. Then there is **government lending** which is carried out on bilateral or multilateral basis. Several governments can also form a consortium to provide resources to a country. Although such lendings are usually provided at concessionary rates and have a long

repayment period, but sometimes these are also provided at commercial rates and terms. Thus, all foreign resources do not amount to just aid or charity.

2.1.4.2 Distribution of foreign resources

There are various criteria for allocation of foreign resources. Some of these are:

(i) **Political reasons**: Politically, foreign resources may be provided to 'friendly' countries in the form of aid.

(ii) **Saving gap**: Foreign resources are also for replenishing the dearth of domestic savings in LDCs. In many countries, a target level of investment is specified to achieve a certain rate of growth of income, and estimates of planned savings are drawn. In case the planned investment exceeds planned savings, the gap is sought to be filled by foreign resources. However, there is also the possibility of a foreign exchange/trade/bottleneck gap along with the saving gap. Where trade gap predominates over savings gap, foreign resources can have a positive effect on growth. Hence an estimation of the two gaps is essential.

(iii) **Absorptive capacity**: Absorptive capacity means a country's ability to absorb capital and use it in a productive way. It depends on the level of income and its growth rate, the supply of skill and the level of average and marginal rates of savings. In foreign resources are to be used to step up the process of capital formation in LDCs, then it is more likely to be met in those LDCs where marginal rates of savings are much higher than the average.

(iv) **Historical factors**: Historically seen, much of foreign resources have flowed from countries to their former colonies.

(v) **Efficiency criterion**: It is opined that foreign resources should be distributed on the basis of their most efficient use. For this, it is necessary to construct a sound index of efficiency. Also, achievement of efficiency could lead to the sacrifice of some other objectives, say employment, or equal distribution of income.

(vi) **Stability**: Stability in prices and trade balances has been regarded as an appropriate criterion for allocating foreign resources, particularly by organizations like the IMF (International Monetary Fund).

(vii) Thus, it can be concluded that it is difficult to find an appropriate criterion for foreign resources allocation. A clear picture of different types of growth paths with foreign resources and their implications regarding inter-temporal saving and consumption for different generations, can provide a guide line.

2.1.4.3 Types of foreign resources:

Foreign resources can be of various types. These can be divided as:

(i) **Tied and untied foreign resources**: Foreign resources can be tied by source (e.g. tied to the imports from donor countries) or by end use (e.g. linked to a specific project). It helps donor countries protect their income and employment. It can also increase pressure in surplus donor countries to similar tying. Tying is also supposed to result in efficient utilization of resources. It enhances the reputation of donor countries.

However, from the recipient country's point of view, tying does not help them to obtain resources at the cheapest prices. In the event of tying both by source and end use, the monopolistic position of the lender may result in a less than optimal situation for the recipient country. Also, costs of tying of resources are considerable. Resources may be tied to the construction of a specific project which does not satisfy the objective of the national plan of the recipient country.

Hence, it has been recommended that all resources should be untied as to their source. Greater co-ordination among the donor countries is necessary for untying foreign resources. However, there is a lack of concerted effort among the economically advanced countries for untying of foreign resources.

(ii) **Foreign resources for projects or plans**: Foreign resources are sometimes given to a particular project in LDCs. It has already been mentioned above that such resources may not promote the basic objective of the national plan of the recipient country. Donor countries may reveal their preference for financing the projects rather than the plans if the national plans are likely to be revised suddenly with frequent changes in the government. Also, if the resources given by the donor country form a small proportion of planned investment, project financing could be considered as more attractive than the financing of the plan. On the other hand, financing of the plan has the advantage of generating greater effort in the recipient country. Plans are supposed to achieve the overall

development of the country and their financing is regarded as preferable by recipient countries. But nowadays very few countries allow projects to be set up without analyzing their impact on the national plan.

(iii) **Bilateral and Multilateral financing**: The bilateral flow of foreign resources is advocated over multilateral finances on the ground that the donor country can keep operational control with less difficulty, there is more effective utilization of foreign resources, and that it is more acceptable to the electorate.

The major drawbacks of bilateral financing is that it is not always meant for the economic development of the country as very often, strings are attached to it, and is generally used to extend political influence over LDCs.

On the other hand, multilateral financing, if properly co-ordinated, can eliminate the inefficiencies in the use of resources. Also, debt servicing can be better tackled if financing is multilateral. But multilateral financing is unlikely to be optimum because there is absence of co-ordination among different donors and between donors and recipient countries. Also, absence of skilled manpower aggravates the problem. If a single agency is formed, then donors may be less willing to contribute to a single international agency and this could reduce the flow of resources.

(iv) Foreign direct investment (FDI) and multinational corporations (MNCs) : Another major source of development finance is private capital flows which allow countries to import more than they export and to invest more than they save. FDI is one major source of private capital flows. There has been a vast increase in the amount of FDI going to LDCs, fuelled by MNCs. FDI brings advantages to the recipient countries by raising the investment ratio above the domestic savings ratio. The investment brings with it knowledge, technology and management skills. It also acts as a catalyst for domestic investment in the same or related fields. A great deal of FDI goes into the tradable goods sector of the recipient countries, which improves the export performance of these countries and earns them foreign exchange. Recent research shows a positive relation between FDI, domestic investment, and growth of GDP.

On the other hand, it is pointed out that investment by MNCs with headquarters in developed countries involves not only a transfer of funds (including reinvestment of profits) but also a whole package of physical capital, techniques of production, products and business practices. But it is doubtful whether such investment contributes to the broader aspects of development relating to pattern of development and the distribution of income. MNCs tend to widen income gap, encourage and manipulate consumption thereby reducing domestic saving. They may introduce inappropriate technology and retard the development of indigenous capital goods industry. Worse, developing countries in which they operate might lose control over economic policy. Thus, developing countries must lay down very clearly the conditions under which they will accept multinational investments. They must monitor the companies' operations to avoid exploitation and distorted development.

(v) **Linking Special Drawing Rights (SDRs) to development**: SDRs, created by IMF, can be linked to aid development projects at a minimum cost. It would enable LDCs not to resort to painful adjustment procedures (deflation, unemployment) to rectify persistent difficulties in their balance of payments. It will also ensure a smooth long-term flow of development finance along with global growth of output and trade. This can also avoid delays in bilateral negotiations.

(vi) **Foreign aid**: Foreign aid can raise both consumption and investment in a developing country. It can increase domestic economic growth by supplementing domestic savings and releasing the constraint on foreign exchange reserves. However, the impact of foreign aid on overall economic growth rates of LDCs depends on the effective use of aid, the rates of return on investment, the nature of infrastructure and availability of physical human capital.

2.1.5 Summing up

Development requires investment, and saving is necessary to fund investment. Domestic saving and investment for growth and development can be supplemented by various types of foreign resource inflows. LDCs must make additional efforts to mobilize and achieve effective use of their internal resources. Along with this, mobilization of external resources, especially longer term resource flows to developing countries are equally important.

2.1.6 Questions for Practice

Long Answer Type

(i) Discuss the role of fiscal policy in economic development.
(ii) Discuss role of monetary expansion in promoting economic growth.
(iii) Discuss the criteria for distribution of foreign resources.
(iv) Discuss the types of foreign resources.

Short Answer Type

(i) Briefly give the concept of foreign resources.
(ii) What are tied and untied foreign resources?
(iii) Write a brief note on VAT as a desirable tax for earning revenue.
(iv) Very briefly give the criteria for distribution of foreign resources.

2.1.7 Suggested Readings:

Note: This lesson is a highly abridged and simplified version of two chapters of Ghatak's book mentioned below. The students would do well to study the original chapters for a detailed study of the subject.

1. Subrata Ghatak: Introduction to Development Economics (Chapters 5 and 6).

2. A.P. Thirlwall: Economics of Development.

3. Gerald M. Meier: Leading Issues in Economic Development.

M.A. (Economics) PART I **PAPER-ECO-104**

Semester I **Economics of Growth and Development**

Lesson No. 2.2 **Author : KANWALJIT KAUR GILL**

THEORY OF DEMOGRAPHIC TRANSITION

Structure :

1. Introduction

Economic Development results in transformation not only of an economy but also of the society in general. When a country develops from a pre-industrial to an industrialised economic system, it has an impact on overall standard of living of the masses. To maintain that high standard, there is a general tendency to limit the family size. Ultimately, a stage comes when birth is very low and death rate is at its lowest, natural level. The level of population also comes down from high expanding to lower stationary stage. Human population stabilises at lower level at higher level of economic development. This is known as the demographic transition. What are causes of this transition, How society acts and reacts to various dimensions of economic development, etc. all this will be discussed in this lesson.

2. Objectives of the lesson

After going through this lesson you will be able :

- to define the concepts related with demographic transition.
- to identify causes of this transition;
- to have an idea about the classicals and modern interpretation of demographic transition; and
- to know about demographic transitional behaviour of your own country i.e. of India.

3. Concept of Demographic Transition

This concept is related with level of change in birth rate and death rate. As a country develops from a low level of pre-industrial, to a high level of industrialised, economic stage, high birth rate and death rate come down to low birth and death rate. **This transition in birth and death rate due to economic development is known as Demographic Transition**. In other words we can say that demographic transition explains population change over time due to change in birth and death rate.

While explaining the **Demographic Transition** we use different demographic variables. These variables are birth rate, death rate, infant mortality rate, maternal mortality rate including migration. These are also known as **Vital Statistics**. Let us have a brief idea about all these demographic variables first, then we will discuss its relationship with population growth which ultimately will explain stages of demographic transition.

3.1 Demographic Variables: Concepts

- **Crude Birth Rate** : Annual number of births per 1,000 population.
- **Crude Death Rate**: Annual number of deaths per 1,000 population.
- **Infant Mortality Rate**: Annual number of deaths of infants under one year of age per 1,000 live births.
- **Total Fertility Rate** : Average number of children that would be born to a women, if she experiences the current fertility pattern throughout her reproductive span i.e. 15-49 years.
- **General Fertility Rate**: Number of live births per 1,000 women in the 15-49 years age group in a giver year.
- **Maternal Mortality Rate** : Number of deaths of mothers during delivery (giving birth to the baby) per 1,000 in a given year.
- **Life Expectancy** : Average number of years a new born child is expected to live under current mortality conditions.

Self Check Exercise-1

(i) What do you understand by the concept of demographic transition.

(ii) Differentiate between General Fertility Rate and Total Fertility Rate.

4. Economic Development and Demographic Transition :

Demographic transition is explained by the behavioural magnitudenal change in birth and death rate influenced by process of economic development. Both these birth and death rate influence the population growth rate. Hence there becomes direct link between population growth, economic development and demographic transition. Population size, age, sex composition and spacial distribution as determined by birth and death rate, changes the demand for consumption and capital goods on one hand and generates supply of labour on the other. This raises the general level of income of the masses and their economic and social status. Overall development affects negatively both fertility and mortality rate, (through health and other medical facilities) and ultimately the overall population of the country.

There is two way relationship between economic development and population growth. These are, infact, interdependent variables. Population acts as a stimulant, to economic development at the same time it acts as an obstacle too.

Traditional Malthusian concern was that population growth will sooner or later run against the earth's stock of finite natural resources. In '**The limits to Growth Club**' of Rome, researchers build the hypothesis that, 'the pace of technological change would be insufficient to overcome supplies of essential resources. Population growth in developing economies creates problem to

economic development through its negative influence on savings per capita, capital formation and excessive demand for consumer and capital goods, which sometimes become unmanageable to comply with. In the wake of growing population other problems like unemployment, poverty and inequality, inflation etc. crop up, along with environmental damage to forests, land, water and other natural resources.

On the other hand Albert O, Hirschman holds the view that population is a stimulant to economic development in the sense that population increases and causes a decline in general standard of living, there is general resistance by the community, society, against it. They try their best to control environment and organise themselves for further development. Lewis argues that, so long as supply of labour is inadequate in relation to the availability of capital and land, under a given technology, any increase in population will be considered beneficial. The argument is supported by Jorgenson and Arther Lewis, and many other demographers. Human beings have a capacity to respond to crises situation and particularly when it threatens to lower their living standards. In such situations better skill and talent help improving the constraints on production. They are the challenge as an opportunity to develop further.

Economic development on the other hand help improving income level, general standard of living, provision of infrastructural and other health and medical facilities, educational institutions etc. All this has a dampening impact on population growth.

Thus, population growth and economic development are the interrelated and interdependent variables. Both these ultimately have an impact on the overall demographic scenario of the economy.

Self-Check Exercise-2

(i) How economic development discourages population growth?

(ii) Why population growth is an obstacle to development?

5. Theory of Demographic Transition

In the proceeding section we have precisely discussed relationship between population growth and economic development. In fact this relationship explains the theories of demographic transition through which all the contemporary developed nations have passed.

As economy grows, it has an impact on overall level of development of the country, economy and the society. From a low level of development, when economy approaches to reach at the highest level, the social set up also

changes and lands at that higher padestral where level of income is high, propensity to consume is low, capital formation is incresing, technological advancement is visible and is within the reach of all masses. At that highest level, birth rate is very low and death rate is lowest at the natural level. This process explains various stages of demographic transition for which we have different theories.

5.1 Classical Theories of Demographic Transition

(a) The study of demographic transition dates long back since Hune Chang, first of all analysed about China's population. He came to the conclusion that non-availability of sufficient food results in more deaths. High infant mortality rate is reported during this phase of low level of economic development. As the process of development speeds up it has a dampening impact first on deaths and then on birth rate. The Mercantalist school, in Europe, of Political Economy supported this argument. But in the initial stage of development they were in favour of increase in population. As population growth, through increased demand, helps generating national income. In fact they ignored the positive checks on population growth.

(b) Thomas Robert Malthus was the first to relate population changes to economic changes in the course of long run economic development. Malthusian population theory is regarded as classical theory of demographic transition, which treats population a fully endogenous to economic growth. Traditional Malthusian belief is that population when unchecked increases in a geometric ratio and food supply in an arithmetic ratio. (An Essay on the Principles of Population – 1798)

Malthus could not visualise the strength of technological factors to discourage this unprecidented growth of population. Economic development and technology in industrialised economies will have automatic barrier to growth of population.

(c) Marxian Theory of population/demographic change states that Every special historic mode of production has its own special law of population, historically valid within its limits alone ….

Kautsky is of the view that ….. over population was the result of variable capital which increases less rapidly as compared to total capital and labouring population.

The theory of Demographic Transition was formulated by the office of population Research in Princeton as a culmination of/or abstraction from previous work on population change (The future population of Europe and the

Soviet Union, Geneva (1944) (Population studies, 50 (1996), 361-387 - Dudley Kirk) Population Projections, 1940-1970.)

