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Lesson No.

1.1. :   Human Capital Model of Robert

1.2 :   Romer's Model of Economic Growth

1.3 :   Baroo and Sala-i-Martin Model

1.4 :   Theories of Migration: Lewi's and Todaro

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1.6 :   Investment Criteria

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Department website : www.pbidde.org

Lesson No. 1.1   **Author : Dr. Ramna Singla**

HUMAN CAPITAL MODEL OF ROBERT LUCAS

Lucas' Model

1.1.1 Introduction:

Uzawa developed an endogenous growth model based on investment in human capital which was used by Lucas. Lucas assumes that investment on education leads to the production of human capital which is the crucial determinant in the growth process. He makes a distinction between the internal effects of human capital where the individual worker undergoing training becomes more productive and external effects which spillover and increase the productivity of capital and of other workers in the economy. It is investment in human capital rather than physical capital that has spillover effects that increase the level of technology.

In the Lucas model, each firm faces constant returns to scale, while there are increasing returns for the whole economy. Further, learning by doing or on-the-job raining and spillover effects involve human capital. Each firm benefits from the average level of human capital in the economy, rather than from the aggregate of human capital. Thus it is not the accumulated knowledge or experience of other firms but the average level of skills and knowledge in the economy that are crucial for economic growth. In the model, technology is endogenously provided as a side effect of investment decisions by firms. Technology is treated as a public good from the point of view of its users. As a result, firms can be treated as

price takers and there can be an equilibrium with many firms as under perfect competition.

Hence, the model upon which many others have leen built, is among the most impcartant endogenous growth models . The model has two seatars the human capital producthather secter and the phiducing human capital and physical capital, respectivety.Individuals have the same level of qualification and expertise. They allocate same of chair time toward proudcing fenal goods and dedicate the remaineing tune to training and studying.

Self check Excercise-I

Q.   Explain the importance of human capital in the lucas growth model?

Ans.   ....

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1.1.2 Model:

Lucas has used production function for the determinatian of the growth procest. Human capital play an impaolant role in the process. It focus to find out how growth of physical capital & human capital affecti the process of eeonomic growth. In this model, human capital is carsideied as leeters. In the first productine sector,human and physical capital is used to crate in come. In the seeond sector only heaman capital is used to produce human capi lal which can the employed in the productive sector or in the human capital producing sector.

To present simple model of human capital production is taken as function of physical capital and human capital.

$y = k^{\alpha} h^{1-\alpha}$ .... (i)

where h – human capital, k – physical capital.

As it is known fact that one part of savings will be spent on physical capital and other part will be spent on human capital. Both these parts can be explained as follows :

The portion of savings spent on the development of physical capital taken as 's' represents the tendency of the development of physical capital :

$k(t+1) - k(t) = sy(t)$ .... (2)

Other part taken as q, represents the tendency of human capital development:

$h(t+1) - h(t) = qy(t)$ .... (3)

For sustainable development of any economy, y, k and h should grow at constant rate. Rate of growth of physical and human capital is

determined by the rate of investment. So, physical and human capital can be presented in proportion. To understand it, first of all, rate of growth of both physical and human capital is measured.

1.1.3 Rate of growth of physical capital :

To get the rate of growth of physical capital, equation (ii) is divided by k(t) and putting the value of y in eq. (f), we get;

$$\frac{k(t+1)-k(t)}{k(t)} = Sr^{1-\alpha}$$

Similarly, we can get the rate of growth of human capital.

1.1.4 Rate of growth of human capital :

$$\frac{h(t+1)-h(t)}{h(t)} = qr^{-\alpha}$$

Because, in the long run, rate of growth of physical capital is equal to the rate of growth of human capital so :

$$sr^{1-\alpha} = qr^{-\alpha}$$

$$r = \frac{q}{s}$$

This ratio can be used to get long-run rate of growth. As in the long run, rate of growth of income, rate of growth of physical capital and rate of growth of human capital will be equal. So

$$\frac{y(t+1)-y(t)}{y(t)} = sr^{1-\alpha} = qr^{-\alpha}$$

$$= s^{\alpha} q^{1-\alpha}$$

So, long-term rate of growth depend on the rate of growth of physical capital and human capital. Law of diminishing return applies to the physical capital. The growth of human capital not only supplements the diminishing returns of physical capital but also help to increase the production at increasing rate by its internal and external positive effects.

1.1.5 Internal effects of human capital :

According to Lucas, total working period of a worker is divided into two parts i.e. time spend in productive activities and time spend in the creation of human capital. If $\mu(h)$ is the time spend on productive activities and $1-\mu(h)$ will be time spend on the creation of human capital.

In an economy, the factors that affect production are not only the number of workers but also the time devoted to productive activities. If $N(h)$ is the number of workers and $\mu(h)$ is the time spent on production activities then effective labour power is the product of two.

$$Ne = \int_{0}^{\alpha} \mu(h), N(h).dh$$

If production is the function of capital stock and effective labour power then :

y = f (k, Ne)

The effect of the level of human capital of labour on the level of wages of labour is known as internal effect of human capital.

1.1.6 External effects of Human capital :

In an economy, level of human capital of any individual, not only affect his own wage rate or productivity but also affect the productivity of other individuals and whole of the economy. It is known as External effect of human capital. For this, average level of human capital is to find :

$$ha = \frac{\int_{0}^{\alpha} h.N(h).dh}{\int_{0}^{\alpha} N(h).dh}$$

In the above equation, ha is average level of human capital. In the perfect competition, all the individuals (workers) are equally productive and give equal time to work, individual level of human capital has no effect on total level of human capital and on average time of work, but average of all this definitely has effect on the level of individual human capital and working hours which is taken as external effect of human capital.

$Q = A.K^{\beta} (t) Ne1-\beta (t)$

After putting the value of Ne

$Q = A.K^{\beta} (t) [\mu(t).h(t).N(t)]^{1-\beta}$

when external effect of human capital is included.

$Q = A.K^{\beta} (t) [\mu(t).h(t).N(t)]^{1-\beta} [ha(t)]^{\alpha}$

To get more human capital, as individual increases the time in 1–μ(t), Individual and total human capital increases which increases the production and leads to the growth of economy at increasing rate. Change in human capital can be measured as follows ;

$h(\hat{t}) = [ha(t)]r . G (1-\mu(t)]$

where G denotes the rate of growth of human capital which is always positive (G>0) but on the level of human capital, law of diminishing returns applies i.e. r<0. For our convenience, if we

assume that r = 1 then the growth of human capital can be written as :

$$\hat{h(t)} = [ha(t)] \cdot G [1-\mu(t)]$$

Now two extreme cases are :

(a) If the individual spend whole of their time in work i.e. $\mu(t)=0$, then maximum rate of growth of human capital can be G. only

$$\frac{\hat{h}(t)}{\hat{h}(t)^r} = G$$

(b) On the other hand if $1-\mu(t)=0$ then rate of growth of human capital will be zero. In this situation, individuals will not spend time to get more human capital.

But generally, in an economy, the value of $\mu(t)$ and $1-\mu(t)$ varies between 0 and 1, so the economy continuously grow. Lucas in his model gives importance to growth of both human capital and physical capital.

So, it can dee concluded that individuals move. from output productia to human capital hoduction when human capital will seait reseing which further implies capital. Consumption will slaut reesing with faster capital accumulation leading to more production of goods. This will eventually lead to the growth of ecanamy.

Self-Check Excersise-2

Q. what are inteanal and extenunal affects of human capital in the determination of growth precess?

Ans ....

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1.1.7 Criticism

Like Romer's model, Lucas model is also not free from flaws:

(i) Lucas does not discuss the structural problems of under-developed and developing economies

(ii) It is the hard fact that in developing economies, there is lack of productivity due to low level of human capital. Alongwith this, these economies are suffering from inefficient distribution of resources and lack of full utilization of resources.

That is why, even a lot of investment is made in human capital in these countries, even though due to the deficiency of proper opportunities, efficient and potential working force go outside the countries. Due to brain-drain, these countries faces the problem of

economic growth. Lucas model is silent about these problems of under developed countries.

3. Developing countries are in the trap of technological dualism, so to assume that homogenous production function in all the sectors of economy is wrong.

Lucas model gives new direction to the growth model of developing economies. Because no country could sustain growth without the growth of human capital.

Conclusion:

The clzawa- luces model explains how economic growth is attrileuted to the accumelation of human capited in long them. In order to produce human capital, eduvation should lie used.

Therefore, the model aisumes that human capital is the only input elements in the education sector. It also asscmes that ecanomic output is developed lay using physical capital and human capital. As a result, the ratio of physical capital to human capital is the measurement used to determine the total capical in the ceenomy. However, the growth of physical capital is surject to law of dineemhing returns. On the other hand human cantral not only supplements the diminishing returns of physical leat it also enhances ecanin growth ley its positive internal and external of effects.

1.1.8 Long Questions :
1. Critically explain Lucas model of economic growth.
2. Explain internal and external effects of human capital.

1.1.9 Short Questions :
1. Explain rate of growth of human capital.
2. Explain rate of growth of physical capital.

1.1.10 Suggested Readings :
1. Lucas Robert E : On the mechanics of Economic Development, Journal of Monetary Economics.
2. Robert J. Barro and Xavier Sala-i-Martin Economic Growth, The MIT Press Cambridge.
3. William D. Nordham, An Economic Theory of Technological Change.
4. Paul M. Roger : Endogenous Technological Change.
5. Robert M. Solow : Technical Change and the aggregate Production Function.
6. Robert J. Barro and Xavier Sala-i-Martin : Economic Growth, the MIT Press Cambridge.

Lesson No. 1.2   **Author : Dr. Ramna Singla**

ROMER'S MODEL OF ECONOMIC GROWTH

Romer's Model

1.2.1 Introduction

Romer's model of Endogenous Technical Change of 1990 identifies a research sector specializing in the production of ideas. This sector invokes human capital alongwith the existing stock of knowledge to produce ideas or new knowledge. To Romer, ideas are more important than natural resources. He cites the example of Japan which has very few natural resources but it was open to new western ideas and technology. It imported machines from the United States during the Meija era, dismantled them to see how they worked and manufactured their better prototypes. Therefore, ideas are essential for the growth of an economy. These ideas relate to improved designs for the production of producer durable goods for final production.

In the Romer model, new knowledge enters into the production process in three ways. A new design is used in the intermediate goods sector for the production of a new intermediate input. In the final sector, labour, human capital and available producer durables produce the final product. And a new design increases the total stock of knowledge which increases the productivity of human capital employed in the research sector.

1.2.2 Assumptions

The Romer model is based on the following assumptions :
1.   Economic growth comes from technological change.
2.   Technological change is endogenous.

3. Market incentives play an important role in making technological changes available to the economy.
4. Invention of a new design requires a specified amount of human capital.
5. The aggregate supply of human capital is fixed.
6. Knowledge or a new design is assumed to be partially excludable and retainable by the firm which invented the new design.
7. Technology is a non-rival input. Its use by one firm does not prevent its use by another.
8. The new design can be used by firms and in different periods without additional costs and without reducing the value of the input.
9. It is also assumed that the low cost of using an existing design reduces the cost of creating new design.
10. When firms make investments on research and development and invent a new design, there are externalities that are internalized by private agreements.

This model recognises technological progress by introducing that the new ideas are generated by the researchers in order to obtain profits from their inventions.

1.2.3 Two main elements in Romer Model

I. Equation describing the production function.
II. Set of equations describing how the inputs for production function evolve over the time.

The model addresses the technilogical spillovers that may be present in the process of industrialisation. It is not any the seminal model leut one of particular relevane far developing countries. The model designs by assuming countries. The model desgins by assuming that growth processes desire from the fire or industry level. Each industry, individuals procues with constant returns to scare, so the model is constent with perfect competion. To some extent it matches the assumptions of solow model. But Romer depauts from solow model by assuming that the ecarniywcde capital stock (K0 psoitvely affects output at the industry level, so that there may be incresing returns to scale at the ecoanywide level.

1. Aggregate Production Function

$$y = k^{\alpha}(AL_y)^{1-\alpha} \qquad (1)$$

Where Y,K and L respectively represent output, capital and labour

α is a parameter between 0 and 1.

- If we suppose that the technology (A) (or new ideas) are given then there are constant returns to the scale.
- If level of technology (say new ideas) vary over the period of time therefore there are increasing returns to scale.
- If you double the capital, labour and stock of ideas, then you will get double the output.

2. Capital accumulates as people in the economy forego consumption at a given rate (i.e. do savings) and capital depreciates at an exogenous rate (d)

$$K^{\theta} =_{sk} Y - dk \qquad \dots\dots\dots\dots (2)$$

3. Labour is equivalent to the population, grows at some constant and exogenous rate.

$$\frac{L^{\theta}}{L} = n \qquad \dots\dots (3)$$

4. Now, if we talk about stock of ideas A (t). A is the number of new ideas produced at any given point in time. In the simplest version of the model, A° is equal to the number of people attempting to discover new ideas, LA is the multiplication of the number of people who are inventing new ideas to the rate at which they produce new ideas.

$$A^{\theta} = \delta L_{A} \qquad \dots\dots (4)$$

The rate at which researchers discover new ideas might simply be a constant. On the other hand, one could imagine that it depends on the stock of ideas that have already been invented. The rate at which new ideas are produced are :

$$\bar{\delta} = \delta . A^{\phi} \qquad \dots\dots (5)$$

Here δ and ϕ are constants. But if

$\phi > 0 \rightarrow$ stock of ideas increases and productivity increases.

$\phi < 0 \rightarrow$ We already have adequate knowledge then it becomes difficult for us to generate new ideas. Just as catching a fish becomes difficult after a point of time.

$\phi = 0 \rightarrow$ old ideas or knowledge has no link with new ideas.

By substituting equation (5) in equation (4)

$$A^{0} = \delta A^{\phi} L_{A}$$

Or

$$A^{0} = \delta L_{A}^{\lambda} A^{\phi} \qquad \dots\dots\dots$$

Here L_{A}^{λ} shows that there occur externalities.

λ shows externalities. There is some mix and match of old ideas with the new ideas which may not be new for the whole economy. (λ < 1 shows duplication of ideas.)

This model contains a full description of the factors that determine the fraction of the population employed in the research and geneating new ideas. The research sector gets rewarded with the patents that allows it to maintain a monopoly in the product invented and wages are equated across various sector. So, the reserch sector hire worked up to the point where the value it is as high as it as to the producres of final output.

Self Check Exercise
Q.   **Descibe the mai elements in the Romar's model of economic grwoth?**

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Convergence: The neo-classical theory supports the facts that there is an invese relationship between the growth and output and the intital level ofper capita income. However, new growth theory asserted that there is no invese relationship as marginal product of capital does not decline. To assess this propostion, following limear equation has been used,

$$g_i = a + b_i (PCY)_i$$

where g_i is the average growth of output per head of country over a no. of years.

a is constant

b_i is the regression coefficent.

PCY_i is the intital level of per capta income of country.

If B_i happens to the signifantly negative, then it would be a case of uncrditional carvergence. It im

1.2.4 GROWTH IN THE ROMER MODEL
What is the growth rate in this model along a balanced growth path? Provided a constant fraction of the population is employed producing ideas the model follows the neoclassical model in predicting that all per capita growth is due to technological progress.

1.2.5 The Balance Growth Path
$$g_y = g_k = g_A \qquad ....6$$

That is per capita output, the capital-labour ratio, and the stock of ideas must all grow at the same rate along a balanced growth path. If

there is no technological progress in the model, then there is no growth. But what is the rate of technological progress along a balanced growth path? The answer to this question can be given by dividing both sides of equation 6 by A yields.

$$\frac{A°}{A} = \delta \frac{L_A^\lambda}{A^{1-\phi}} \qquad ....7$$

Along a balanced growth path, $A°A/ = g_A$ is constant. But this growth rate will be constant if and only if the numerator and the denominator of the right-hand side of equation (7) grow at the same rate. Taking logs and derivatives of both sides of this equation.

$$0 = \lambda \frac{L_A}{L_A} - (1-\phi)\frac{\dot{A}}{A} \qquad ...8$$

Along a balanced growth path, the growth rate of the number of researchers must be equal to the growth rate of the population- if it were higher, the number of researchers would eventually exceed the population, which is impossible. That is, $L_A/L_A = n$. Substituting this into equation 8 yields

$$g_A = \frac{\lambda n}{1 - \phi} \qquad .... (9)$$

If we take $\lambda = 1$ and $\phi = 0$

$$g_A = \frac{1 \times n}{1 - 0} = \frac{n}{1} = n$$

$g_A = n$

This shows that growth in technological progress is equal to the growth in population.

1.2.6 Criticism

Like neo-classical models, Romer's model is also based on such assumptions which are not applicable to developing countries. It is not possible that there is same production function in any one sector and in all sectors of the economy because there is technological dualism in these countries. Secondly, due to structural differences, there are many imperfections between these developed and developing countries. These countries also suffer from many institutional difficulties – Romer's model does not pay any attention to these difficulties. So the implications of Romer's model to the developing countries becomes very limited.

Thirdly, developing and developed nations also differ in respect to their political, social and economic problems. So, to make comparison of their economic growth is not possible.

Fourthly, developing nations could not make the full utilization of their existing fixed capital due to the deficiency of capital. Romer's model is silent about this. Actually the lack of incentives cause a slow growth of economic growth.

Lastly, most of the developing countries are in transitional phase i.e. they are moving from traditional setup to modern setup. During this phase of time, mostly the factors are not efficient enough. This affects the economic growth of these countries. Romer's model discusses only the long-term causes and the solution of the long term problems.

1.2.7   Long Questions :

1. Critically explain Romer's model of economic growth.
2. What is growth rate in Romer's model?

1.2.8   Short Questions:

1. Write down the assumptions of Romer's model.
2. Explain in brief balanced growth path.

1.2.9   Suggested Readings :

1. Robert J. Barro and Xavier Sala-i-Martin Economic Growth, The MIT Press Cambridge.
2. William D. Nordham, An Economic Theory of Technological Change.
3. Paul M. Roger : Endogenous Technological Change.
4. Robert M. Solow: Technical Change and the aggregate Production Function.