Though there was by no means the first to state the essentials of the theory of demographic transition, Notestein's early formulation is accepted as the classic. Other classicals can be reffered to as Warran Thompson (1929) Landry (1934) Carr-Saunders' etc.

5.1.1 Stages of Demographic Transition (Classical Version)

Although the transition in population size had been noted since 1920's the iconic graph illustrating this transition does not seem to have been used till 1960's. It was Maurice Satin (1969) who explained model of demographic transition with the help of graphic presentation by using empirical data. He, along with other scholars presented 'An Alternative visualisation of the Demographic Transition Model'. As per this model there are four stages of demographic transition which are explained by variations in birth rate and death rate, brought out by economic development. These stages are : **First**, stable population growth at highest level, **second,** increasing rate of population growth with high birth rate and declining death rate; **third,** rapidly decreasing rate of population growth, with falling birth rate and low death rate and finally the **fourth** stage of small, stable population at lower birth and death rate, depicting population size as a 'logistic S-Curve'.

Warren Thompson, 1929, specified three different types of countries grouped as Group A, Group B and Group C, with different rates of growth of population.

Like Thompson, Notestein (1945) assumed that fertility would decline more steeply than it did in fact, with economic development, in the urban industrialised society. Urban life stripped the family of many functions in production, consumption recreation and education ... Large families discourages labour movement.

Frank Notestein Model of demographic transition states that there are four stages of classical demographic transition.

Stage I - Pre-Transition - High birth rate & High death rate population grwoth was kept low as stated by Malthus by preventive and positive checks/measures (famine war, pestilence, etc.)

Stage II - Early Transition - death rate begins to fall, birth rate is still high - pulation grows rapidly

Stage III - Late Transition :

- Birth Rate starts declining
- Death Rate is falling at a faster rate.
- Population growth rate decelerates.

Stage IV - Post Transition

- Societies are at advanced stage of development
- Both Birth Rate & Death Rate are low
- Population growth rate is negligible and has a tendency to decline.

Thus Notestein gave much importance to socio-economic factors as decline of population growth. Coale and Hoover suppoted this argument but they gave equal importance to cultural aspects also. Earlier Malthus had advocated postponment of marriage as a means of restraining population growth (Preventive Check)

Reasons for decline in mortality and fertility with transition of society from pre-industrial traditional level to post-industrial modern urban level may be stated as follows:

Mortality - Rising income though contributed to reduction in mortality but - development of modern state was a decisive factor. In general, establishment of public order directly reduced deaths from wars tribal and clan-feuds and random violence. Probably indirect effect of establishment of infrastructure in transport and commerce might have impact on reduction in famines, epidemics, improvement in traditional agriculture. Other argue that improved nutrition and resistance against deadly disease, availability of hygine and other facilities also contribute to this direction.

Health and medical facilities helped controlling tuberculosis, diarrhoea etc. Kuznets see reduced mortality as the pre condition of modernisation

Fertility level, as pointed out by Notestein is determined by the level of industrialisation, urbanisation, level of per capita income and social mobility. Sometimes recurrence of famines, wars and epidemics also have direct impact on change in demand for children which affects fertility level. Notestein is of the view that, "as the level of economic development rises, leading to rise in per capita income, it directly results in break-even point with respect to stages of demographic transition, that is, from high mortality and high fertility stage to low mortality with stable or falling fertility'...

Coldwell integrates all economic, cultural and institutional theories of fertility decline. In contrast to the original theory he holds that , "pre-transition fertility behaviour was rational". He is of the opinion "that fertility behaviour is rational only within the framework established by social ends. All societies are

economically rational but the 'ends' served differ from society to society. His theory of demographic transition is termed as 'Wealth Flow theory of fertility Decline' In this view the fundamental issue in demographic transition is the direction and magnitude of international wealth flows. At first in pre-modern societies the flow is from children to parents, from the younger to the older generation. .... When there is transition from the extended to the nuclear family, the pendulm swings and the direction of the flow is now from parents to children. In this situation being childless is the most rational economic behaviour.

Thus classical version of Demographic Transition is based on some important aspects viz. Birth Rate and Death Rate variations due to economic shifts of society from pre-industrial, rural traditional state to post-industrial, urban, modern state, where both fertility and mortality rates decline and after passing through different stages, population is stable at a lower level of Birth and Death Rate.

5.2 Modern Theory of Demographic Transition

Historically impact of economic development on population change has been synthesised in the form of demographic transition. From Notestein warron Thompson, A.J. Coole and E.M. Hoover, Harvey Leibenstein etc, have tried to explain theory of demographic transition with the help of various stages of population growth based on level of births and death rate which are directly affected by economic development.

The traditional theory has been put forward by the neo-classical demographers, also known as neo-Malthusians, or the modern demographers.

5.2.1 Stages of Demographic Transition in Modern Models

Modern theories of Demographic Transition are also explained with the help of stages of transition in population followed by economic developments.

C.P. Blacker postulates five stages, namely - high stationary stage, early expanding stage, late expanding stage, low stationary stage and the diminishing stage. Thomson and Notestein had grouped the extreme stages, on both ends, and expressed that there are three stages of demographic transition.

However M. Todaro explains that, all the contemporary developed nations have more or less passed through the same three stages of modern population history.

6. Features of Stages of Demographic Transition - As mentioned earlier the stages of demographic transition are explained with the help of variations in

birth and death rate followed by change in level of economic development. Some of the demographers are of the view that there are five stages while others like M. Todaro put them into four. Combining both the Classical and Modern versions with the help of certain features let us explain these stages :

Basically there are three stages;

(i) High growth potential but low actual growth.

(ii) Late expanding stage and

(iii) Low stationary Stage.

The explanation of these stages can be easily given with the help of certain features or the variables. These variables are - birth rate, death rate, population growth rate, nature of economy, level of development of that economy, social structure and availability of other related infrastructural facilities like education, medical and health, transport and other services of daily use. With respect to these variables we can now explain features of different stages of demographic transition

Stage I - High Growth Potential:

During this stage nature of economy is agrarian/peasant which is a subsistance economy. Level of income being low it is characterised as a stagnant economy. Social structure is traditional and backward. There is general resistance to any innovation. There is economic advantage of having larger family size, hence birth rate/fertility is high. On the other hand poverty, ignorance, primitive conditions of sanitation, lack of preventive and curative medical and health facilities etc. lead to equally higher death rate. High mortality rate among children forces the couple to enlarge their family size to make sure of survival of at least three children, to take care in their old age, destitute. In this situation with high birth and death rate actual population growth is not high, but it is almost stable at higher level with high growth potential.

Stage II - Late Expanding Stage

High growth potential of first stage is realised in the high actual population growth during this phase. As the pace of economic development sets in due to movement towards industrialisation, urbanisation of population also starts; and introduction of better technology picks up rate of growth of economy.

In this transitionary phase more and more jobs are created, per capita income increases as compared to earlier phase, some infrastructural investment also takes place. Education and wealth facilities, though at lower level, become

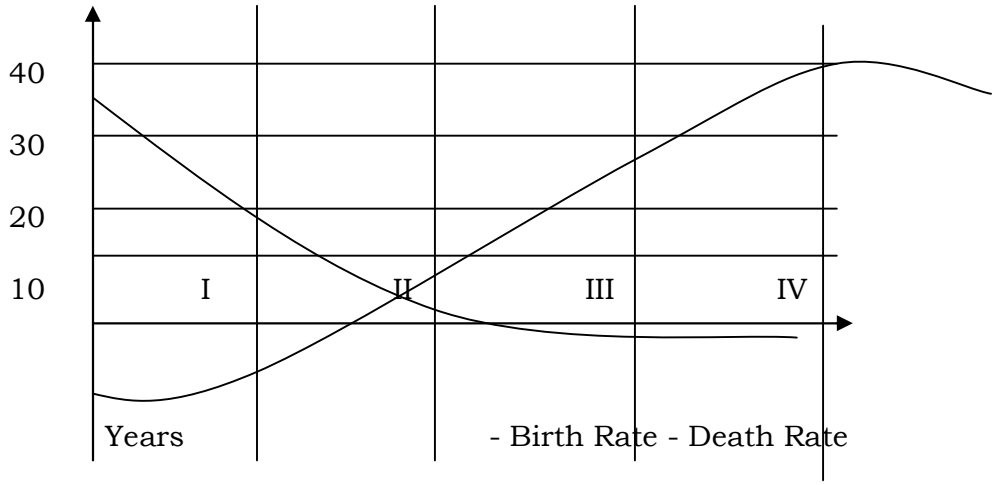
available. But there is complete control on epidemics and deadly diseases, improved transportation facilities movement of labour as well as of food grains. All these factors reduce death rate. But urge to have larger family size is still there. There is control on birth rate but death rate declines sharply during this phase. Gap between birth rate and death rate is highest during the later phase of this stage which leads to the economy to experience a stage of late expanding. This middle part is known as the phase of 'Population Explosion'.

Stage III - Low Stationary Stage :

The gap between high birth rate and falling death rate led to sharp increase in population growth. The second stage can be marked as the beginning of the demographic transition.

The third stage occurs when the forces influencing modernisation and development cause fertility to decline. Economic development changes the nature of economy from the traditional agrarian to modern industrialised economy, urbanisation and movement towards commercial countries facilitates easy access to education, health transport and other facilities. Wider dispersion of education helps improving status of women in the society. Female participation in work force discourages enlarging family size. In urban cenres and in industrialised economies utility function of children is relatively less as compared to their cost-function. The consciousness to maintain a certain level of standard of living tends to reduce fertility. Since death rate is already low at its natural level, lower birth/fertility rate results in very low population growth. Ultimately a stage comes when both birth rate and death rate are lowest (death rate nearly stagnant) population growth rate is stationary, sometimes even declining.

Diagrammatic presentation of these stages of demographic transition is given below :



1. high stationary
2. Early expanding → high growth potential
3. late expanding
4. low stationary
5. Declining → Low stationary stage

Reasons for changes in Birth Rate
Ist and IInd stage

- More children needed for family income especially in farming
- low survival rate
- religious/social encouragement
- no or negligible family planning
- (in 3rd stage) improve medical care and diet fewer children needed, for upwards mobility
- (in 4th and 5th stage) family planning, good health, improving status of women, late marriage and lesser time available for reproduction (lower fertility span)

Reasons for changes in Death Rate

Ist stage - Disease, famine, poor medical knowledge higher IMR.

2nd & 3rd Stage - improvement in medical care, water supply, sanitation, fewer children needed etc.

4th and 5th stage - Good Health, food availability updated medical facilities.

(Explanation of all these variables has already been given the preceeding sections).

7. Indian Experience

Indian population is second highest in the world. The first higherst populated country is China. Kingsley Devis has divided the history of Indian Demographic Transition (DT) into three segments, viz; the traditional history before sixteenth centurey, second, year from 1600 to 1670 and third, starting from 1831 to 1941. But idealy we have classical and modern models of the theory of Demographic Transition. First regular census was undertaken during 1881. As

per Kingsley Davis thesis, Indian population increased from 120 million in 1800 to 255 million in 1871. Mahalanobis and Bhatacharia are of the same opinion when population increased from 207 million in 1801 to 256 million in 1871.

In fact population change/increase before 1881 was negligible. It was only after that period when regular census are there and as per these records we can study demographic transitional behaviour in India.

As the census information Indian population was stable from 1901 to 1911-21 at a higher level with, CBR ranging from 48.9 to 46.4 and CDR between 44.4 to 42.6 per thousands, Natural growth rate in population was only 6.6 which even declined during the decade of 1911-21. Population declined from 238.40 million in 1901 and 252.09 in 1911 to 251.32 million in 1921.

From 1931 to 1981 natural growth rate in population has been observed as very high with small variations in Birth Rate and Death Rate. During the last two decades of 1981-91 and 1991-2001 national growth rate has started negative trend though absolute population is increasing but sharp fall in death rate, 9.0 per thousand, in 2001 and birth rate as low as 26.0 per thousand, NGR is 17.0

To put in the category of Demographic Transition Indian experience is as follows:

i) 1881 to 1911-21 - Low actual growth but high growth potential

ii) 1931 to 1961-71 - Early expanding stage

iii) 1981 to 1991 - Late expanding stage

iv) 1991 to 2001 - early declining stage

The detailed analysis of these phases reveals that after experiencing stage of 'Population Explosion' during the period of 1951-81 India's population growth rate started declining, with Birth Rate coming down from 30.5 to 26.0 per thousand in 2001 and Death Rate declining from 10.2 to 9.0 per thousand during the same period and natural growth rate registering a decline from 22.2 in 1971-81 to 20.3 in 1981-91 and 17.0 percent in 2001.

Hence as per the analogy of Demographic Transition. India has touched the last stage of declining growth rate of population. It is evident from the table-1 below.

Table-1
Demographic Transition in India

Year	Crude Birth Rate	Crude Death Rate	Natural Growth Rate	Stage of Transition
1881-1891	48.9	41.3	7.6	
1891-1901	45.8	44.4	1.4	
1901-1911	49.2	42.6	6.6	I
1911-1921	48.1	47.2	0.9	
1921-1931	46.4	36.3	10.1	
1931-1941	45.2	31.2	14.0	
1941-1951	39.9	27.4	12.5	II
1951-1961	41.7	22.8	18.9	
1961-1971	41.2	19.0	22.2	
1971-1981	37.2	15.0	22.2	
1981-1991	30.5	10.2	20.3	
1991-2001	26.0	9.0	17.0	III
2005	23.8	9.6	16.2	

Source: Census of India - General Population Tables

8. Summing up:

In the present lesson we have discused the concept of demographic transition with the help of variations in birth rate, death rate which have direct impact on change in population growth rate. The theory of demographic transition is also explained using these concepts. Classical demographers explain various stages of demographic transition with sociological factors, whereas the neo-classical and modern thinkers take technological factors also with the help of advancement in economic level of society, attitude towards life also changes, which ultimately determines the size of total population. The family size model explains the utility and cost functions of enlarging or limiting the family size with social advancement.

Indian experience of these transitions is that we have also passed through these different stages of DT. Now with BR falling, and DR at its lowest natural level, we have also entered in the last stage of declining natural growth rate of population though absolute population is still quite high.

9. Suggested Readings :

Coale, A.J. and Hoover, E.M. : Population Growth and Economic Development A Case of study of India's Prospects. Princeten Uni. Press. 1958

Ghosh, B.N. Studies in Population and Economic Development Vol -1 Deep & Deep Publication New Delhi 1987

Kanwaljit Kaur Gill : Population Growth, Family Size and Economic Development. Deep & Deep Publication, 1995.