Barro and Sala-i-Martin model

1.3.1 Introduction
1.3.2 Objectives of lesson
1.3.3 Definitions of Convergence.
1.3.4 Interpretation
1.3.5 Conditional Convergence
1.3.6 Conclusion
1.3.7 Short answer type questions
1.3.8 Long answer type questions
1.3.9 Recommended Books

1.3.1. Introduction

The existence of convergence across economic units is an important economic question. Labor and public finance economists want to know whether relatively poor families will remain poor for many generations and whether the dynasties that will be rich in a hundred years are the same ones that are rich today. They also want to know whether the degree of income inequality across families increases or falls over time. The reasons for finding these questions interesting are obvious to anyone interested in general welfare and to policy-makers who want to engage in redistributive policies and efforts to achieve social peace.

Macroeconomists and theorists of economic growth are interested in exactly the same questions. For them, however, the relevant unit of analysis is not the family but rather the country or the region within a country. For example, they want to know whether, in our world, rich countries will remain rich and poor countries will remain poor for many decades. They are also interested in knowing whether the distribution of world income and output across countries is becoming increasingly equal over time.

These important questions lie at the heart of the convergence debate. Even though economists have been interested in these issues for many decades, it was not until the end of the 1980s that the convergence debate captured the attention of mainstream macroeconomic theorists and econometricians.   In addition to the inherent importance of the

questions dealt with, the reason for this sudden increase in interest was two-fold. First, the existence of convergence across economies was proposed as the main way to test the validity of modern theories of economic growth. Moreover, estimates of the speeds of convergence across economies were thought to provide information on one of the key parameters of growth theory: the share of capital in the production function. For this reason, growth theorists started paying close attention to the evolution of the convergence debate. Second, and perhaps more importantly, the data set on internationally comparable GDP levels for a large number of countries became ready for use in the mid1980s. This new data set allowed empirical economists to compare GDP levels across a large number of countries economies and to look at the evolution of these levels over time, a necessary feature for the study of the convergence hypothesis.

1.3.2. Objectives of lesson
In this lesson we will study convergence,definitions, conditional convergence.

1.3.3 Definitions of Convergence.
Two main concepts of convergence appear in the classical literature. They are called β-convergence and σ-convergence. There is absolute β-convergence if poor economies tend to grow faster than rich ones1 Imagine that data on real per capita GDP for a cross-section of economies between
years t and t+T. If we estimate the following regression

$$(1) \qquad \gamma_{i,t,t+T} = \alpha - \beta \cdot \log(y_{i,t}) + \epsilon_{i,t} \, ,$$

Where $\square_{i,t,t+T}$ =log($Y_{i,t+T}/Y_{i,t})/T$ is economy I's growthrate of GDP between t and t+T, and log($y_{i,t}$) is the logaritham of economy I's GDP per capita at time t and we find β>0, then we say that the data set exhibits absolute β-convergence.

The concept of σ-convergence can be defined as follows: a group of economies are converging in the sense of σ if the dispersion of their real per capita GDP levels tends to decrease over time. That is, if

$$(2) \qquad \sigma_{t+T} < \sigma_t \ ,$$

where σ_t is the time t standard deviation of $log(y_{i,t})$ across i.[4] The concepts of σ- and absolute concepts of σ-and absoluteβ-convergence are, of course, related. If we take the sample variance $log(Y_{i,t})$ from (1), we will get a relation between σ_t and σ_{t+T} which depends on β. Intuitively, we can see that if the GDP levels of two economies become more similar over time, it must be the case that the poor economy grows faster. As an illustration, Figure 1 displays the behavior of the log of GDP per capita for two economies over time. Economy A starts out being richer than economy B. There is an initial distance or dispersion between the two levels of income. In Panel A, the growth rate of economy A is smaller than the growth rate of economy B between times t and t+T and, therefore, we say that there is β-convergence. Since dispersion at t+T is smaller than at time t, we also say that there is σ-convergence. Note that it is impossible for the two economies to be closer together at t+T without having the poor economy (in this case economy B) growing faster. In other words, a necessary condition for the existence of σ-convergence is the existence of convergenceβ.
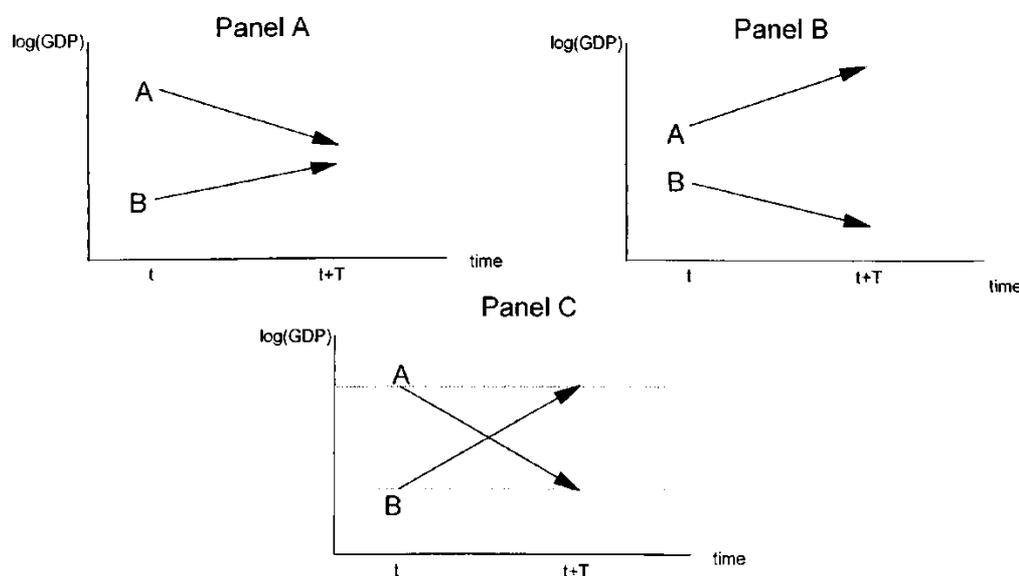

Figure 1

Moreover, it is natural to think that when a poor economy grows faster than a rich one, then the levels of GDP per capita of the two economies will become more similar over time. In other words, the existence of β-convergence will tend to generate σ-convergence. Panel A in Figure 1 is an example where β-convergence exists and is associated with σ-convergence. Panel B provides an example where the lack of β-convergence (the rich economy grows faster) is associated with the lack of σ-convergence (the distance between economies increases over time). Hence, it would appear that the two concepts are identical. However, at the theoretical level, it is possible for poor countries to grow faster than rich ones, without observing that the cross-sectional dispersion fall over time. That is, we could in principle find β-convergence without equal to the standard deviation of the level divided by the mean.

Finding σ-convergence: In Panel C, for example, where the poor economy grows faster so there is β-convergence. However, the growth rate of B is so much larger than the growth rate of A that, at time t+ T, B is richer than A. In fact, the example is such that, at time t+ T, the distance between A and B is the same as it was at time t (except that now the rich economy is B). Hence, the dispersion between these two economies has not fallen so there is no σ-convergence. In fact it could have constructed the example so that the dispersion at t+ T was larger than at t. In that case there would have been σ-divergence despite the fact of there being β-convergence. It follows that β-convergence, although necessary, is not a sufficient condition for σ-convergence.

The reason why the two concepts of convergence do not always show up together is that they capture two different aspects of the world, σ-convergence relates to whether the cross-country distribution of world income shrinks over time or not. β-convergence, on the other hand, relates to the mobility of the different economies within the given distribution of world income. Panels A and B are examples where the movements of the various economies over time changes the final distribution of income. Panel C, on the other hand, is an example where there is mobility within the distribution, but the distribution itself remains unchanged.

Having made the theoretical distinction between σ and β convergence, this distinction is not as important. The reason is that, when it comes to real world data, whenever we observe σ-convergence, we also observe β-convergence.

Maddison [1991] provided data on GDP levels across a cross-section of 13 rich countries starting in 1870. These data were constructed following the methodology of the UN's International Comparison Project (ICP) so, in principle, the data across countries can be compared and are, therefore, suitable for use in the analysis of convergence. The main disadvantage of these data is that they are available for rich countries only, a problem that proved fatal for the study of convergence. Using Maddison's data, Baumol [1986] documented the existence of cross-country convergence. He found that convergence was especially strong after world war II. This evidence, however, was quickly downplayed by Romer [1986] and DeLong [1988] on the grounds of ex-post sample selection bias. By working with Maddison's data set of nations which were industrialized ex-post (that is, by 1979), those nations that did not converge were excluded from the sample, so convergence in Baumol's study was all but guaranteed.