10. Questions

10.1 Long Answer Type Questions :

1. State and explain stages of demographic transition as suggested by classicals.

2. Through which stage of demographic transition. India is passing, Give evidence in support of your answer.

(B) Short Answer Typer Questions:

1. Define the concept of Birth Rate, Death Rate, Infant Mortality rate.

2. What do you understand by demographic transition.

3. Why demographic transition takes place.

LESSON NO. 2.3 **AUTHOR : DR. HARVINDER KAUR**

THEORY OF BIG PUSH
(Rosenstein Rodan, Murphy, Shleifer and Vishny)

INTRODUCTION

In order to launch the economies of underdeveloped countries on a path of self-sustained growth, the thesis of big push is considered to be the best by many economists. Rosenstein Rodan's thesis is that a 'big push' or a large comprehensive programme is needed in the form of a high minimum amount of investment to overcome the obstacles to development in an under-developed economy and to put them on a path towards progress. It suggests that proceeding "bit by bit' will not be of great help. Kevin M Murphy, Andrei Shleifer and Robert W. Vishny in 1988-89 have also exlored that simultaneous industrialisation of many sectors of the economy can be profitable to less developed countries.

In this lesson, following two theories of big push are discussed :

I. Rosenstein Rodan's Thesis of Big Push

II. Murphy, Shleifer and Vishny's Theory of Big Push for Industrialisation

I ROSENSTEIN RODAN'S THESIS : Main Proposition

The theory of 'BIG PUSH' is associated with the name of Professor Paul N. Rosenstein Rodan. He builds up a case for giving a big push to an underdeveloped economy in order to put it on the path of successful development. It is only a big push that can release these economies from the inertia of underdevelopment. Prof. Myrdal supporting a 'Big Push' thesis, observes that "Backwardness and poverty naturally make it difficult for a country to mobilise enough resources for a big plan, but these are precisely the reasons why the plan has to be big in order to start development, and that market forces by themselves can not do it, implies the thesis of big push." The development process by its very nature is a series of discontinuous jumps. It is because of this that underdeveloped countries have suffered from long period of stagnation. To come out of this stagnation the economy needs a very large dose of investment or 'big push'. Economists recommend that Governmental initiaties are vital and important for their nation's development.

According to Rosenstein Rodan, small isolated efforts cannot put these economies on the path of economic development. To stress his argument, he quotes an analogy from an MIT study that, 'There is a minimum level of resources that must be devoted

to.....a development programme, if it is to have any chance of success. Launching a country into self-sustaining growth is a little like getting an airplane off the ground. There is a critical ground speed which must be passed before the craft can become airborne". A minimum quantum of investment is a necessary though not sufficient condition of success. What we can draw from this is that a minimum quantum of investment is necessary condition of success. Small doses of investment will not bring the desired results.

The term 'big push' refers to the transitional output expansion that may occur in a less developed economy when various manufacturing sectors expand output simultaneously, thereby increasing demand for each other's products and shifting the economy to high production equilibrium. He introduced the idea of simultaneous expansion of various sectors of the economy and co-ordinated investments in order for a country to get out of the trap of no-industrialisation.

Main features of the theory of Big Push :

1. **Massive investment :** The theory of big push recommends massive investment at the very outset to start the process of growth.
2. **Investment in different sectors :** The theory envisages the need for investment across different channels of growth.
3. **Planned industrialisation :** The theory stresses the need for planned industrialisation of underdeveloped countries.

Justification of the Big Push : The main basis upon which the Big Push theory of investment is justified has been the possibility of obtaining external economies. According to Rosenstein Rodan, the emphasis upon external economies is a major mark of difference between static theory and a theory of growth. In static theory, external economies are relatively less important but in a theory of economic growth they have got special significance.

According to the Big Push Theory, “A development programme must be at least of a certain size, or called ‘critical minimum’, to reduce indivisibilities and discontinuities in the economy and to overcome the diseconomies of scale.” This theory stresses the need for obtaining external economies which arise from the simultaneous establishment of technically interdependent industries. Thus, big push is necessary to overcome the indivisibilities and discontinuities found in an economy and for attaining external economies of scale. Unless these indivisibilities are overcome, economic development cannot become a self-sustaining process.

Indivisibilities and External Economies : Rosenstein Rodan explains difference between three different kinds of indivisibilities which need high amount of investment and, in turn, obtain external economies :

(i) Indivisibility of the Production Function (lumpiness of captial).

(ii) Indivisibility of Demand (Complementarity of demand)

(iii) Indivisibility (kink) in the Supply of Savings.

(i) Indivisibility of the Production Function :

The production function in underdeveloped countries may have several indivisibilities like indivisibilities of input, output and process of production etc., but the indivisibility in the supply of the social overhead capital is the most important. Because of its indivisibility, this sort of investment can be a great source of external economies and increasing returns. The creation of social overheads like power, transport, communication, etc. requires huge initial investments. These are lumpy investments requiring long gestation period. They create infrastructure and provide investment opportunities in other industries. Its services cannot be imported.

The investment in social overhead capital must precede the quickly yielding directly productive activities. Rosenstein Rodan points out, "In addition, there is also an irreducible minimum industry mix of different public utilities so that an underdeveloped country will have to invest 30-40 percent of its total investment in these channels."

Rosenstein Rodan further emphasises four indivisibilities of social overhead capital :

— Investment in social overhead capital is indivisible and irreversible in time. It cannot be reversed. It must precede other types of investment, for example, directly productive investment. Since its services cannot be imported so it must be created within the economy.

— It has a particular minimum durability.

— Its gestation period is long.

— It has minimum industry-mix which cannot be reduced.

The indivisibility of social overhead capital is a great obstacle in the development of underdeveloped countries. A high initial investment in 'infrastructure' (another common term for social overhead capital) or a 'big push' is a pre-condition for creating proper climate for productive investments in the economy.

(ii) Indivisibility of Demand :

Indivisibility of demand refers to complementarity of demand. Workers do not spend all their wages on a single product, but they spend their wages on a number of products. In an underdeveloped economy, the market is small due to low level of income. Since the market is small, few investments are made. Complementarity of demand necessitates expansion of markets. Investment in a number of industries simultaneously would create large demand for various products and, thus, the market expands, giving further stimulus to investments.

Rosenstein Rodan explains this issue with the help of an example:

"If a hundred workers who were in disguised unemployment (i.e., with marginal productivity of their labour equal to zero) in an underdeveloped country were put

into a shoe factory, their wages would constitute additional income. If the newly employed workers spent all of their additional income on shoes they produce, the shoe factory, would find a market and would succeed. In fact, however, they would not spend all of their additional income on shoes; these are no 'easy' solution of creating in this way an additional market. The risk of not finding a market reduces the incentive to invest and the shoe factory investment project will probably be abandoned. Let us vary the example : instead of a hundred (unemployed) workers in one shoe factory. Let us put ten thousand workers in one hundred factories (and farms) who will produce the bulk of such (wage) goods on which the newly employed workers will spend their wages. What was not true in case of one single shoe factory will become true for the complementary system of one hundred factories."

In simple words, if a hundred workers are removed from agriculture where their productivity is zero, and employed in a shoe factory, their wages would be additional income which they would like to spend on a number of goods and not just on shoes. Hence the shoe factory will not find a market for its product. A large part of shoe production would remain unsold.

In such a condition, there will be little incentive to invest. However, instead of putting workers in one shoe factory, if several industries are established and thousands of workers are employed in a series of industries producing different kinds of goods, these workers will spend their additional wages for purchasing different products. In this way, the workers in different factories will become customers of each other.

J.B. Say's 'Law of Markets' will come into operation, viz., "supply creates its own demand." Risk of not getting a market will, thus, be reduced and there will be more incentive to invest. In other words, investment decisions are interdependent or indivisible. Unless there is assurance that complementary investments will be forthcoming, individual investment decisions will be highly risky and they may not be undertaken.

Thus, a large scale investment programme is necessary to ensure complimentary investments and to make possible individual investments.

(iii) Indivisibility in the Supply of Savings :

The indivisibility in the supply of saving is also put forward as an argument in favour of 'Big Push' in underdeveloped countries. Investment in a number of industries simultaneously requires a large number of savings. However, underdeveloped countries suffer from a vicious circle of low savings and low incomes. The supply of savings are highly price-inelastic, but are highly income elastic. There are indivisibilities in the supply of, savings. The supply of savings would increase only when additional resources are mobilised through new investments. The income level will increase in the first stage. Through proper mechanism, it should be ensured that the marginal rate of savings is very much higher than the average rate of saving in the second stage.

Prof. Rosenstein Rodan states this problem as 'a high minimum quantum of investment requires a high volume of saving which is difficult to achieve in low income underdeveloped countries. The way out of this vicious circle is to have first an increase in income and to provide mechanisms which assure that at the second stage the marginal rate of savings be very much higher than the average rate of savings.

Thus, the third type of indivisibilities are in the supply of savings which demands sacrifice on the part of the people to save more from the additional income.

Because of these indivisibilities, small efforts may not lead to a sufficient impact on growth. An atmosphere of development is only created when investment of a minimum size is made within an underdeveloped country.

Critical Assessment of Rodan's big push thesis

Prof. Rosenstein Rodan's theory of 'Big Push' can be regarded as superior to the traditional static equilibrium theory in several respects. This theory maintains that development process is a series of discontinuous jumps which seems to be correct. The theory is all realistic in its assumption about the indivisibilities of the production function. It examines the path towards equilibrium and not merely the conditions at a point of equilibrium.

But despite of all these merits, the 'Big Push" theory has been criticised on the following grounds :

(i) In Big Push theory, huge investment in social-overhead capital is justified on the basis of external economies. Thus, the basic concept of the theory is not Rosenstein's own. The concept of external economies is an old concept.

(ii) Jacob Viner points out that developing countries realise substantial economies from world trade independently of home investment. Rodan has recognised this fact, but keeps silent over the reality that in the newly developing countries investment for export and for marginal import substitutes occupies a large chunk of total investment. But these types of investments produce negligible external economies. Hence the external economies argument for Big Push loses its significance.

(iii) One important point of criticism against this theory is that while it emphasises the importance of massive investment in capital goods and consumer goods industries and economic and social overheads, it does not recognise the importance of stepping up investment in agriculture and primary industries. In agriculture oriented underdeveloped economies, a 'Big Push' of large investment in irrigation, transportation facilities, land reforms and in improving agricultural practices through better tools, fertilisers etc. are as important as

investment in other sectors.

(iv) This theory emphasises the need of a high minimum amount of investment on social overhead. Overhead capital has a high capital-output ratio and a very long gestation period. An under developed economy with scanty financial reforms finds it difficult to bear such a huge cost.

(v) Big Push theory is also not supported by the history of development of advanced countries. The economic development of most of the advanced countries scarcely seem to be the result of crash programme. Historically, the presence or absence of a Big Push has not been a distinguishing feature of growth anywhere.

II. Murphy, Schleifer and Vishny's Theory of Big Push for Industrialisation: Kevin M.Murphy, Andrei Shleifer and Robert W.Vishny of University of Chicage in 1988-89 explored Rosenstein- Rodan's idea that simultaneous industrialization of many sectors of the economy can be profitable not only in the developed countries but to less developed countries too," They took the example of Britain, Korea and Japan's Industrialisation process in the development of these countries.They found that the countries that grew rich have industrialized, whether it is the case of eighteenth century Britain or twentieth- century Korea and Japan. Lack of growth of under developed countries is mainly because of the small size of the domestic market which is the main constraint in the way of industrialization of these countries. Because of the small size of the domestic market in these countries, these have remained unindustrialized and poor.In such a situation, when external trade is not possible(due to closed economy or higher costs),the firms are not capable to enjoy economies of large scale production,as a result industrialisation process is badly impacted. K.M.Murphy, A Shleifer and R.W.Vishny analysed role of industrialization and big push in the context of an imperfectly competitive economy with aggregate demand spillovers . They have presented some models of economies with small domestic markets for generating a big push and explored their relevance for less developed countries. They have discussed how these markets can expand so that a country can get out of the no-industrialization trap. In the words of Murphy ,Shleifer and Vishny," when domestic markets are small and world trade is not free and costless, firms may not be able to generate enough sales to make adoption of increasing return technologies profitable , and hence industrialization is stalled. They are of the view that" with the industrialization of one sector, the size of the market in other sectors get enlarged. In this process, the role of government intervention is also important."Such spill-overs give rise to the possibility that co-ordination of investment across sectors - which the government can promote-is essential for industrialization.

They have associated the big push with multiple equilibria of the economy. Multiple equilibria originate from pecuniary externalities generated by imperfect competition with large fixed costs.

How does model work?

Murphy, Schliefer and Vishny are of the view that simultaneous industrialization of many sectors can be self- sustaining and profitable even if no sector can break even when investing alone. Such a big push can help under-developed economies to move from a 'bad' underdevelopment equilibrium to 'good' industrilisation equilibrium. The role of complementaries between various sectors is significant to bring this change which work through market size effects. To tackle the problem of inefficiency of the under developed equilibrium, the government policy can play an important role in promoting the co-ordination of investments across sectors.

Assumptions of the model:-

1. It is assumed that there is only one factor of production i.e. labour and it has fixed total supply;
2. The labour market has traditional sector as well as modern sector. Workers in the modern sector receive higher wages. High modern wages is one circumstance in which co-ordination problem may exist. Even if modern sector wages are no higher than those in the traditional sector,there may be co-ordination problems.
3. In the traditional sector there are constant returns to scale, while in the modern sector there are increasing return to scale of production.
4. Each good receives a constant share of consumption out of national income.
5. The economy is closed.
6. There is perfect competition in the traditional sector. This means that there is free entry and no economic profits.
7. The source of multiplicity of equilibria is pecuniary externalities generated by imperfect competition with large fixed costs.
8. The role of government intervention is important .

The theory is explained with the help of following models:

(i) A Simple Aggregate Demand Spillovers Model
(ii) A Model with a Factory Wage Premium.
(iii) A Dynamic Model of Investment
(iv) A Model of Investment in Infrastruture

(i) A Simple Aggregated Demand Spillovers Model with a Unique Equilibrium

In this model, the situation when profit spillovers across sectors are present, but these are not sufficient to generate the conditions for the big push, is explained . One firm can have positive spillover effects on other firms if and only if it makes positive profit itself. In a given period of economy with a representative consumer, with Cobb-Douglas utility function,all goods have the same expenditure shares. Thus, consumer spends whole income Y on every good. There are L units of labour with inelastic supply. Since labour is the only factor of production, so he owns all the profits of the economy. His income Y is equal to (Pi-1) π plus income from units of labour.

$$y = \pi + L \quad \text{---------- (1)}$$

Where π is aggregate profits

Each sector consists of two types of firms. Firms which use traditional technology operate with a constant returns to scale and each sector has a unique firm with access to an increasing returns technology. Since this firm is alone, so will be referred to as a monopolist.