The solution to the sample selection problem was to analyze a larger set of countries. This is where the newly created Summers-Heston data set came in handy. This data set involved GDP levels for more than one hundred countries. Unlike Maddison's project, however, where the time series dimension of the data was quite large, the first year for which the Summers and Heston data is available is 1960. Hence, by using the Summers-Heston data set analysts could study a broader set of countries, but the cost was a much shorter time span.
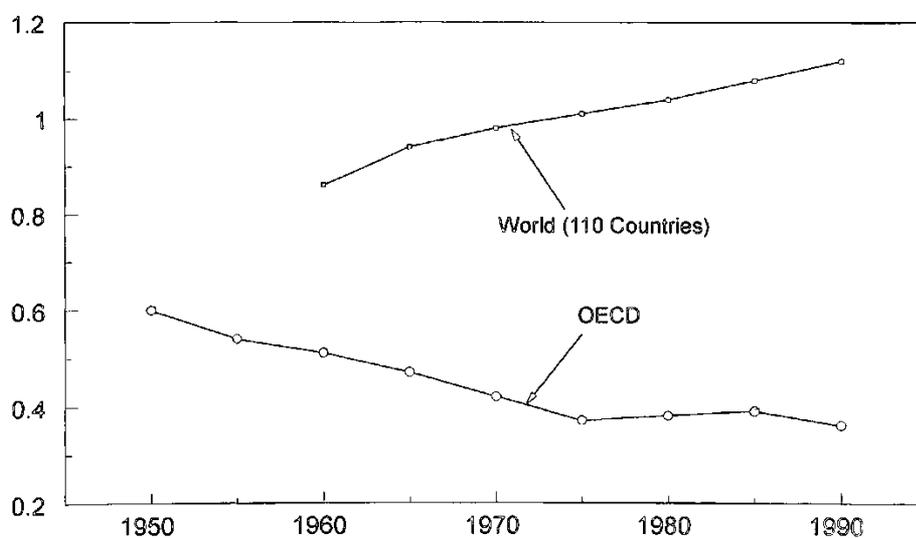

Figure 2: Dispersion of GDP Across 110 Countries

In Figure 2, I display the behavior of the dispersion of GDP per capita for the set of 110 countries for which I have data in all years between 1960 and 1990. Note that the dispersion, o, increases steadily from a=0.89 in 1960 to o=l. 12 in 1980. The cross-country distribution of world income has become increasingly unequal: we live in a world where economies have diverged (in the sense of o) over the last 30 years.
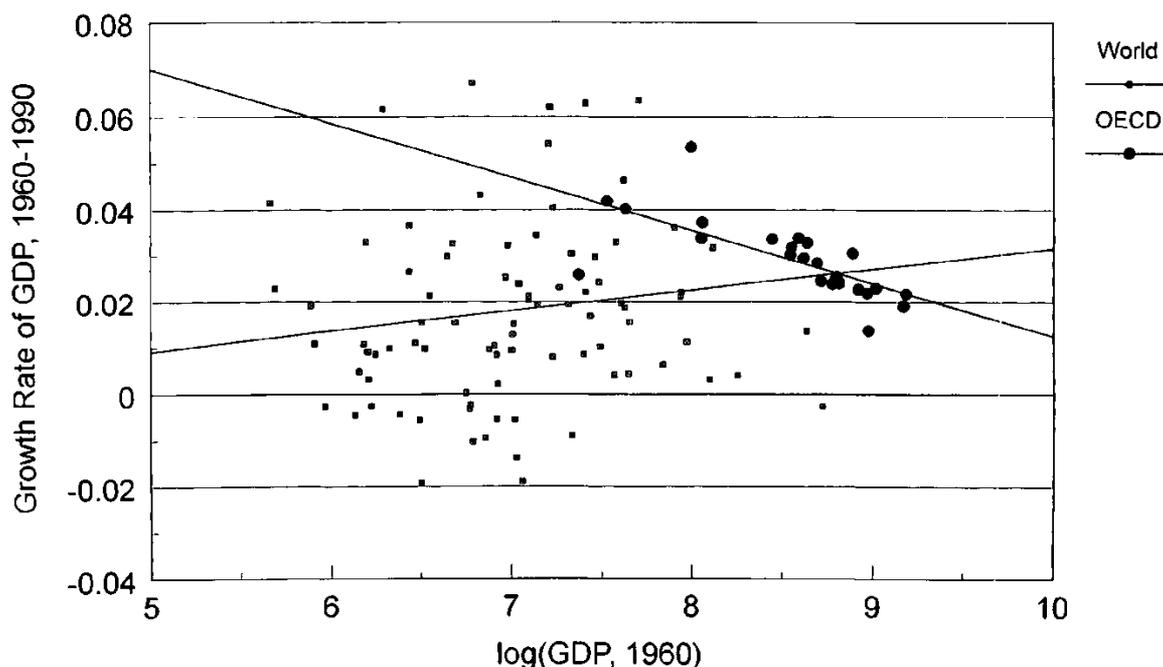

Figure 3: Convergence Across Countries, 1960

Figure 3 analyzes the existence of β-convergence across the same set of 110 economies. On the horizontal axis, I display the log of GDP per capita in 1960. On the vertical axis, I depict the growth rate between 1960 and 1990. The figure shows that the relation between growth and the initial level of GDP is not negative. In fact, the slope of the regression (also shown in the figure) is positive, although the fit is far from impressive.

In order to quantify the lack of convergence across these 110 countries, estimated the following non-linear equation.

$$(3) \quad \gamma_{i,t,t+T} = a - \left(\frac{1-e^{-\beta \cdot T}}{T} \right) \cdot \log(y_{i,t}) + \epsilon_{i,t,t+T} \cdot$$

The reason for estimating (3) instead of the linear version that appears in (1) is that I want to compare the speed of convergence across data sets that have different time lengths. The OLS coefficient in (1) would be inversely related to T(the length of the period over which I compute the growth rate.) The reason is that, if there is convergence, the growth rate should fall over time (because when the economy is richer, the growth rate is predicted to be smaller.) When we average long periods of time, we combine early periods with large growth rates with later periods with small growth rates. Hence, the growth rate predicted by the original (low) level of income is smaller the longer the time period of analysis. Note that as Tgoes to infinity, the coefficient on the linear regression (1) goes to zero. As Tgoes to zero (that is as the time period of analysis becomes short) the coefficients in the linear and non-linear equations coincide.

A second reason for estimating the non-linear equation (3) instead of (1) is that, as I will argue in the next section, the convergence hypothesis has been discussed in the context of models of growth. The log-linearization of neoclassical model around its steady state yields an equation like (3). In that context, the parameter β can be interpreted as the speed of instantaneous convergence of an economy towards its steady-state position.

1.3.4. Interpretation of these findings in the light of Models of Economic Growth: Absolute versus Conditional Convergence

The lack of convergence across countries is an interesting finding on various grounds. It says that, in our world, the degree of cross-country income inequality not only does not tend to disappear, but rather tends to increase over time. It also suggests that the countries that are predicted to be richer a few decades from now are the same countries that are rich today. These findings may be used by economists or politicians to devise international institutions of cooperation or help that tend to overturn this somber tendency.

These findings were also seen by growth theorists in the middle of the 1980s as evidence against the neoclassical model of Ramsey [1928], Solow [1956], Cass [1965], and Koopmans [1965], and as support for their new models of endogenous growth. The intuition behind this conclusion is the following: the assumption of diminishing returns to capital implicit in the neoclassical production function has the prediction that the rate of return to capital (and therefore the growth rate of capital) is very large when the stock of capital is small and vice versa. If the only

difference across countries is their initial levels of capital, then the prediction of the neoclassical growth model is that poor countries with little amounts of capital will be poor and will grow faster than rich countries with large amounts of capital, so there will be cross-country β-convergence . Since the model does not predict the type of overshooting displayed by the economies in Figure 1 's Panel C, the prediction of B-convergence   will tend to be associated with a reduction of cross-economy dispersion over time, i.eσ-convergence .

More precisely, consider a neoclassical model with a Cobb Douglas production function

$$Y_{i,t} = A_i \cdot K_{i,t}^{\alpha} \cdot L_{i,t}^{1-\alpha}$$, where $Y_{i,t}$ is economy i's aggregate output at time t, $K_{i,t}$ and $L_{i,t}$ are the

stock of capital and labor in that economy respectively, and A_i is the level of technology. Following Solow [1956], suppose that the saving rate in this economy is constant (the key results do not depend on this assumption) and that the rate of depreciation of K is δ, the rate of population growth is n and the rate of productivity growth is x   The dynamic equation that characterizes the behavior of economy i over time says that capital accumulation is the difference between overall savings and effective depreciation. If we log-linearize this dynamic equation around the steady state, we find that the growth rate of economy i between periods t and t+T is given by (3). Moreover, the parameter β is exactly equal to

$$(4) \qquad \beta = (1 - \alpha) \cdot (\delta + n + x) ,$$

whereα is again the capital share in the production function. Since, according to the neoclassical model, 0<α<l, the prediction is that β>0. In other words, the neoclassical model predicts convergence.
The Absolute Convergence Fallacy.

The argument that says that the neoclassical model predicts convergence relies heavily on the key assumption that the only difference across countries was their initial levels of capital. In the real world, however, economies may differ in other things such as their levels of A_i or their propensities to save. If different economies have different parameters, then they will have different steady states and the above argument (developed by the early theorists of endogenous growth) will be flawed. The intuition can be captured by a simple two-economy example. Imagine that the first economy is poor but is in the steady state.