Industrialisation requires the input of F units of labour and allows each additional unit of labour to produce á>1 units of output. The monopolist invests (industrialises) only if he can earn a profit at the price he charges.

When income is y, the profit of a monopolist who spends F to industrialise is: π (small Pi) $= \frac{\alpha - 1}{\alpha}$ y-F $= \alpha$ y-F--------(2)

When a fraction n of the sectors industrialise, aggregate profits are

$$\pi_{(n)} = n\,(a\,y - F) \text{----------(3)}$$

Substituting (3) into(1) yields aggregate income as a function of the fraction of sectors industrialising

$$y\,(n) = \frac{L - nF}{1 - n\,a} \quad \text{----------(4)}$$

Here, L – nF is the amount of labour used in the economy for actual production of output ,while 1\1 – n a is multiplier showing that an increase in effective labour raises income by more than one. The reason is that the expansion of low-cost sectors also raises profits.

(ii) A Model with a factory Wage premium

This model of the big push relies on a wage premium in mass production. This is based on Rodan's theory that "to bring farm labourers to

work in a factory, a firm has to pay them a wage premium. But unless the firm can generate enough sales to people other than its workers, it will not be able to afford to pay higher wages. If this firm is the only one to start production , its sales might be too low for it to break even. In contrast, if firms producing different products,all invest and expand production together, they can all sell their output to each other's workers and so can afford to pay a wage premium and still break even." Murphy, Shleifer and Vishny have constructed a model on these lines.

Suppose there are two sectors traditional sector of cottage production of manufactures and modern industrialising factory. Cottage industry works on constant-returns to scale (á=1), while modern factory uses increasing returns to scale *(á>1)*. The wage in cottage production is set to one and total labour supply is fixed at L.Cottage producers are competitive, but access to increasing returns to scale technology is restricted to a separate monopolist. All prices are kept at unity since demand is unity elastic.

So, it is easy to calculate the competitive factory wage, W.In order to make a worker indifferent between modern factory and traditional cottage production employment, the monopolist pays a minimum wage : w =1+v>1 which is the minimum wage necessary to get them out of cottage production.

In this case, the monopolist's profit is given by

$$\pi = y\left(1-\frac{1+v}{a}\right) - F(1+v)$$

Price of commodity is one, per- unit variable cost is $\frac{1+v}{a}$

The monopolist will invest only on the fixed cost F(1+v) if the productivity gain from using increasing returns to scale must exceed the compensating differential that must be paid to workers, that is *>1+v*. The modern factory will not be able to afford any labour and will be unable to cover variable cost if this condition does not hold true. This model can have two equilibrium situations one with industrialization and another without industrialization.

First Equilibrium position when no industrialization takes place:-

$$L\left(1-\frac{1+v}{a}\right) - F(1+v) < 0$$

For fear of not being able to break even, no firm incurs the fixed cost,and the production is being done in traditional cottage sector. Income is equal to L, the wage bill of the cottage labour, since no profits are earned. For this to be an equilibrium, in this case in no sector would a monopolist want to set up a factory if he has to pay the required factory wage.

Second Equilibrium, when all sectors industrialise:-

In this case, all sectors industrialse and the quantity of output produced in each sector is á(L-F), since price is unity so, it is the value of output. Labour is the only input, so total factor payments are wages, which are equal to L(1+v).In this equilibrium position, profits must be positive:

$$\pi = \alpha(L-F) - L\ (1+v) > 0$$

This condition satisfies the expectation of industrialization self-fulfilling,

(iii) A dynamic model of investment

Murphy, Shleifer and Vishny have explored the case that if a firm uses resources to invest at one point in time, it decreases aggregate demand today but can generate labour saving at a later point and can raise aggregate demand tomorrow. In order to prevent the inefficient under - investment because of the shift in the composition of demand away from today's goods and towards tomorrow's goods, the role of the government in coordination of investments is important.

The importance of big push is explained with the help of a two- period model in a dynamic condition.Suppose a good q is produced in both the periods. In such a case when constant returns to scale technology is available in the first and the same in the second period as well as a potential monopolist can use increasing returns to scale. So, the decision whether or not to invest in the first period depends on the equilibrium interest rate and on income in period two, If the demand that firms expect to obtain in the second period is too low for them to break even on their investments, so they do not invest. In such a situation, the realized level of income is indeed low, and the no-industrialisation equilibrium is sustained. It is the second period cash flow generated through increased aggregate demand which gives rise to a second equilibrium, in which the economy makes the big push with Industrilisation .

In the first equilibrium, no sector incurs the fixed cost F in period I, and no industrialization takes place. Income in each period is equal to wage income : y1 = y2 =L

Equilibrium with Industrialisation

The income effect in many cases is more significant than the interest rate effect. Consequently, Simultaneous investment by many firms can become profitable even when each lose money investing alone independently, In this equilibrium with

industrialization, each sector incurs the fixed cost F in the first period, and the first period income is :-

$$y1 = L - F$$

On the basis of this income,the second period income is higher because of higher profits:-

$$y2 = L + \pi = L + \alpha y2 = L$$

Profits are denoted by ð, in periods 1 and 2 aggregate incomes by y1 and y2 , units of labour by L, Fixed cost is denoted by F.

It thus suggests the movement from the use of competitive CRS technologies to the use of less competitive IRS technologies in the less developed countries in the initial stages of industrialization, the 'big push' is good in these economies . To sustain a big push, the role of government to coordinate agents plans and for providing investment subsidies to bring about a critical mass of investment is substantial.

(iv) A model of investment in infrastructure

Rosenstein Rodan considered infrastructure as an important part of the big push. Murphy, Shleifer and Vishny too have emphasised that building infrastructure especially a railroad is especially important because it is associated with industrialization very closely. It can bring down effective production costs. Since the external effects of an investment are not noticed by the firm making it, so there is possibility of multiple equilibria again. If there is lack of enough potential industrial customers, the railroad might not get built and industrialization might not take place.

Even when it is socially efficient to build a rail road, it might not get built because of two reasons. (i) If it is unable to price- discriminate between its users and it can extract only part of the social surplus that it generates. (ii) A situation in which the railroad builder does not expect to get customers, it will not be built.

If a railroad is built it creates big push type results in the first peried. In the words of Murphy,Shleifer and Vishny,"As a result of infrastructural facilities, Investment-by a sector benefits other sectors in a way that is not captured by profits. An investing firm raises the demand in the second period and helps other firms make money. By using railroad service, an investing firm helps pay for the fixed cost of the railroad. The railroad, in turn, reduces the production costs of other sectors." They have suggested the role of the government in subsidising the railroad which might be helpful. A coordination of investments by enough private users of the railroad to get to the equilibrium with industrialization is also needed.

This theory thus analyses many conditions under which a backward economy can make a big push into industrialisation. This can be done by coordinating investments across sectors.

Questions for your practice

1. Critically examine Rosenstein Rodan's theory of Big Push.
2. How external economies can be obtained with the help of Big Push ?
3. Write short answers of the following questions :
   (i) Explain in nutshell the theory of Big Push ?
   (ii) Indivisibilities in the production function require a sizeable initial amount of investment. How ?
   (iii) Explain indivisibility of demand.
   (iv) What is role of big push ?
   (v) Explain indivisibility in the supply of savings?
   (vi) What are external economies ?
4. Discuss Murphy, Schleifer and Vishny's Theory of Big Push for Industrialisation.
5. Explain the role of aggregate demand spillovers and factory wage premium in the theory of big push for industrialisation.

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LESSON NO. 2.4 **Author : Dr. Partap Singh**

Harrod and Domar Growth : Model

1. Introduction

Harrod (1939) and Domar (1946) attempted to integrate Keynesinan analysis with elements of economic growth. They used production function with little substitutability among the inputs to argue that the capitalist system is inherently unstable.

Domars's growth model is frequently bracketed with that of Harrod because of the similarity between his central result and Harrod's fundamental equation. It is due to the similarities between the central results of economic growth models associated with Harrod and Domar that the joint title, 'Harrod Domar' is normally used to refer to their approach to growth. This so called H.D. model in spite of generic similarities with earlier model of Marx, Cassel & others broke fresh ground and started the snowball of modern growth theory.

As said earlier also, both the models begins from a fundamentally Keynesian framework, but move into the long-run by eschewing Keynes's assumption that the rate of investment did not., increase the size of the capital stock (an assumption only suitable in the framework of the short-run analysis of income determination). The proliferation of articles in economic journals on economic growth theories has been one of the most notable features of the economic analysis from where we can safely conclude that Harrod and Domar were the pioneers of this movement. Their theories and their 'vision' have, however, been subjected to sustained criticism from within a few years of their first appearance and alternative competing theories, using different assumptions and producing radically different conclusions, have emerged.

2. Assumptions of H-D Model :

1. The average propensity to save is equal to the marginal propensity to save.
2. The marginal propensity to save remains constant.
3. There is fixed proportion of capital and labour in the production

process.

4. There is no depreciation of capital goods which are assumed to possess infinite life.
5. Fixed and circulating capitals are lumped together under capital.
6. There is only one type of product.
7. There is an initial full employment equilibrium level of income.
8. There is the absence of government interference.
9. Closed economy.
10. There are no lags in adjustments between investment productive capacity.
11. The capital co-efficient, i.e., the ratio of capital stock to income assumed to be fixed.
12. There are no changes in interest rates.
13. The general price level is constant.
14. Saving and investment relate to the income of the same year.

3. Explanation of the Model*

All the economic growth theory is based on the idea unless the initial savings are available, there would be no investment and hence no expansion. This signified the necessity to understand the basic concept of macroeconomic balance which is fundamental to understand the foundations of all models of economic growth. The same is explained with the following diagram showing income flowing "out" of firms as they produce and income flowing back "into" firms as they sell. Saving is a leakage from the system, i.e., the demand for consumption goods falls short of the income that created this demand. This gap is filled up by the demand for capital goods by the investors. Macroeconomic balance, therefore, is achieved when this investment demand is at a level that

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* The treatment is based primarily on Debraj Ray, Economic Development, 2000. Appendix to chapter 3, of his book records the simple algebra involved in this lesson.

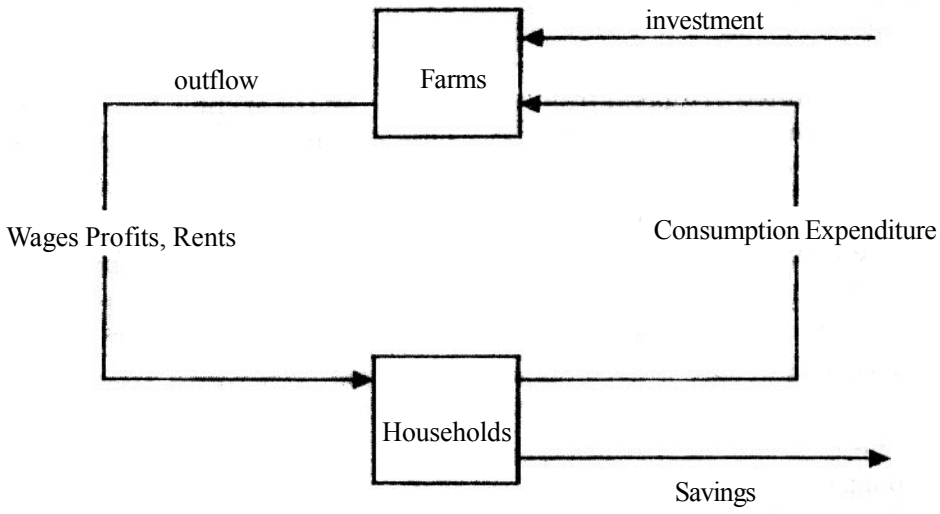


Fig.1 Production, Consumption, savings investment

exactly matches the savings leakage. Volume of savings and investments is an important determinant of the growth rate of an economy. Thus, economic growth is positive if investment is greater than the amount necessary to replace depreciated capital. This leads to the next period's cycle to recur on a larger scale and to the expansion of the economy, otherwise, it is stagnant or may even shrink.

The Harrod-Domar equation which firmly links the growth rate of the economy to two fundamental variables i.e., the ability of the economy to save and the capital-output ratio can be had by resorting to the following national income accounting equation.

$$Y(t)= C(t) + S(t) \quad \ldots(i)$$

i.e., the value of output/national income must be matched to goods produced for consumption plus investment for all dates i.e.,

$$y(t) = c(t) + I(t) \quad \ldots(ii)$$

Thus, the familiar equilibrium condition of elementary macroeconomics or macroeconomic balance equation is,

$$S (t) = I(t) \quad \ldots(iii)$$

i.e., aggregate planned investment must equal aggregate planned saving.

Now the basic argument is that investment augments the national capital stock K and replaces the part of it which is wearing out. If a fraction δ of the capital stock depreciates, then the capital stock must change overtime as follows :

$$K(t+1) =(1-\delta) K(t) + I(t) \quad \ldots (iv)$$

Now using the important concepts of saving rate s(t) /y(t), denoted as S and

the capital-output ratio K(t)/Y(t) denoted as θ, combining equations (iii) and (iv), and moving around a bit, the very influential equation, that we get is,

$$S/\theta = g + \delta \qquad \ldots(v)$$

Here g is the overall rate of growth or [Y(t+1) - Y(t)]. This is the Harrod-Domar equation, named after R. Harrod and E. Domar. This equation links the growth rate of the economy to fundamental variables;

(i) the ability of the economy to save.

(ii) the capital-output ratio.

It is possible to accelerate the rate of growth by pushing up the saving rate. Similarly, by increasing the rate at which capital produces (a lower θ), growth could be enhanced. This H.D. equation, intact, has deeply influenced the Central Planning in countries; such as, India and erstwhile Soviet Union. To incorporate the effects of population growth, a small amendment to the H.D. Model is required. The equation as currently stands, is a statement regarding the rate of growth of total gross national product (GNP), not per capita GNP. To get the per capita growth in GNP, it is a must to net out the effects of population growth. Now if population (P) grows at rate n, so that P(t+1) = P(t) (1+n) for all t, our equations can be converted, into per capita magnitudes, i.e.,

$$S/\theta = (1+g^*)(1+n) - (1-\delta) \qquad \ldots(vi)$$

g*. is the rate of per capita growth here.

The equation (v), in fact, is an expression that combines some of the fundamental features underlying growth, such as, the ability to save and invest (denoted by s), the ability to convert capital into output (which depends inversely on θ), the rate of capital depreciation (δ) and, the rate of population growth (n).