Accordingly, its growth rate is zero. The second economy is richer, but has a capital stock below its steady-state level. The model predicts that its growth rate is positive and, therefore, will be larger than the growth rate of the first economy, even though the first economy is poorer! What the model says is that, as the capital stock of the growing economy increases, its growth rate will decline and go to zero as the economy reaches the steady state. Hence, the prediction of the neoclassical model is that the growth rate of an economy will be negatively related to the distance that separates it from its own steady state. This is the concept known in the classical literature as conditional β-convergence(the concept of β-convergence discussed above is sometimes called absolute convergence to distinguish it from its new conditional counterpart.) Only if all the economies converge to the same steady state does the prediction that poor economies should grow faster than rich ones hold true. The reason is that, in that case, poor economies will be unambiguously farther away from their steady state. Put in another way, only if all the economies have the same steady state, do the conditional convergence and the absolute convergence hypotheses coincide. Since the neoclassical model predicts conditional convergence, the evidence on absolute convergence discussed in the previous section says little about the validity of the model in the real world.

To test the hypothesis of conditional convergence one has to, somehow, hold constant the steady state. Classical analysts have tried to hold the steady state constant in two different ways. The first one is the introduction of variables that proxy for the steady state in a regression like (1) or (3). In other words, instead of estimating (1) or (3) one estimates

$$(5) \quad \gamma_{i,t,t+T} = a - \left(\frac{1 - e^{-\beta \cdot T}}{T} \right) \cdot \log(y_{i,t}) + \psi \cdot X_{i,t} + \epsilon_{i,t,t+T} \quad ,$$

where $X_{i,t}$ is a vector of variables that hold constant the steady state. If the estimate of β is positive, once $X_{i,t}$ is held constant, then we say that the data set exhibits conditional β-convergence.

The second way to hold constant the steady state is to restrict the convergence study to sets of economies for which the assumption of similar steady state is not unrealistic. For example, because we think that the technology, institutions, and tastes of the African economies are

very different from those of Japan or the United States, the assumption that these economies convergeto the same steady state is not realistic. However, the technological and institutional differences across regions within a country or across "similar" countries (like, for example, those of the OECD) are probably smaller. Hence, we may want to look for absolute convergence within these set of "more similar" economies.

1.3.5. Conditional Convergence

The concept of conditional convergence defined above suggests the estimation of a multiple regression like (5). If the neoclassical model is correct and the vector X successfully holds constant the steady state, we should find a positive β. The key, therefore, is to find variables that proxy for the steady state and economic theory should guide our search for such variables. Different versions of the neoclassical model suggest different variables. The strict version of the Solow model, for example, says that steady state depends on the level of technology, A, the saving rate, and the parameters δ, n, and x. A broad interpretation of "technology" would allow A to capture various types of distortions (public or otherwise), political variables, etc. Following Barro [1991], a large literature has estimated equations like (5). In this literature, more than 50 variables have been used in this type of analysis (and found to be significant in at least one regression). The key point is that, once some variables that can proxy for the steady state are held constant, the estimate of β becomes significantly positive, as predicted by the neoclassical theory. This finding is robust to the exact choice ofX. Forexample, columns 2 and 3 of Table 1 report the estimate of β when additional variables are held constant. In this particular case, the primary and secondary school enrollments, the saving rate, and some political variables are used as the vector X. Note that, unlike column 1, the estimate of β is now positive and significant, $\beta=0.013$ (s.e.=0.004). Column 3 divides the sample period 1960-1990 into two subperiods and estimates β by restricting it to be the same across sub-periods. The estimated β is 0.025 (s.e.=0.003).

The conclusion is that the sample of 110 countries in the world displays conditional β-convergence. Furthermore, the estimated speed of conditional convergence is close to 2 percent per year. I should emphasize, however, that this does not mean that poor economies grow faster or that the world distribution of income is shrinking. These are phenomena captured by the concepts of absolute β-convergence and σ-convergence and, in this sense, the set of economies diverges

unambiguously. What this evidence says is that economies seem to approach some long-run level of income which is captured by the vector of variables X, and the growth rate falls as the economy approaches this long-run level.

1.3.6. Conclusion

There are four main lessons to be gained from the classical convergence literature. First,the cross-country distribution of world GDP between 1960 and 1990 did not shrink, and poor countries do not grow faster than rich ones. Using the classical terminology, in our world there is no σ-convergence and there is no absolute β-convergence. Second, holding constant variables that could proxy for the steady state of the various economies, the same sample of 110 economies displays a negative partial correlation between growth and the initial level of GDP, a phenomenon called conditional β-convergence. Interestingly, the estimated speed of conditional convergence is close to 2 percent per Second, the speed of convergence, β, has been estimated to be within a narrow range of two percent per year (P=0.02). Although this is a very robust and strongly significant finding, I would like to emphasize that a speed of 2 percent per year is very small. For example, it suggests that it will take 35 years for half of the distance between the initial level of income and the steady state to vanish. This is quite slow.

1.3.7 Short answer type questions

Write short notes on:
(i)   Convergence
(ii)   Conditional convergence
(iii)   Absolute convergence

1.3.8 Long answer type questions

(i) Explain Barro and Sala-i-Martin'n model
(ii) Describe conditional and absolute convergence.

1.3.9 Recommended Books

1.   Development Economics by Debraj Ray
2.   Development Economics by R. Barro
3.   Development Economics by M. P. Todaro

Theories of Migration: Lewis and Todaro

4.1   Introduction

In underdeveloped or developed countries most of the population lived in rural areas and they are earning their livelihood from the agriculture sector. Lewis and Tadaro believe that there is unlimited supply of labour in the agriculture sector and disguised unemployment exists. They have tried to explain that how migration of surplus labour from rural to urban areas can be used in one way or the other way to promote the overall development of the economy.

4.2   Objectives of lesson

In this lesson we will discuss that rural-urban migration will not only reduce the excess burden of agriculture sector but it also fulfill the demand for the supply of labour for the growth of manufacturing sector and it is also beneficial for economic development.

4.3   Explanation of Lewis's theory

Lewis believes that an unlimited supply of labour may be said to exist in those

countries where population is so large relatively to capital and natural resources that there are large sectors of the economy where the marginal productivity of labour is negligible, zero or even negative. In under-developed countries an unlimited supply of labour is available at a subsistence wage. Economic development takes place when capital accumulates as a result of the withdrawal of surplus labour from the 'subsistence' sector to the 'capitalist' sector.

4.3.1 Definition of capitalist sector and subsistence sector
Capitalist Sector:

Capitalist sector is that part of the economy which uses reproducible capital and pays capitalists for the use thereof. It employs labour for wages in different segments of industrial sector for earning profits.

Subsistence Sector:

It is that part of economy which does not use reproducible capital. In this sector people live at subsistence level. Economic situations are such that which keep them continuously at subsistence level. In this sector, output per head is lower than the capitalist sector. It mainly includes agriculture which is predominantly labour intensive, uses poor techniques of cultivation and has low productivity.

4.3.2 Assumptions of the theory

Lewis starts with the assumption that there is perfectly elastic supply of labour at subsistence wage in the case of number of under developed countries. Such economies are overpopulated relatively to capital and natural resources so that marginal productivity of labour is negligible, zero or even negative.

Due to the existence of unlimited supply of labour, new industries can be established or existing industries expanded without limit at the current wage by drawing upon labour from the subsistence sector i.e. subsistence wage. The m sources from which workers would be coming for employment at the subsistence wage as economic development proceeds are the farmers, the casuals, the petty traders, the retainees (domestic and commercial) women in household and population growth.

Capitalist sector needs skilled workers. Lewis argues that skilled labour is only a 'quasi bottleneck' a temporary bottleneck, it can be removed by providing training facilities to unskilled workers.

Lewis assumes that it is the only capitalist sector which utilises its savings productively. The subsistence sector on the other hand spends their savings, if any, on the unproductive pursuits like purchase of jewellery, marriages and so on. Propensity to save of this sector is comparatively low. Lewis feels that if the pace of income generation in the industrial sector is accelerated, even at the cost of some agricultural income, it will lead to more capital formation, consequently, more industrial growth.

Self check exercise
      Q 1.   Define capitalist sector.
      Q2.   Define subsistence sector.
   Q3.   What are the assumptions of the theory?

4.3.3   The working of the theory:

What determines the subsistence wage at which surplus labour is available for employment in the capitalist sector? It depends upon the minimum earnings required for subsistence. The earnings in the subsistence sector set a floor to wage in the capitalist sector. In practice, capitalist wages are 30% higher than subsistence sector due to

    (a)   A substantial increase in output of the subsistence sector which by raising real income might induce workers ask for a higher capitalist wage before offering themselves for employment.

    (b)   If with the withdrawal of labour form the subsistence sector total product remains the same, the average product and hence the real income of those remaining behind will in the capitalist sector.

    (c)   The high cost of living and some humanitarian considerations may move the employers to raise the real wage or governments may encourage the trade unions and support their wage bargaining efforts.

The supply of labour is however considered to be perfectly elastic at the existing capitalist wage. Since the marginal productivity of labour in the capitalist sector is higher than the capitalist wage, this results in the capitalist surplus.

The savings generated in the capitalist sector through- the employment of this labour can be reinvested, leading to more employment of surplus labours form the subsistence sector, more savings more employment and so on. This process of expansion goes on for some time. Following figure explains this process.
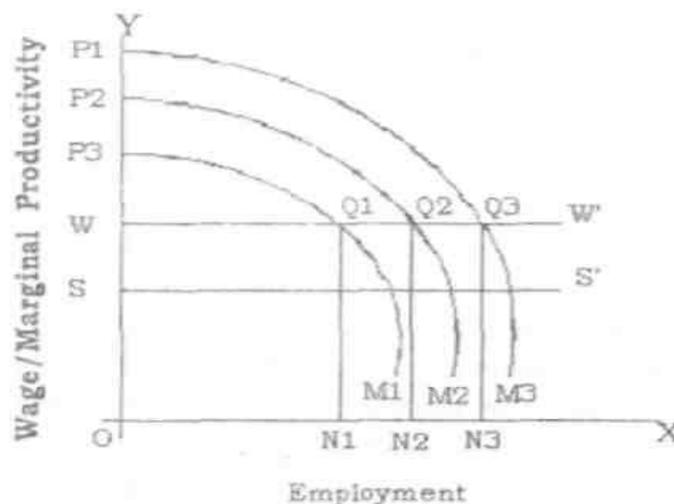
Here OS is the institutional wage is rural sector and OW represents the conventional wage in the industrial sector. The supply of labour is unlimited, as shown by the horizontal supply curve WW. In the beginning, when ON^1 labour is employed in the capital sector, its marginal productivity is $P'Q^1$ and the total output of this sector is $OP'Q^{\wedge 1}$. Out of this workers are paid wages equal to the area $OWQ'-N^1$. The remaining area $WP'Q^1$ shows surplus output. This is the capitalist surplus or total profit earned by the capitalist sector. When this surplus is reinvested the marginal productivity curve shifts upward to $P^2 Q^2 M^2$ The capitalist surplus and employment are now larger than before being WP^2Q^2 and ON^2 respectively. Further, reinvestments raise the marginal productivity curve and the level of employment to PQ^3 and ON^3 and so on till the entire surplus labour is absorbed in the capitalist sector. After this, the supply curve WW will slope from left to right upward like an ordinary supply curve, and wages and employment will continue to rise with development.

Thus, capital is formed out of profit earned by the capitalists. According to Lewis, if technical progress is capital saving, it may be considered as an increment in capital and if it is labour saving, it may be considered as an increment in the marginal productivity of labour. As such he does not make any distinction between growth of technical knowledge and the growth of productive capital.

Self check exercise

Q4.   Why capitalist wages should be more than subsistence wages?

Q5.   How are savings generated in capitalist sector?   .

4.3.4   Role of State and Private Capitalists:

According to Lewis, even the state can act as a capitalist and supplement the efforts of the private capitalist. It can even tax the subsistence sector for getting funds for investment. It can also resort to deficit financing for this purpose. The state capitalist accumulates capital faster than the private capitalist once the capitalist sector has emerged, says Lewis, it is only a matter of time before it becomes sizable.

4.3.5   Role of Bank credit

The above explanation gives the impression that capital is created out of profit, but it is also created out of the bank credit. In an underdeveloped economy which has abundant idle resources and shortage of capital, credit creating has the same effect on capital formations as of profits. It will raise output and employment. But expansion of bank credit can lead to inflation, but Lewis says, it is only for some time. When the surplus labour is engaged in the capitalist sector and paid out of created money prices rise because of income increases while consumer goods output remains constant. This is only a temporary phenomenon, as soon as capital goods start producing consumption goods, prices start falling. Lewis, in fact, feels that, "inflation for the purpose of capital formation is very different kind of fish." It is self destructive. Prices begin to rise but are sooner or later over taken by rising output, and may in the last state end up lower than they were at the beginning.

The inflationary process also comes to an end when voluntary saving increase to

level where they are equal to the inflated level of investment. As capital formation is taking place all the time, output and employment rise continuously and so do profits. Since higher profits lead to higher saving, a time will come when savings increase so much that new investments can be financed without recourse to bank credit. The analysis also applies to the government which receives back the inflation financed money in the form of taxes. Secondly, when national income increases with rising output, it is not required to resort to deficit financing.

Self check exercise

Q6.   What is the role of bank credit in economic development?

Q7.   How state can act as capitalist according to Lewis?

4.3.6   Decrease in the Pace of Expansion of the Capitalist Sector:

If unlimited supply of labour is available at a constant wage rate, the capitalist sector continues to grow and earn profit and reinvest it. As soon as the process of the transfer of the labour from the rural sector to urban sector course to halt, the progress of industrial sector, other things remaining same, slows down. According to Lewis, there are four reasons due to which labour may no longer be available to the industrial sector at constant wages.

(a)   With the capital formation gradually the surplus labour is absorbed and consequently the labour on the constant wage rate does not remain available to the capitalist sector.

(b)   If the capitalist sector expands so rapidly that it reduces absolutely the population in the subsistence sector, the average productivity of labour rises in the latter sector because there are very few people to share the product and so the capitalist wages rise in the former sector.

(c)   If as **a** result of the expansion of capitalist sector, the terms of trade turn against this sector with rising prices of raw materials and food, the capitalists will have to pay higher wages to the worker.

(d)   If the subsistence sector adopts new techniques of production, real wages would rise in the capitalist sector and so reduce the capitalist surplus.

(e)   If the workers in the capitalist sector imitate the capitalist way of life and agitate for higher wages and if successful in raising their wages, the capitalist surplus and the rate of capital formation will be reduced.

Self check exercise

Q8.   What are the reasons for which labour may no longer be available to the Capitalist sector?

Q9.   How the growth process ends up in Lewis theory?

**4.3.7   Impact of Open Economy:**

When capital accumulation catches up with the labour supply, wages begin to rise above the subsistence level, and the capitalist surplus is adversely affected. However, if there is still surplus labour in other countries, the capitalists can avoid this in one of two ways, by encouraging immigration or by exporting their capital to countries where there is still

abundant labour at a subsistence wage. These possibilities have been ruled out by Lewis himself. If abundant immigration of unskilled workers is released by the subsistence sectors of other countries then it is theoretically possible that the immigration of skilled workers may reduce the demand for the services of native unskilled workers. Mass immigration of unskilled labour is not possible because other countries with higher wages do not allow it. Second, in every country where the wage level is relatively high, the trade unions are bitterly hostile to immigration, except of people in special categories and take steps to have it restricted. The result is that real wages are higher than they would otherwise be while profits, capital resources and total output are smaller than they would otherwise be. The export of capital is therefore a much easier way out for the capitalists, since trade unions are quick to restrict immigration, but much slower in bringing the export of capital under control. The effect of exporting capital is to reduce the creation of fixed capital at home, and therefore to reduce the demand for labour. The export of capital means the excess of imports over exports and an adverse balance of payments. If the cost of imported goods is high, money wages cannot be reduced. The application of this theory to underdeveloped countries will, therefore, create balance of payment difficulties. Thus Lewis suggests strict exchange control measures for such economies.

4.3.8   A Critical Appraisal:

This theory is applicable to the over populated underdeveloped countries. Most of the assumptions of this theory are not accepted by economists and are criticised as below:-

1.   This theory is based on the assumption of the existence of disguised unemployment and removal of these workers form the agriculture sector to industrial sector do not affect the agriculture production. Schultz has tried to prove that there is no disguised unemployment in the underdeveloped countries. According to him, marginal productivity of workers in the agriculture sector may be quite low but not zero.

2.   Higgins's has highlighted the seasonal nature of agriculture. He feels that in any backward economy the whole of labour force in agriculture sector is fully employed for many weeks of the year during sowing and harvesting seasons and as such, no part can be-permanently transferred to the industrial sector. This can be done only after suitable investment in agriculture has been made for the mechanization of agriculture.

3.   Lewis assumes that the capitalist surplus is reinvested in productive capital but if the productive capital happens to be labour saving. It would not absorb the labour and the theory breaks down. This can be illustrated with the help of a diagram.