By expanding right hand side of equation (vi)

We get $s/\theta = g^* + n + \delta - g^*n \qquad \ldots(vii)$

This equation (vii) goes well with equation (v) and can be substituted for equation (vi) without much loss of accuracy.

By having another look at the basic H-D model as captured by equation (vi), we come to know that if saving rates, capital-output ratios, population growth rates, and depreciation rates are such and such, then the resulting growth rate is so many percentage points. Thus, we can make "if-then" statements and they make good sense, in many causes, though in many cases they do not. The reason for the latter is the fact that the very parameters (saving rates, capital-output ratios) used to predict growth rates may themselves be affected by the growth process itself. Alternatively speaking, such variables may not be exogenous to economic growth, rather, may themselves be determined endogenously.

The different sources of endogeneity that may affect the workings of the simple H-D model are;

The Endogeneity of Savings

The rate of savings, perhaps the most important parameter in the H-D model, may itself be influenced by the overall level of per capita income in the society, not to mention the distribution of that income among the population. At low levels of individual income, saving rates are usually small or even negative. In the poor countries, majority of the citizens being close to subsistence levels of consumption are unlikely to have a high savings rate. Under such conditions, the government policy is ineffective to raise the savings rate significantly. The growth efforts, therefore, must rely on other sources of capital accumulation, such as aid or external credit.

Thus, as the economy grows, the scope for saving increases: Savings may or may not grow as notions of "What is necessary" in a society can and do change. Thus, United States, one of the world's richest countries, also has one of the world's lowest saving rates. In these situations, however, there is much scope for affecting the rate of savings by govt. policy. Other many such examples can be cited for the poorest, richer or middle-income societies.

Such concepts/situations necessitate an adjustment in the H-D Theory :although not a drastic one : as income changes, the savings rate that enters into the H-D formula equation (vi) will change. This creates a tendency overtime for the growth rate of the economy to change in a way that shows the movement of the savings rate with income. Thus, the simple H-D model based on exogenous saving rate is a neutral theory of economic growth. It gives no explanation as to why growth rates systematically differ at different levels of income. There is no "feedback" from the level of per capita income to the many parameters which affect the growth process. Neutrality of H-D model is lost due to this amendment and a pattern linking per capita income to growth rates is created.

2. The Endogeneity of Population Growth :

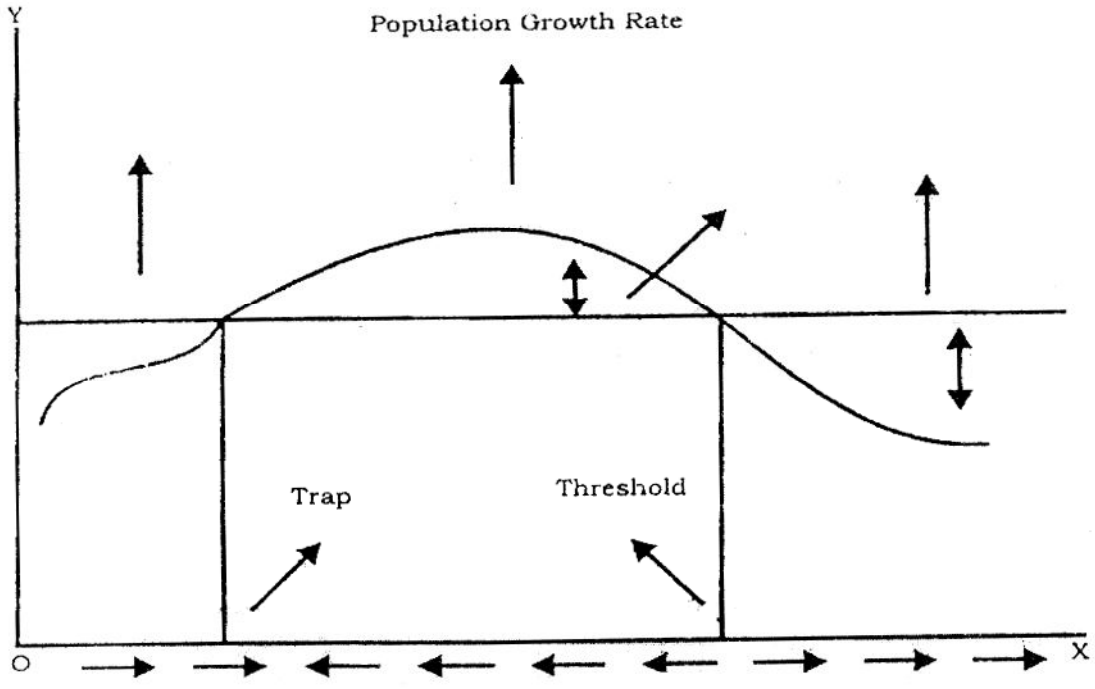
The population growth rates may vary also just as the saving rate might 'vary'. Enormous evidence is there which suggests that population growth rate change systematically with the society's overall level of development. Thus, this becomes another reason for the variation in per. capita growth rates that is quite independent of any systematic variation in the savings rate.

This fundamental variation of population growth rates with the level of development is known as demographic transition. This phenomenon is very important to understand the process of economic development. In many different countries, infact, an "invesse-u" shaped behaviour of the population growth rate has been found and is referred to as demographic transition. This is shown in Fig-2

The line/curve drawn parallel to the ox, axis is flat it shows the overall growth rate (not per capita, but net of depreciation) in the H-D model as given by equation

(v). The line is flat as the analysis has been simplified by assuming that all parameters other than the population growth (including the saving rate) are unaffected by per capita income.

We know from our approximated version of the H.D equation (vii) that the growth rate of per capita income is just the growth rate of overall income (net of depreciation) minus the rate of population growth. It is the same as shown in Fig.2, as the vertical distance between the two curves at every level of per capita income. It is clear from this reformulation of H-D model, that the rate of growth of per capita income turns out to depend on the current income level. For example, in the above diagram, the rate is initially positive (upto the "Trap" level of per capita income), it is negative (upto the "Thresh hold" level of per capita income), and then positive again. It is easy to understand the meaning of "Trap" in this context. For example, if the start is made just above the critical level of per capita income, population growth will outstrip overall income growth and in per capita income terms the economy, infact, will become poorer. The directions of movement in per capita income are shown by the little arrows along the horizontal axis.



Per Capita Income

Fig.2. Endogenous population growth & economic growth

Similarly, if the economy is initially to the right of the threshold, per capita income will increase over time and the economy will be in a sustained growth phase. What follows is that in the absence of some policy that pushes the economy to the right of the threshold, the economy will tend to be caught in the trap. In general, the diagram suggests that there are situations in which a temporary boost to certain economic parameters, may have sustained long-run effects. Suppose the economy being just to the left of the threshold is sliding back toward the trap (as population growth exceeds income growth)then in such a situation, a jump in the savings rate can shift the rate of overall income growth to a level that outstrips the population growth rate, and therefore, pulls the threshold down. This can be seen through Fig. 2 by pushing up the flat line in imagination and seeing that the threshold moves to the left. In such situation, the economy can grow. Thus, it is also clear that the policy that boosts savings does not have to be a permanent one. Thus , once the economy crosses a certain level of per capita income, the old savings rate will suffice to keep it sliding back, because due to higher standard of living, population growth rates fall of their own accord.

In a nutshell, the point about which we must be very aware is that the factors which we treat as exogenous (e.g., savings) may well be influenced by the outcomes that they supposedly cause (e.g., income or its growth rate). This, of course, does not mean that there is no casual relationship at all between savings and growth rates, rather it means that the feedback from growth to saving is also significant and we need to incorporate this fact in theory.

More important than the mere recognition of the endogeneity factor is the understanding that such features may fundamentally alter the way we think about the economy and about policy.

3. Criticism of the H.D Model

(i) Model which assumes a constant capital-output ratio implying zero substitutability between capital and labour is inappropriate to analyse the long-run process of economic growth. Beginning with Solow and Swan in 1956, a series of models of economic growth have been constructed which explicit postulate varying degrees of possible flexibility in the capital-out put ratio. We must also be clear that the most important difference between the H-D theories and the more recent developments does not stem merely from the different assumed degree of flexibility of the capital-output ratio.

(ii) The Harrod-Domar approach is misleadingly simple in the rigidity of its assumptions and the naivety of its construction :

It is perhaps resonable to argue that too many of the variables in their model are assumed to be exogenously determined, but both Harrod and Domar were explicitly searching for simple relationships relevant to the dynamics of the macro economy

and, even so, it would be difficult to argue that their approach is substantially less 'realistic' than many of the more complicated models that have been developed in recent years. Even though their purpose was to isolate some of the problems that a growing economy might encounter, it might be argued that their assumptions and apparatus were not inappropriate. On the other hand, their models are rigid. Thus, it can be safely supposed that their application in contexts other than those for which they were designed could well be misleading.

(iii) The H-D approach seems inconsistent with the experience of real growing economies :

Since they wrote during or immediately after the Great Depression, the vision associated with their theories was not originally considered implausible. Their arguments, therefore, were received sympathetically by many economists and very little of this analysis plays a role in today's thinking. R.M. Solow in his, Growth Theory: An exposition in (1970) has written that, if it is too much to say that steady-state growth is the normal state of affairs in the advanced capitalist economies, it is not too much say that divergences from steady-state growth appear to be fairly small, casual and hardly self-accentuating.'

Despite these criticisms, nobody can deny that they re-emphasized the 'classical' role of savings in the accumulation of capital after the Keynesian controversies on the role of savings in the context of the level of national income determination. To study economic development, the central ideas of their models, in fact, cannot be ignored.

Short Answer Type Questions

(a) What is macroeconomic balance?

(b) Discuss whether the following statements are true or false?

(i) According to Harrod-Domar model, if the capital-output ratio in. a country is high, that country will grow faster.

(ii) The Harrod-Domar model states that a country's per capita growth rate depends on its rate of saving, whereas the Solow model states that it does not.

6. Suggested Readings

1.	Hywel G. Jones	:	An Introduction to Modern Theories of Economic Growth, 1976
2.	Debraj Ray	:	Development Economics, 2000.
3.	Robert J. Barro X avier Sala-i-Martin	:	Economic Growth, 1995
4.	M.L. Jhingan	:	The Economics of Development Planning.

LESSON NO. 2.5 **AUTHOR: KAJAL GUDWANI**

KALDORAND MIRRLEES MODEL

1. Introduction

Kaldor and Mirrlees model(growth model with induced technical progress) highlights the importance and the vital role of technical progress in the growth process of an economy. This model, however, differs from Kaldor's earlier theories(1957 and 1961) mainly in following respects:

i. It gives more explicit recognition to the fact that technical progress is infused in the economic system through the creation of new equipment, which depends on current gross investment expenditure. The 'technical progress function' of this model explains the relationship between the rate of change of gross (fixed) investment and the rate of increase in labour productivity on newly installed machines.

ii. It takes explicit account of obsolescence caused by the fact that the profitability of plant and equipment must diminish with time owing to the

competition of equipment of superior quality and efficiency installed at subsequent times.This model assumes that operative lifetime of the equipment is determined by a complex of economic factors which govern the rate of obsolescence and not by physical wear and tear.

iii. The continuing obsolescence is broadly foreseen by the entrepreneurs who take it into account in framing their investment decisions.

iv. This model takes into account of the fact that some proportion of existing stock of equipment disappear each year through physical causes like accidents, fire,explosions etc. This gives rise to some physical depreciation in addition to obsolescence.

v. Under continuous technical progress and obsolescence, there is no way of measuring the 'stock of capital'. This model therefore, avoids the notion of a quantity of capital. The system operates solely with the value of current gross investment (gross fixed) capital expenditure per unit of time and its rate of change in time.

2. Assumptions

The discussion of this model is based on the following assumptions:

i. Like all 'Keynesian' economic models, it assumes that savings are passive. The level of investment is based on the investment decisions of the entrepreneurs, and it is independent of the propensities to save. It postulates an economy in which the mechanism of profit and income generation will create sufficient savings to balance the investment.

ii. This model relates to an isolated economy with continuous technical progress and steady rate of increase in the working population. Both are determined by exogenous factors.

iii. The model assumes that investment is primarily induced by the growth in production and that the underlying conditions are such that growth equilibrium necessarily carries with it a state of continuous full employment. This will be the case when purely endogenous growth rate (as determined by the combined operation of accelerator and the multiplier) is operative. Starting from any given state of surplus labour and underemployment, continued growth (as determined by endogenous factors) will necessarily lead to full employment sooner or later.

iv. It is also assumed that each entrepreneur, operating in imperfectly competitive markets, aims at maximising the growth of his own business. For that reason he would prefer to maintain an appreciable amount of excess capacity as to be able to exploit any chance to increase his selling power either by increasing his share of market or by invading other markets. However, when gross investment per period is in excess of the number of workers available to handle the new equipment, the degree of excess capacity would steadily rise. Whatever relationship between the capacity and output may be, sooner or later, a point will be reached when the number of workers available for operating new equipment would exert a dominating influence on the volume of investment decisions in the economy.

v. This model is based upon the assumption of fixed coefficients and complete indivisibility of the plant and equipment.

3. Working of the Model

On the basis of the assumptions discussed above, we will explain the working of the model.

The relationship between investment per machine, gross investment and number of workers can be expressed in the form of an identity given below:

$i_t = I_t/n_t$

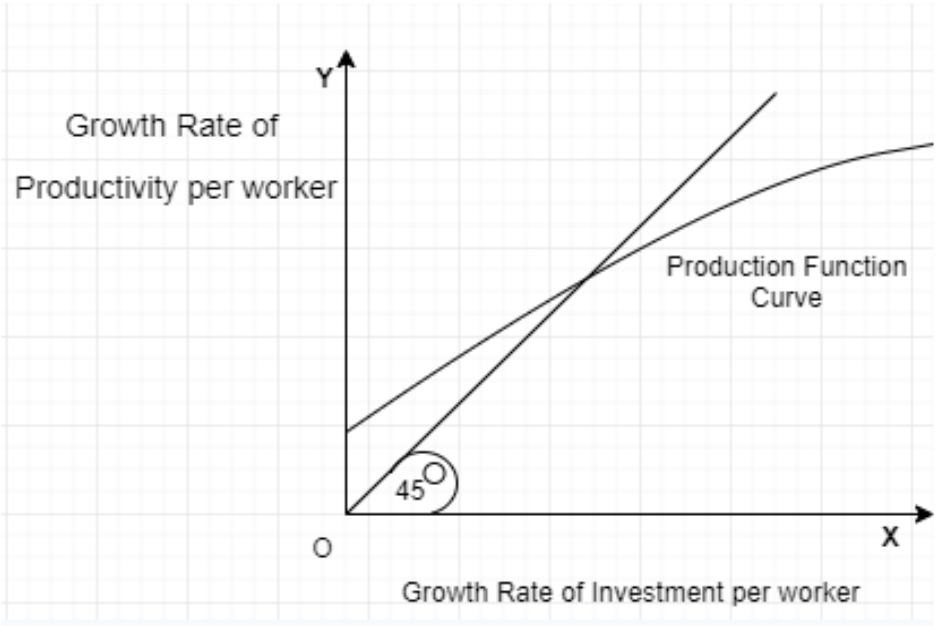
where i_t refers to the amountof investment per operator on machine in 't' time period. I_t is gross investment in fixed capital in same time period and n_t stands for the number of workers available to operate new equipment per unit period. This identity explains that the amount of investment per operative on machine is identically equal to the rates of gross investment and available workers to handle the new machines. Using symbols Y_t for gross national product at 't', $N_t$for theworking population and y_t for the output per head, we can express the relation between the three in the form of an identity:

$y_t = Y_t/ N_t$

It is assumed that machines are of constant physical efficiency during their lifetime, so that the growth of productivity is entirely due to the infusion of new machines into the system through gross investment. It means that technical progress function which makes the annual growth rate of productivity($\dot{p}_t/p_t$) per worker operating on new equipment is a function of the rate of growth of investment ($\dot{i}_t /i_t$) per worker. The relation between the two can be expressed as under:

$(\dot{p}_t/p_t) = f(\dot{i}_t /i_t)$ with $f(0) > 0$, $f' > 0$, $f'' < 0$

This relationship is illustrated in the figure below:



The growth rate of investment per worker is shown on X- axis and rate of growth of productivity per worker is depicted on Y-axis. The ray drawn with an angle of 45^o indicates that a constant rate of investment per worker overtime will itself increase productivity per worker. The curve indicates the production function and it shows that the rate of growth of productivity will be an increasing function of the rate of growth of investment per worker, though at a diminishing rate.

Both output per operative and investment per operator are measured in terms of money values deflated by an index of the prices of wage goods. This means that change in the prices of equipment goods in terms of wage-goods will cause shifts in the technical progress function. When there is reasonably stable trend in prices of equipment goods in terms of wage goods, there is likelihood of the function to remain stable in time for any particular value of I_t / $Y_t$in money terms and system may possess a steady growth equilibrium with a constant (equilibrium) value of I_t/Y_t.

Self-Check Exercise 1

Q. Give any two assumptions of Kaldor and Mirrlees model?

4. Risk and Uncertainty

While making an investment decision, the entrepreneurs face the problem of risk and uncertainty. Under stable price system, this problem may not arise. But market imperfections do give rise to risk and uncertainty. To explain this phenomenon, we shall make two assumptions. In the first place, we shall assume that entrepreneurs will only invest in their own business in so far as this is consistent with maintaining the earning power of their fixed assets above a certain minimum, a minimum which in their view, represents the earning power of fixed assets in the economy in general. If the earnings of a particular firm are low in relation to the capital employed, the financial position of the firm will become weaker and there will be enhanced risk of bankruptcy or take-over bids. It is therefore, reasonable to assume that sum of the expected profits anticipated from operating the equipment during its anticipated period of operation, must earn a rate of profit that is at least equal to the assumed rate of profit on new investment in the economy.

In the second place, under the conditions of continuing technical progress, the expectations concerning the distant future are regarded more uncertain than the expectations for the near future, where the incidence of risk is less significant. The entrepreneurs will make the selection of those investment projects which qualify to cover the cost of the fixed assets within a certain period.

5.Constraints

This model is subject to two constraints (conditions) which are as under:

$w_t >= w_{min}$ and $\pi > = m$

The first constraint ($w_t >= w_{min}$) explains that wage rate resulting from the model must be above a certain minimum (determined by the subsistence needs). The second constraint (π > = m) indicates that the share of profits resulting from the model must be higher than a certain minimum (the so-called degree of monopoly or 'degree of imperfect' competition).

6. Condition for Steady Growth

Having discussed the working of this model we shall now investigate whether this system provides a solution in terms of a steady growth (or golden age) equilibrium? The steady growth requires that the rate of growth of output per head ($\bar{y}$/y) should be equal to the rate of growth of productivity ($\bar{p}$/p) on new investment and both these are equal to the rate of growth of (fixed) investment per worker ($\bar{\imath}$/i) and to the rate of growth of wages ($\overline{w}$/w). It implies that system will be in a stable equilibrium when we have the following equalities:

$\bar{y}$/y =$\bar{p}$/p = $\bar{\imath}$/i = $\overline{w}$/w

These equalities are subject to the conditions that share of investment in output I/Y, the share of profits in income (π) and the period of obsolescence of equipmentremain constant.

Self-Check Exercise 2

Q. Specify the two constraints of the model?

7. Summary

We, now make general observations about the working of this model.

i. The system of the model shows that technical progress is the main engine of economic growth.

ii. Technical progress has been interpreted in the form of rate of investment on the newly produced capital equipment.

iii. Entrepreneurs' investment decisions are determined by a number of factors like, rate of growth of productivity, rate of obsolescence, average life time of equipment, share of investment in income, the share of profits and relationship between investment and potential output (i.e., the capital-output ratio on new capital).

iv. This model is Keynesian in its mode of operation (entrepreneurial expenditure decisions are primary; income, etc. are secondary). It is non- neo- classical in character implying that technological factors (marginal productivities or marginal substitution ratios) play no role in the determination of wages and profits.

v. A production function in the sense of a single-valued relationship between capital, the labour force and output all at a time clearly does not exist. Everything depends on how the collection of equipment goods has been built up.

vi. The technical progress function is quite consistent with a technological investment function i.e., a functional relationship exists between investment per worker and output per worker. However, owing to anticipated obsolescence and uncertainty, it would not be correct to say that marginal product of investment plays a role in determining the amount per man. Since the profitability of operating the equipment is expected to diminish with time, the marginal addition to the stream of profits (which we may call marginal value productivity) will be something quite different from the marginal product in the technological sense, and unlike the latter, it will not be a derivative of a technological function alone, but will depend on the whole system of relationships.

vii. This technical progress function implies some restraint on the nature of technological change. Every change in the rate of investment per worker implies a change to which new ideas (innovations) are actually exploited. Capital-saving innovations which increase the output-capital ratio and output-labour ratio, are more profitable to the entrepreneurs than the labour-saving ones, that yield the same rate of increase in labour productivity. Clearly the former is exploited first and the balance of technological change will appear more capital-using implying greater rate of increase in investment per man. There is, therefore, always some rate of increase in investment per worker which allows output per man to grow at the same rate as investment per man. In that sense 'neutral' technical progress appears. The only sense in which technical progress postulates 'neutral' technical progress is the sense in which 'unneutral' technical progress necessarily involves either a continuous acceleration or deceleration in the rate of increase in productivity for any given value of $\bar{\imath}$/i.

Self-Check Exercise 3

Q. Describe the condition for steady growth of the model?

_____

_____

_____

_____

8. Criticism

i. **Unrealistic Assumptions:** This model is based on a number of assumptions which may not hold true in the present dayworld. In the present dynamic world, it is difficult to presume that parameters governing technical progress will remain constant. With the changing parameters, the working of this system poses a problem.

ii. **Role of Government Ignored:** This model is based on induced investment and entrepreneurs make the investment decisions depending on a number of parameters. The technical progress interpreted in terms of increase in fixed capital does not fall exclusively in the domain of private sectors. These days a number of research projects are undertaken by the governments that give boost to technical progress.

iii. The model fails to describe that behavioral mechanism which could tell that distribution of income will be such like that the steady growth is automatically attained.

9. Conclusion

The main practical conclusion for economic policy that emerges from this model is that any scheme leading to accelerated retirement of old equipment is bound to accelerate for a temporary period the rate of increase in output per head($\bar{y}$/ y),since it will increase n_t(the number of workers available for new machines) and hence I_t. A more permanent curve however, requires stimulating the technical dynamism of the economy, which is not only a matter of more scientific education and more expenditure on research, but of higher quality business management which is more alert in searching for technical improvements and less resistant to their introduction.

10. Technical terms

a) Obsolescence: It is the state of being which occurs when an object, service, or practice is no longer wanted even though it may still be in good working order.
b) Depreciation: A reduction in the monetary value of an asset over time, due to use, wear and tear.
c) Infusion: The introduction of a new element or quality into something.
d) Restraint: A measure or condition that keeps someone or something under control.
e) Stimulating: It refers to encouraging or arousing interest or enthusiasm.

11. Short answer type questions

A. Describe the relationship between growth rate of productivity per worker and growth rate of investment per worker along with diagram?
B. Describe in brief about risk and uncertainty?

12. Long answer type questions

A. Explain in detail Kaldor and Mirrlees model?

13. Recommended Books

Economics of Development and Planning: M.L. Taneja and R.M. Myer

LESSON NO. 2.6 **AUTHOR : DR. RAMNA SINGLA**

SOLOW-MEADE MODEL OF ECONOMIC GROWTH

2.6.1 Introduction

Professor R.M. Solow builds his model of economic growth as an alternative to the Harrod-Domar line of thought without its crucial assumption of fixed proportions in production. Solow postulates a continuous production function linking output to the inputs of capital and labour which are substitutable.

2.6.2 Assumptions

Solow builds his model around the following assumptions:

(1) One composite commodity is produced.
(2) Output is regarded as *net* output after making allowance for the depreciation of capital.
(3) Three are constant returns to scale. In other words, the production function is homogeneous of the first degree.
(4) The two factors of production, labour and capital, are paid according to their marginal physical productivities.
(5) Prices and wages are flexible.
(6) There is perpetual full employment of labour.
(7) There is also full employment of the available stock of capital.

(8) Labour and capital are substitutable for each other.
(9) There is neutral technical progress.
(10) The saving ratio is constant.

2.6.3 Explanation of MODEL

Given these assumptions, Solow shows in his model that with variable technical coefficient there would be a tendency for capital labour ratio to adjust itself through time in the direction of equilibrium ratio. If the initial ratio of capital to labour is more, capital and output would grow more slowly than labour force and vice versa. Solow's analysis is convergent to equilibrium path (steady state) to start with any capital labour ratio.

Solow takes output as a whole, the only commodity, in the economy. Its annual rate of production is designated as *Y(t)* which represents the real income of the community, part of it is consumed and the rest is saved and invested. That which is saved is a constant *s,* and the rate of saving is *sY(t). K(t)* is the stock of capital. Thus net investment is the rate of increase of this stock of capital *i.e.*, *dk!dt* or *K*. So the basic identity is

$$\dot{K} = sY \quad ...(1)$$

Since output produced with capital and labour, technological possibilities are represented by the production function

$$Y = F(K, L) \quad ...(2)$$

that shows constant returns to scale.

inserting equation (2) in (1), we have

$$\dot{K} = sF(K, L) \quad ...(3)$$

In equation (3), *L* represents total employment.

Since population is growing exogenously, the labour force increases at a constant relative rate *n.* Thus

$$L(t) = I_{ne}^{nt} \quad ...(4)$$

The right hand side of equation (4) shows the compound rate of the growth of labour force from period *0* to period *t*. Alternatively, equation (4) can be regarded as a supply curve of labour. "It says that the exponentially growing labour force is offered for employment completely inelastically. The labour supply curve is a vertical line, which shifts to the right in time as the labour force grows according to (4). Then the real wage rate adjusts so that all available labour is employed, and the marginal productivity equation determines the wage rate which will actually rule."

By inserting equation (4) in (3), Solow gives basic equation

$$K = sF\left(K, I_{ne}^{nt}\right) \quad ...(5)$$

He regards this basic equation as determining the time path of capital accumulation, *K,* that must be followed if all available labour is to be fully employed. It provides the time profile of the community's capital stock which will fully employ the available labour. Once the time paths of capital stock and of the labour force are known, the corresponding time path of real output can be computed from the production function.

Possible Growth Pattern. In order to find out if there is always a capital accumulation path consistent with any rate of growth of the labour force towards steady state, Professor Solow introduces his fundamental equation

$$r = sF(r, 1) - nr \qquad ...(6)$$

In this equation r is the ratio of capital to labour (K/L), n is the relative rate of change of the labour force $\left(\dot{L}/L\right)$. The function $sF(r, 1)$ represents output per worker as a function of capital per worker. In other words, it is the total product curve as varying amount r of capital are employed with one unit of labour. The equation (6) itself states that the rate of change of capital-labour ratio (r) is the difference of two terms, one representing the increment of capital [$sF(r, 1)$] and the other increment of labour (nr).

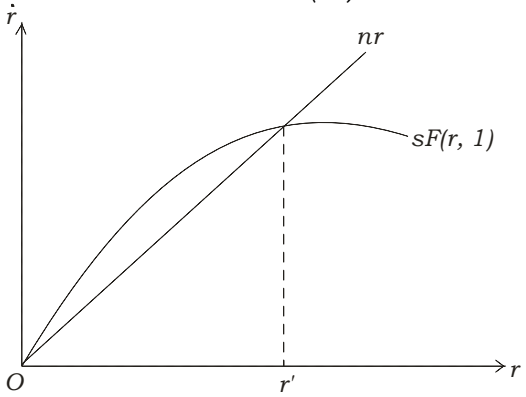


Fig. 1

Solow illustrates possible growth patterns based on his fundamental equation (6) in Fig. 1, where the ray through the origin is the function nr. The other curve represents the function $sF(r, 1)$. It is so drawn as to show diminishing marginal producitivity of capital. At the point of intersection of the two curves $nr = sF(r, 1)$, and $\dot{r} = O$. Then $r = r'$. Where $r = O$, the capital-labour ratio is a constant and the capital stock must expand at the same rate as the labour force, *i.e., n.* Once the capital-labour ratio r' is established. It will be maintained, and capital and labour will grow in proportion.

What will be the behaviour of the capital-labour ratio if there is a divergence between r' and r. If r lies to the right of r' or $r > r'$ then $nr > sF(r, 1)$, and r will decrease toward r'. On the contrary, if r lies to the left of r' or $r<r'$, $nr < sF(r, 1)$, and r will increase toward r'. Thus the equilibrium value r' is stable. "Whatever the initial value of the capital-labour ratio, the system will develop *toward* a state of balanced growth at the natural rate... If the initial capital stock is below the equilibrium ratio, capital and output will grow at a faster pace than the labour force until the equilibrium ratio is approached. The growth of output is always intermediate between those of labour and capital." But the strong stability shown in the above figure is not inevitable. It depends on the shape of the productivity curve $sF(r, 1)$. In Fig. 2 the productivity curve $sF(r, 1)$ intersects the ray curve nr at three points r_1, r_2 and r_3. But r_1 and r_3 are stable equilibrium positions because the total productivity curve $sF(r, 1)$ is above nr but at r_2 it is below nr. Therefore, r_2 is an unstable equilibrium position. "Depending on the initial observed capital-labour ratio, the system will develop either to balanced growth at capital-labour ratio r_1 or r_3. In either case labour supply, capital stock and real output will asymptomatically expand at rate n, but around r_1 there is less capital than around r_3, hence the level of output per head will be lower in the former case than in the latter. Figure 2 has been drawn so that production is possible without capital; hence the origin is not an equilibrium 'growth' configuration."