Quantity of Labour
Employment
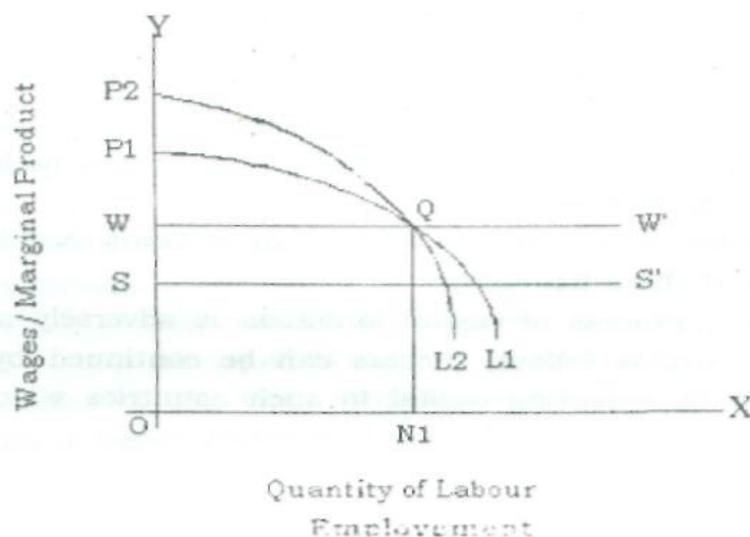
In this diagram curve P^2L^2 has a greater steeper slope than $P'L^1$ thereby showing labour saving technique. With the shift in the Marginal productivity curve upward from $P'L'$ to P^2L^2 the total output has risen substantially but the total output has risen substantially but the total wage will have been reduced.

4   Profits of the industrial sector may not be reinvested. The model assumes that entire surplus is reinvested for its further expansion. The industrialist may use their surpluses for speculative purposes. They too' can spend their surpluses on unproductive activities.

5   Only higher capitalist wages will not lead to the movement of surplus labour from the subsistence sector to the capitalist sector. People are so intensely attached to their family and land that they do not like to leave their kith and kin. This is the main weakness of the theory.

6   Lewis' view is that inflation for the purpose of capital formation is self destructive is difficult to believe in the face of acute shortage of consumer goods. Production of consumer goods fails to increase rapidly due to structural rigidities. On the other hand, the marginal propensity to consume of the people is nearly unity. So that all increase leads to inflationary rise of prices.

7   The Lewis theory is based on the assumption that a capitalist class exists in underdeveloped countries. Infact, the entire process of growth depends on the existence of such a class which has the necessary skill to accumulate capital. In reality such enterprise and initiative conspicuous by its absence in the majority of underdeveloped countries.

8   Lewis, in the analysis of dual economy theory, does not study the problem of aggregate demand. He assumes that whatever is produced in the capitalist sector is either consumed by itself or is exported. He does not even analyse the possibility of the capitalist sector selling its products to the subsistence sector.

Self check exercise
Q10.   What are the limitations of Lewis's theory?
Q11.   Critically evaluate Lewis's theory of unlimited supply of labour?

4.4 Explanation of Tadaro theory

The migration of labour from rural to urban areas is an important part of the urbanization process in developing countries. The labour-related migration from rural to urban areas, a general pattern which plays a central role in the urbanization process and is often viewed as the labour market adjustment to the inter-sectoral shift in importance from agriculture to manufacturing and services. Tadaro theory is relevant to developing countries where wages are not fixed by institutional forces. Internal migration in general and rural urban migration in particular has been viewed favourable in economic development. Rapid internal migration is thought to be a desirable process by which surplus rural labour has withdrawn from traditional agriculture to provide cheap manpower to fuel a growing modern industrial complex. The process was deemed socially beneficial, since human resources were being shifted from locations where their marginal social products were often assumed to be zero to places where these marginal products were not only positive but also rapidly growing as a result of capital accumulation and technological progress.

Numerous studies have now documented the fact that throughout the developing world rates of rural-urban migration continue to exceed rates of urban job creation and to greatly surpass the capacity of both industry and urban social services to absorb this labour effectively. Rapid migration viewed by economists as an unambiguously beneficial process necessary to solve problems of growing urban labour demand. On the contrary, migration today is being increasingly viewed as the major contributing factor to the ubiquitous phenomenon of urban surplus labour and as a force that continues to exacerbate already serious urban unemployment problems caused by growing economic and structural imbalances between urban and rural areas.

4.4.1 Assumptions of the theory

1. Two-Sectors: Rural and Urban. Rural sector produces agricultural goods and the urban sector produces manufactured goods.
2. Marginal product of labour in both agriculture and manufacturing is positive and depends on the amount of labour employed in both the sectors.
3. Producers in both sectors are profit maximisers.
4. Full employment in the rural sector.
5. Migration is positively related to the urban-rural real income differential.
6. Migration is an increasing function of the probability of obtaining an urban job.

Self check exercise
Q1.   What is rural-urban migration?
Q2.   What are the assumptions of the Tadaro theory?

4.4.2 Working of the theory

Migration exacerbates these rural-urban structural imbalances in two major direct ways. First, on the supply side, internal migration disproportionately increases the growth rate of urban job-seekers relative to urban population growth, which itself is at historically unprecedented levels, because of the high proportions of well-educated young people who dominate the migrant stream. Their presence tends to swell the growth of urban labour supply while depleting the rural countryside of valuable human capital. Second, on the demand side, most urban job creation is more difficult and costly to accomplish than rural employment creation because of the need for substantial complementary resource inputs for most modern-sector industrial jobs. People migrate to improve their education or skill level, to escape social and cultural imprisonment in homogeneous rural areas, to escape rural violence and political instability and to join family and friends who have previously migrated to urban areas.

Starting from the assumption that migration is based primarily on privately rational economic calculations despite the existence of high urban unemployment. The Todaro theory postulates that migration proceeds in response to urban-rural differences in *expected rather than actual earnings.* The fundamental premise is that as decision-makers migrants consider the various labour-market opportunities available to them as, say, between the rural and urban sectors, choosing the one that maximizes their "expected" gains from migration. Expected gains are measured by the *difference in real incomes between rural and urban work opportunities* and the *probability of a new migrant's obtaining an urban job.* A schematic framework describing the multiplicity of factors affecting the migration decision is portrayed in figure.
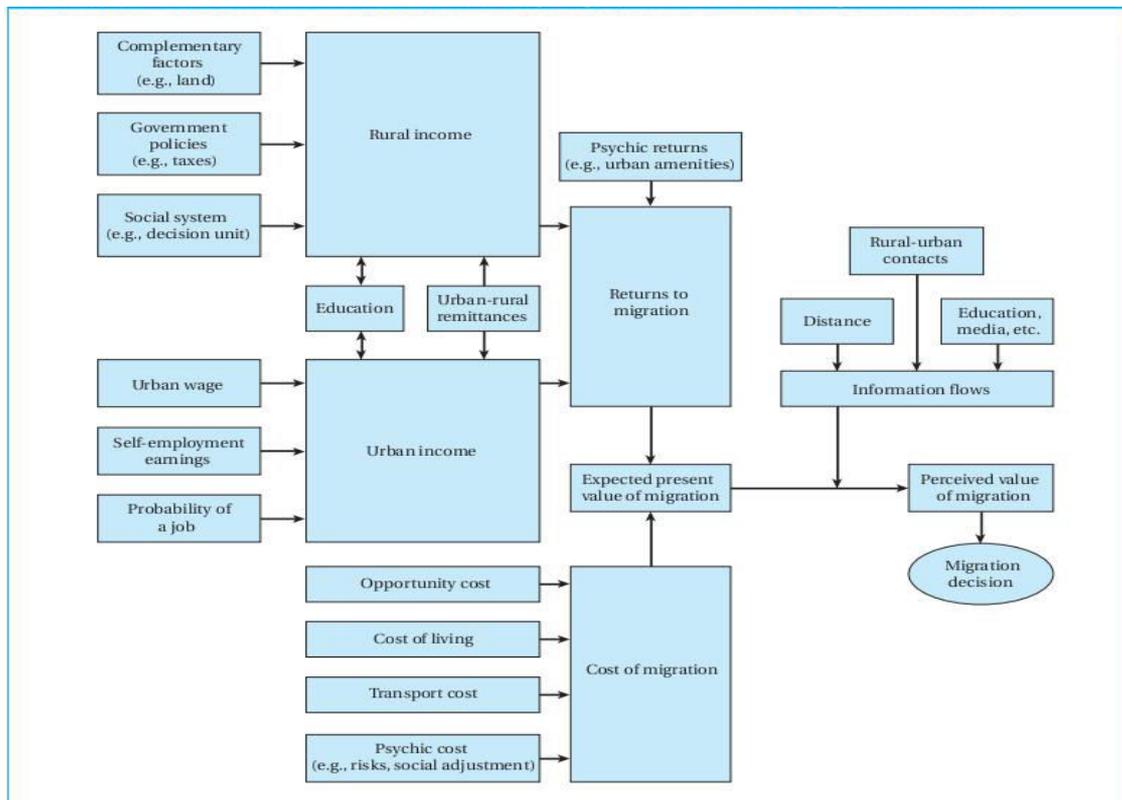
While the factors illustrated in figure include both economic and noneconomic variables, the economic ones are assumed to predominate. Decision to migrate the individual must in effect balance the probabilities and risks of being unemployed or underemployed for a considerable period of time against the positive urban-rural real-income differential. That it is possible for our hypothetical migrant to earn twice as much annual real income in an urban area as in his rural environment may be of little consequence if his actual *probability* of securing the higher-paying job within a year. The theory assumes that members of the labour force both actual and potential compare their expected incomes for a given time horizon in the urban sector with prevailing average rural incomes and migrate if the former exceeds the latter.