Solow points out that Fig. 2 does not exhaust all possibilities. He shows two more possibilities, as shown in Fig. 3. The ray nr depicts the equilibrium growth path where the warranted and natural rates of growth are equal. The curve $s_1F'(r, 1)$ which is above nr represents a highly

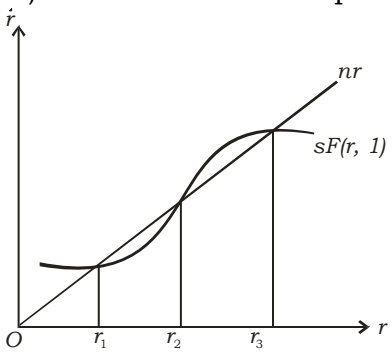


Fig. 2

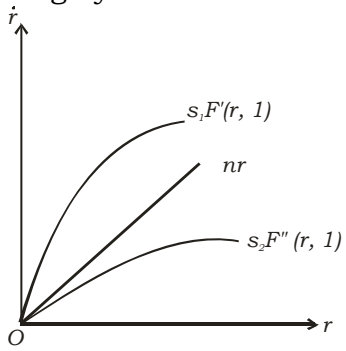


Fig. 3

Productive system in which capital and income increase more rapidly than the labour supply in this system, which is of perpetual full employment, income and saving increase so much that the capital-labour ratio increases

limitlessly. On the other hand, the curve $S_1F''(r, 1)$ depicts a highly unproductive system in which the full employment path leads to ever diminishing per capita income. However, aggregate income rises in his system because net investment is always positive and the labour supply is increasing. It is to be noted that both the systems have diminishing marginal productivity throughout.

Professor Solow concludes his model thus: "When production takes place under the usual neo-classical conditions of variable proportions and constant returns to scale, no simple opposition between natural and warranted rates of growth is possible. There may not be…any knife-edge. The system can adjust to any given rate of growth of the labour force, and eventually approach a state of steady proportional expansion," *i.e.:*

$$\frac{\Delta K}{K} = \frac{\Delta L}{L} = \frac{\Delta Y}{Y}$$

2.6.4 A Critical Appraisal

The Solow model is a major improvement over the Harrod-Domar model. The Harrod-Domar model is at best a knife-edge balanced in a long-run economic system where the saving ratio, the capital-output ratio, and the rate of increase of the labour force are the key parameters. If the magnitudes of these parameters were to slip even slightly from the dead centre, the consequences would be either growing unemployment or chronic inflation. In Harrod's terminology, this balance is poised on the equality of Gw (which depends on the saving and investing habits of households and firms) and Gn (which depends, in the absence of technical change, on the increase of the labour force). According to Solow, this delicate balance between Gw and Gn flows from the crucial assumption of fixed proportions in production whereby there is no possibility of substituting labour for capital. If this assumption is abandoned, the knife-edge balance between Gw and Gn also disappears with it. He, therefore, builds a model of long-run growth without the assumption of fixed proportions in production demonstrating steady state growth.

Solow is a pioneer in constructing the basic neo-classical model where he certain the main features of the Harrod-Domar model like homogeneous capital, proportional saving function and a given growth rate in the labour force. He takes a continuous production function, which has come to be known as the neo-classical production function, in analysing the process of growth. The assumption of substitutability between labour and capital gives the growth process an adjustability and provides a touch of realism. Unlike the Harrod-Domar model, he demonstrates steady-state growth paths. Last but not the least, the long-run rate of growth is determined by an expanding labour force and technical progress. Thus Professor Solow has successfully shunted aside

all the difficulties and rigidities which go into the modern Keynesian income analysis.

2.6.5 Meade's Neo-Classical Model of Economic Growth

Introduction: Professor J.E. Meade of the University of Cambridge constructed a model of economic growth in his book "A Neoclassical Theory of Economic Growth". He tried to establish a relationship between population growth & economic growth.

2.6.6 Assumptions

1. No government interference
2. Closed economy
3. Perfect competition
4. Two commodities i.e. consumption goods and capital goods.
5. There is full use of hand & labour
6. Machines are the only form of capital in the economy.
7. Machines are assumed to be alike.
8. Assumption of perfect Malleability of machinery. This means that the ratio of labour to machinery can be changed both in short & long run.
9. Assumption of depreciation by evaporation. This means each year some percent of machine wears out & require replacement.

2.6.7 Explanation of Model

In an economy the net output produced depends upon four factors

$$\boxed{Y = f(K, L, N, T)} \qquad \ldots(1)$$

Y is the total output which depends upon

(a) K = Net stock of capital/machines
(b) L = Amount of working population/labour force
(c) N = Land and Natural resources
(d) T = Technical knowledge that improves over time/ Technological progress

Assuming that amount of land and natural resources (LN) to be constant. The growth of output per year depends upon the growth of K (capital), L (labour force), T (technical knowledge with time). Here T is denoted by Y' in the following equation

$$\boxed{\Delta y = f(V.\Delta K + W.\Delta L + \Delta Y)} \qquad \ldots(2)$$

Here, Δ = increase
V = Marginal product of capital
W = Marginal produce of labour

Y' = Used in place of T.

Dividing both sides by Y of equation 2.

As the annual proportionate growth rate of output is

$$\boxed{\frac{\Delta y}{Y} = \frac{V}{Y} \cdot \frac{\Delta K}{K} + \frac{W}{Y} \cdot \frac{\Delta L}{L} + \frac{\Delta Y'}{Y}} \quad ...(3)$$

Here

$\frac{\Delta Y}{Y} \Rightarrow$ Proportionate growth rate of output

$\frac{\Delta K}{K} \Rightarrow$ Proportionate growth rate of capital stock

$\frac{\Delta L}{L} \Rightarrow$ Proportionate growth rate of labour force

$\frac{\Delta Y'}{Y} \Rightarrow$ Proportionate growth rate of technological progress

$\frac{V}{Y} \Rightarrow$ Contribution of capital in output

$\frac{W}{Y} \Rightarrow$ Contribution of labour force in output

Suppose $\frac{\Delta y}{Y} = y, \quad \frac{\Delta K}{K} = K, \quad \frac{\Delta L}{L} = L,$

$\frac{\Delta y'}{Y} = r, \quad \frac{V}{Y} = U, \quad \frac{W}{Y} = Q$

Putting y, V, L, r, K, Q in equation (3)

$$\boxed{Y = UK + QL + r} \quad ...(4)$$

This shows that growth rate of output is weighted/measured sum of three other growth rates.

The real growth rate or the real index of growth is not measured by the growth rate of output/income (y) but is measured by the real income per head (y – L).

$$\therefore \quad \boxed{Y - L = UK + QL + (r - L)}$$

This shows that with technological progress, the real income per head increases.

OR

$$\boxed{(Y - L) = UK - L + QL + r} \quad ...(a)$$

This shows that with increase in capital stock, the real income per head increases.

OR

$$\boxed{Y - L = UK + (1 - Q)L + r}$$

This indicates that with the increase is labour force. The real income per head decreases. This is because as the land or natural resources are assumed constant, so more labour force on same amount of land results in decline of marginal product of labour.

To introduce savings we assume savings are equal investments (I=ΔK= S)

If $\frac{\Delta K}{K} = \frac{SY}{K}$

$$UK = \frac{VK}{Y}.\frac{\Delta K}{K} \qquad \left[\text{Since } \frac{\Delta K}{K} = \frac{SY}{K}\right]$$

$$UK = \frac{VK}{Y} \cdot \frac{SY}{K} = VS \qquad ...(b)$$

The basic relationship between growth rate of real income per head can be expressed in the following 3 ways:

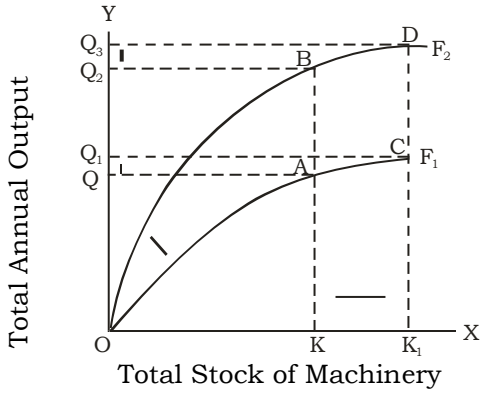
$$\boxed{Y - L = UK - (1 - Q)L + r}$$

OR

$$Y - L = \frac{VK}{Y}.\frac{SY}{K} - (1 - Q)L + r$$

OR

$$Y - L = VS - (1 - Q)\,L + r \qquad \left[\text{as } VS = \frac{VK}{Y}.\frac{SY}{K} \text{ as in b}\right]$$



First we assume that population and technical progress is constant i.e. OF_1 is the production function. When capital stock the production function. When capital stock was OK the total annual output generated was AK or OQ. But with the time as capital stock increases from OK to OK, with same

technical progress and population the increase in output is CK, or OQ. The increase in output at decreasing rate when capital stock increase because MPP_K decreases with increase because of obsolete technology. Now when technological progress – takes place but working population or labour force is still constant the production function increases to OF_2. Capital stock the output generated is BK or OQ_2. But when the capital stock increases with technological progress the total annual output increases to K, D or O Q_3. This shows that total annual output increases when capital stock and technological progress increases.

2.6.8 State of Steady Growth Rate

Prof. Meade assumed that population is not constant and it is growing at a constant proportionate rate. Whereas, the technical progress is constant. Since the population is growing at a constant rate then the growth rate in income per head (Y – L) is also constant. This signifies the state of steady economic growth.

The steady growth rate requires following 3 conditions:

(a) All elasticity of substitution of factors is equal to 1.
[Increase in capital = Fall in labour]

(b) Technical progress is neutral towards all factors

(c) The proportion of
- Profits saved
- Rents saved
- Wages saved are constant

The above three conditions explain of National income is distributed among: Profits, Rents & Wages

The savings done by the three are also in same proportion

$$\boxed{Sy = SvUY + Sw\ Qy + Sg\,ZY}$$

Here SvUY = the amount of profits saved out of the total profits
SwQY = the amount of wages saved out of total wages
SgZY = the amount of rents saved out of the total rents.

Cancelling Y from both sides

$$\boxed{S = SvU + SwQ + SgZ} \quad ...(c)$$

If Sv, Sw, Sg, U, Q, Z all are constants then 'S' is constant.

Net rate of growth output is

$$Y = UK + QL + r$$

Since labour and technical progress are constant and since equation c assumes U and Q constant then Y will be constant if K is constant.

Now K will be constant if Y/k will be constant if both grow at same rate per annum or if y = K.

∴ For steady growth rate, growth of income should be equal to the growth of capital stock (K).

2.6.9 Critical Growth Rate

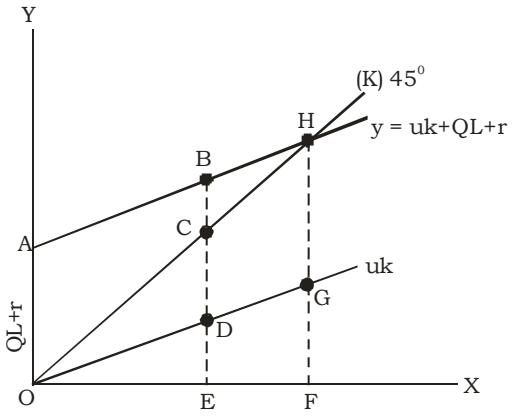
The amount in capital requires to achieve steady growth rate (y = k) is called critical growth rate. The increase in the capital stock required to achieve the equilibrium between growth rate income (y) and growth rate of capital (k). So that y = k like this steady growth is achieved.

The critical growth rate is denoted by a

$$a = Ua + QL + r$$
$$a - Ua = QL + r$$
$$a(1-U) = QL + r$$
$$a = \frac{QL + r}{1 - U}$$

The growth rate of capital (y) stock is $\frac{QL + r}{1 - U}$ and the national (y) income is $\frac{QL + r}{1 - U}$ means no increase in capital stock is required as y = k and steady growth is achieved.

$\frac{QL + r}{1 - U}\left[\frac{SY}{K}\left(\frac{QL + r}{1 - U}\right)\right]$ and national increase is $\left(\frac{QL + r}{1 - U}\right)$. This means K < Y. Means steady growth rate is not being achieved. Therefore capital stock has be increases in order to achieve steady growth rate.



Growth rate of Capital Stock

EF = Critical Growth rate of Capital

In the above diagram OX axis we take growth rate of capital stock & OY axis we take growth rate of total National output.

UK curve shows marginal product of capital.

Y curve shows total growth of NY. 45^0 (K) shows growth rate of capital stock. When capital stock is OE, the growth rate of capital stock K is CE and total national income is BE. The national income is more than the growth rate of capital by BC. This shows that the steady growth is not being achieved as K < Y. But when capital stock is increased from OE to OF the growth rate of capital stock (K) is HF and national income is also HF which shows the steady growth at point H. (where k = y). The amount of capital increased to achieve steady growth is EF which shows critical growth rate of capital.

2.6.10 Merits

(1) The Model explains the affect of population growth, K accumulation and technology progress on economic development.
(2) If also explains the conditions of steady growth.

2.6.10.1 Demerits

(1) Unrealistic assumptions: It is based on unrealistic assumptions like perfect competition, laissey faire, constant returns to Liale.
(2) Omission of Investment Function: It does not recognise the importance of investment function. If considers only the production function.
(3) Social and Institutional Factors Ignored: These factors are considered vital for development, But in this model they have been completely ignored.
(4) International Force not discussed: Role of factors like foreign capital, foreign made, international economic relations are not discussed.
(5) Obsolete in Theory: Mrs. Robinson expresses the view that theoryness does not generate K accumulation and investment decisions depend upon. Entrepreneurial experiences, government policies etc.
(6) Unrealistic in Posintates: Meade has assumed an all purpose capital good that can be used over a broad range of capital-labour caties.
(7) Grroneus in Methodology: Aggregate production function does not provide information of marginal products of production factors. A given level or a given increment of aggregate capital can represent quite different assemblies of physical equipment.
(8) Faulty in Empirical Testing: This theory lacks empirical evidence. To study practical implications of any theory it is required.

2.6.11 Conclusion

The criticism would make one conclude that this model is not good. But no model of economic growth is perfect and complete in itself, and so is the Neo classical model. There is always scope for modification and improvement. Like Solow has attempted to modify the model.

2.6.12 Questions

2.6.12.1 Long Questions

1. Critical explain Solow's model of economic growth.
2. Illustrate Growth Model of Meade. Also give to criticism.

2.6.12.2 Short Questions

Write note on the following:

1. State of steady growth rate
2. Critical growth rate

LESSON NO. 2.7 **AUTHOR : DR. RAMNA SINGLA**

UZAWA-LUCAS MODEL OF ECONOMIC GROWTH

Structure

2.7.1 Introduction

The neo-classical methodology which mainly relied on aggregate capital stock and aggregate production function, etc. has provided the modern economics a good basic starting point. The mathematical methods of dynamic optimization and differential equations have further added sophistication in the modern theory of growth.

Harrod in 1939 and Domar in 1946 tried to integrate Keynesian economic analysis with economic growth. Solow in 1956 and Swan in 1956 made another important contribution. The main aspect of Solow-Swan model is the neo-classical production function with specification of constant returns to scale, diminishing returns to capital and labour and positive elasticity of substitution between inputs.

After the mid 1980's there was lot of research on the determinants of long-run economic growth. The concept of capital was broadened to include both physical and human capital. The tendency of diminishing return to accumulation of capital was avoided. Uzawa-Lucas model of economic growth is an attempt in this direction. Uzawa developed his model in 1965 and Lucas in 1988. In these models the only input in education sector is human capital. The

presence of human capital in these models helped to avoid diminishing returns to capital. The economy in the absence of technological progress, in the presence of human capital, can lead to long-run per capita growth.

2.7.2 Objectives

The objective of this lesson is to understand the process of economic development under the conditions of the broader concept of capital. The capital has been considered in terms of physical capital as well as human capital. Moreover, the model is developed on the assumption that education sector does not utilize any amount of physical capital. Moreover, the various mathematical equations are to be understood.

Explain of Uzawa Lucas Model

Uzawa developed his model in 1965 in his article "Optimal Technical Change in an aggregative Model of Economic Growth and Lucas developed a similar model in 1988 in "On mechanics of Economic Development". Baro and Martin have given the main aspects of these models in his book under Uzawa-Lucas model. This lesson is based on the material developed by them.

2.7.3 Uzawa-Lucas Model

Uzawa-Lucas model is based on the assumption that the production of human capital does not require any physical capital i.e. $\eta = 0$, where η is share of physical capital in education. The specification $\eta = 0$ implies $v = 1$, where v is the fraction of human capital used in production of goods. It is so because of the assumption that human capital is not productive in education sector. Therefore all of it used in goods sector. The production function, thus takes the form:

$$Y = C + K + Sk$$
$$= A\, k^{\alpha} (\mu H)^{1-\alpha} \qquad ...(1)$$

Where Y is the total output which is distributed among consumption (C) and investment (K + SK). Here K is $\frac{\partial K}{\partial t}$ or net investment, and SK is the total depreciation in the physical capital. However S is the rate of depreciation. The above production function is of Cobb-Douglas type where $a + (1 - a) = 1$. It implies constant returns to scale.

In the above production Function the (μ H) is the amount to human capital. If H is the rate of growth of human capital i.e. $H = \frac{\partial K}{\partial t}$, then

$$\dot{H} + SH = B(1 - \mu) H \qquad ...(2)$$

Where δH is the total depreciation in the human capital. The gross investment in Human capital is ($\dot{H}$ + SH). It is equal to the fraction of human capital used in education, multiplied by total human capital (H) and technological coefficient ($\dot{B}$). The value of B is always positive. All these variables will be constant in the steady state.

In order to make the analysis dynamic let us use the ratios $\frac{K}{H} = W$ and $x = \frac{C}{K}$. Along with two equations given above (1 and 2) we shall get the following expressions for the growth rates of physical capital and human capital:

$$\frac{\dot{K}}{K} = A\mu^{(1-\alpha)} - x - \delta \qquad ...(3)$$

$$\frac{\dot{H}}{H} = B(1-\mu) - \delta \qquad ...(4)$$

The growth rate of physical capital-human capital ratio $\left(\frac{K}{H}\right)$ is given by

$$\frac{\dot{W}}{W} = \frac{\dot{K}}{K} - \frac{\dot{H}}{H} = A\mu^{(1-\alpha)} W^{-(1-\alpha)} - B(1-\mu) - x \qquad ...(5)$$

The growth rate of consumption in given by

$$\frac{\dot{C}}{C} = \frac{1}{\theta}(r-p) \qquad ...(6)$$

Where r is the marginal product of physical capital. It is equal to

$$\left[\alpha\ A\ \mu^{1-\alpha} W^{-(1-\alpha)} - \delta\right]$$

The growth rate of the ratio consumable goods to physical goods is given by

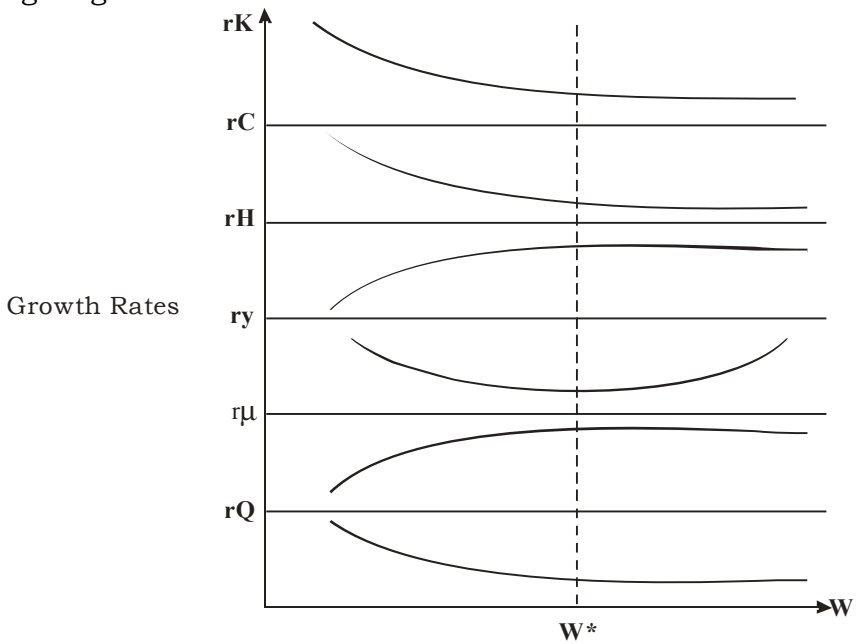
$$\frac{\dot{x}}{x} = \frac{\dot{C}}{C} - \frac{\dot{K}}{K} = \left(\frac{\alpha-\theta}{\theta}\right) A\ \mu^{1-\alpha}\ W^{-(1-\alpha)} + x^{-\frac{1}{\theta}}\left[(1-\theta)+P\right] \qquad ...(7)$$

Finally the growth rate fraction of human capital in the production sector is given by

$$\frac{\dot{\mu}}{\mu} = \frac{B(1-\alpha)}{\alpha} + B\ \mu - x \qquad ...(8)$$

2.7.4 Pattern of Growth Rates in the Uzawa Lucas Model

The pattern of growth rates in the Uzawa-Lucas model can be shown through the following diagram.



In the above diagram, along y-axis, growth rates are measured and along x-axis ratio of physical capital to human capital (W) is measured. W* is the steady state value of W. The pattern of growth rate of broad output is shown by rQ. The pattern of growth rate of human capital is shown by rH, of physical capital by rK and of goods output ry. Besides rμ is shown the pattern of fraction of capital devoted to goods production. The pattern of growth rate of consumption is shown by rC.

It is seen from the above diagram that the growth rate of human capital is monotonically increasing with an increase in W.

The growth of physical capital $\left(\frac{\hat{K}}{K}\right)$ is inversely related around the steady state position W*.

The growth rate of output of goods is shown to either rise or fall with W. The relationship of the growth rate with W is U-shaped.

The growth rate of broad output $\left(\frac{\dot{Q}}{Q}\right)$ is shown to be monotonically

decreasing function of W.

The rate of growth of consumption, the diagram shows, is a downward sloping curve with W.

2.7.5 Discussion of Uzawa-Lucas Model

In the uzawa-lucas model the pattern of the growth rate of consumption $\left(\frac{\dot{C}}{C}\right)$ is shown as inversely related with the ratio of physical capital to the human capital $\left(\frac{K}{H}\right)$. This growth ate tends to rise with the amount of imbalancing between human and physical capital, that is if human capital is more in relation to physical capital ($W<W^*$). This model shows that an economy will recover faster in response to a war because during war physical capital is mostly destroyed. Bat in case of an epidemic, the recovery of the economy will be slower because in this situation it is the human capital which is mainly destroyed.

The basic assumption of the model is that the education sector is relatively in tensive in human capital. It implies that marginal product of human capital in goods sector is high. Therefore the growth in this sector is expected to occur because of high growth rate of human capital. This fact generally persuades to allocate more human capital to production of goods rather than in education. This tends to retard the economy's growth rate when W rises above W*.

The uzawa-Lucas model of economic growth also explains the behaviour of saving rate. Gross saving, as we know, is defined as that portion of output of goods which is not consumed. The uzawa-Lucas model shows that a less developed country which starts growing with a relatively scarcity of human capital will grow at a slower rate because the gross-saving rate would be smaller.

In a two sector economy where consumer goods are produced by one technology and the human capital with another technology, then the human capital goods sector will show constant returns while the consumer goods sector follows diminishing returns.

2.7.6 Steady State Analysis

In the steady state the variable μ i.e. freedom of human capital in Production, technological coefficient (B) and the share of physical capital in education (x) are all constant. The steady state is a situation when rate of change in μ, rate of change in W and rate of change in x are all equal to zero i.e.

$$\dot{\mu} = \dot{w} = \dot{x} = 0$$

Uzawa-Lucas model with the help of various equations shows that in the steady state rate of return and growth rates of consumption, physical capital, output of goods and broad output are given by

$$r^* = B - \delta$$

Where B = technological coefficient and

δ = Rate of Depreciation

2.7.7 Generalized Uzawa-Lucas Model

Generalized Uzawa-Lucas model of economic growth is also based on the similar assumption that education is relatively intensive in human capital. But this model allows the presence of physical capital in education sector ($\mu > 0$). Since the ratio of physical capital employed in the Production sector to the human capital employed in this sector converges monotonically to its steady state value, the rate of return and growth rate of consumption conerages monotonically to their steady state values. Thus, this result is similar to the Uzawa-Lucas model with no physical capital in education sector.

Baro and Martin have shown that for the reasonable values of the parameters thXconclusions of Uzawa-Lucas Model stand provided we drop the assumption that e education sector has no physical capital. The effect of imbalance between physical capital and human capital as shown earlier are also valid for the Generalized Uzawa Lucas model of economic growth.

2.7.8 Summary

Uzawa-Lucas model is one of the attempts where the concept of capital was broadened to include both physical and human capital to explain the process of economic growth. In this model the tendency of diminishing returns to accumulation of capital was also avoided. The model considers the human capital as the only input in education to avoid the diminishing returns to capital so as to explain the long-run per capita growth in the absence of exogenous technological progress. Infact human capital takes the place of technological improvement in the theory of long-run growth.

Uzawa-Lucas model is based on the assumption that production of human capital involves no physical capital. The production used is one which corresponds to Cobb-Douglas Production Function $Y = AK^{\alpha} (\mu H)^{1-\alpha}$ where $\alpha + (1 - \alpha) = 1$, showing constant returns to scale. With the help of differential calculus variety of growth rates are derived in the model.

The dynamics of Uzawa-Lucas model of growth shows that the growth rate of consumption is inversely related to the ratio of physical capital to human

capital$\left(\frac{K}{H}\right)$. This growth rate tends to rise with the amount of imbalance between physical and human capital. The model predicts that an economy will recover faster in a situation of war because most of the physical capital is destroyed by war. If there is an epidemic, the economy will recover slowly because there is mainly loss of human capital.

The model also shows that marginal product of human capital is high in goods sector. Thus there will be a motivation to allocate more human capital to goods sector than in education. This tendency would retard the growth rate in the economy.

The Uzawa-Lucas model also shows that the developing countries would grow at a lower rate in the initial stage because of relatively scarce human capital but as the economy approaches its Steady state the growth rate will rise.

Uzawa-Lucas model also identifies the steady state conditions for an economy. The economy will be in steady state when $\dot{\mu} = \dot{w} = \dot{x} = 0$. With the help of equations, the model shows that in the steady state the rate of return, growth rates of consumption, physical capital, output of goods and broad output will be given by

$$r^* = B - \delta$$

Where B = technological coefficient and δ is for rate of Depreciation

The generalized Uzawa-Lucas model allows for presence of physical capital in the education sector and shows that results are similar to the Uzawa-Lucas model with no physical capital in education. Baro and Martin have shown that for the "reasonable" values of the parameters the conclusions of Uzawa-Lucaus model still hold provided the assumption of "no physical capital in education sector" is dropped. The imbalance between physical and human capital also does not disturb the results of Uzawa-Lucas model.

2.7.9 Meaning of the Symbols and Concepts used in the Model

- Y is the output of goods which is distributed among consumption and investment.
- η is the share of physical capital in education sector.
- α is the share of physical capital in the production sector.
- μ is the fraction of human capital used in Production. Its value lies between 0 and 1 i.e. $0 \leq \mu \leq 1$.
- v is the fraction of physical capital used in production. Its value lies between 0 and 1 i.e. $0 \leq v \leq 1$.
- $(1-\mu)$ denotes fraction of human capital used in education.

(1–v) denotes fraction of physical capital used in education.
B denotes the technological coefficient.
W is the ratio of physical capital to human capital $\left(\frac{K}{H}\right)$.
Q denotes broad output.
δ is the rate of depreciation.
P is the shadow price. It is equal to the ratio of marginal product of human capital in goods sector (wage rate) to its marginal productivity in the education sector. Shadow price depends on the ratio of physical capital.

2.7.10 Questions

2.7.10.1 Long Questions

1. Discuss the Uzawa-Lucas model of Economic Growth. Is it an improvement over Solow-Swan Model?
2. Discuss the process of economic growth when education sector does not depend on physical capital. How steady state is arrived in such a situation.

2.7.10 Write Notes on

(a) Steady State
(b) Growth of Human Capital in the Uzawa-Lucas Model
(c) Growth of Consumption in the Uzawa-Lucas Model.

References

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