Suppose that the average unskilled or semiskilled rural worker has a choice between being a farm labourer for an annual average real income of, say, 50 units or migrating to the city where a worker with his skill or educational background can obtain wage employment yielding an annual real income of 100 units. The more commonly used economic models of migration, which place exclusive emphasis on the income differential factor as the determinant of the decision to migrate, would indicate a clear choice in this situation. The worker should seek the higher paying urban job but this type of analysis is not very realistic in the context of the institutional and economic framework of most Third

World nations. First, these countries are beset by a chronic and serious problem of urban surplus labour, so that many migrants cannot expect to secure high-paying urban jobs immediately upon arrival. In fact, it is much more likely that upon entering the urban labour market many migrants will either become totally unemployed or will seek casual and part-time employment in the urban traditional sector for some time.

Self check exercise

Q3. Define opportunity cost?

Q4. How migration is possible through education?

Q5. How migration is effected by economic variables?

We can understand the Tadaro theory with the help of an econometric model and a diagram.

Probability of obtaining an urban job (π) is directly related to the rate of new employment opportunities (λ) and indirectly related to the rate of unemployment (S-N)

$$\pi = \frac{\lambda N}{S-N} \qquad \qquad .....(i)$$

'N' indicates the rate of urban employment

Expected urban-rural wage differentials (d) depends on probability of obtaining urban employment (π), rural wage (r) and rate of urban employment (w)

$$d = w.\pi - r \qquad .... (ii)$$

By filling the value in (i)

$$d = w.\frac{\lambda N}{S-N} - r \qquad \qquad .... (iii)$$

The rate of new employment opportunities (λ) depends on urban wages (w) and government policy (a)

$$\lambda = f(w, a)$$

As government policies promotes new employment opportunities and if there is any change in government policy and will increase the employment means

$$\frac{\partial \lambda}{\partial a} > 0$$

If there is an increase in urban labour supply due to changes in government policy then it can be shown as:-

$$\frac{\partial S}{\partial d} = \frac{\partial S}{\partial d}.\frac{\partial d}{\partial \lambda}.\frac{\partial \lambda}{\partial a} \qquad \qquad .... (iv)$$

If government policies create new employment opportunities in urban sector and it effects the urban-rural expected wage differentials and through this there is a change in labour supply in urban sector. In the above mentioned equation we can obtain the value of $\frac{\partial d}{\partial \lambda}$ with the help of differentiation of equation (iii). In equation (iii), if there is any change in 'λ' we can examined the expected changes in rural urban income differentials and it can be written as:-

$$\frac{\partial d}{\partial \lambda} = \frac{w. N}{S\text{-}N}$$
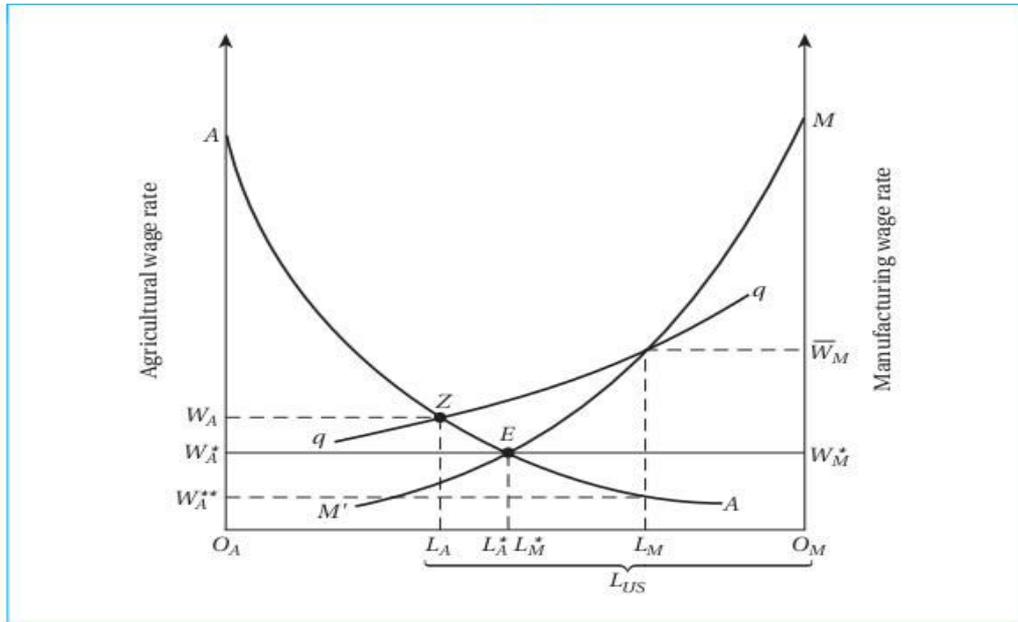
By putting the above values in equation (iv)

$$\frac{\partial S}{\partial \lambda} = \frac{\partial y}{\partial d} \cdot \frac{w. N}{S - N} \cdot \frac{\partial \lambda}{\partial \alpha} \qquad \dots \dots (V)$$

If increase in labour supply is more than rate of new employment opportunities in urban sector then there is an increase in unemployment in urban sector means disguised unemployment should be increased in the urban sector.

$$if \ \frac{\partial s}{\partial \alpha} = \frac{\partial (\lambda N)}{\partial \alpha} \ or \ \frac{\partial s}{\partial \alpha} > N \frac{\partial \lambda}{\partial \alpha}$$

or by putting the value of $\frac{\partial s}{\partial \alpha}$ from equation (iv)

$$\frac{\partial S}{\partial d} \cdot \frac{w. N}{S\text{-}N} \cdot \frac{\partial \lambda}{\partial a} > N \frac{\partial \lambda}{\partial a}$$

or

$$\frac{\partial S}{\partial d} > \frac{S\text{-} N}{w}$$

or

$$\frac{\partial S/_S}{\partial d/_d} > \frac{w. \pi\text{-}r}{w} \cdot \frac{S\text{-}N}{S}$$

Assume only two sectors, rural agriculture and urban manufacturing. The demand for labour in agriculture is given by the negatively sloped line *AA'*. Labour demand in manufacturing is given by *MM'*. The labour force is given by line OAOM. In a new classical, flexible-wage, full employment market economy, the equilibrium wage would be established at W*A= W*M with OAL*A workers in agriculture and OML*M workers employed in urban manufacturing. All available workers are therefore employed. Urban wages are institutionally determined as assumed by Tadaro at a level WM, which is a considerable distance above W*A and there is no unemployment, OMLM workers are getting urban jobs and the rest, OALM workers are working in rural areas. Now we have an urban-rural real wage gap of $\overline{W}M - W**A$, with $\overline{W}M$ institutionally fixed. If rural workers are free to migrate then despite the availability of only OMLM jobs, they are willing to take their chances in the urban job lottery. If their chances of securing one of these favoured jobs is expressed by the ratio of employment in manufacturing LM to the total urban labour pool, *LUS* then the expression

$$WA = \frac{LM}{LUS} (\overline{W}M)$$

Shows the probability of urban job success necessary to equate agricultural income WA with urban expected income (LM/LUS) ($\overline{W}M$), thus causing a potential migrant to be indifferent between job locations, the locus of such points of indifference is given by *qq'* curve in figure. The new unemployment equilibrium now occurs at point Z, where the rural- urban actual wage gap is $\overline{W}M$- WA, OALA workers are still in the agricultural sector and only OMLM of these workers have modern- sector jobs paying $\overline{W}M$ wages.

The rest OMLA- OMLM are either unemployed or engaged in low- income informal-sector activities. Thus higher proportions of rural educated migrate than uneducated- because they have a better chance of earning even higher wages than unskilled migrants.

4.4.3 Features of Tadaro theory

In summary, there are four essential features of the basic Todaro migration theory:

1. Migration is stimulated primarily by rational economic considerations of relative benefits and costs, mostly financial but also psychological.
2. The decision to migrate depends on "expected" rather than actual urban-rural real wage differentials where the "expected" differential is determined by the interaction of two variables-the actual urban-rural wage differential and the probability of successfully obtaining employment in the urban modern sector.
3. The probability of obtaining an urban job is inversely related to the urban unemployment rate.
4. Migration rates in excess of urban job opportunity growth rates are not only possible but rational and likely in the face of continued positive urban-rural expected income differentials. High rates of urban unemployment are therefore inevitable outcomes of the serious imbalances of economic opportunities between urban and rural areas of most underdeveloped countries.

4.4.4 Policy Implications of Tadaro theory

Although the Tadaro theory might at first seem to devalue the critical importance of rural- urban migration by portraying it as an adjustment mechanism by which workers allocate themselves between rural and urban labour markets, it does have importance policy implications for development strategy with regard to wages and incomes, rural development and industrialization.

1. Imbalances in urban-rural employment opportunities caused by the urban bias, particularly first city bias, of development strategies must be reduced. If urban wage rates to rise at a greater pace than migration in spite of rising levels of urban unemployment. This influx of people into urban areas not only gives rise to socioeconomic problems in the cities but may also eventually create problems of labour shortage in rural areas, especially during the busy seasons. These social costs may exceed the private benefits of migration.
2. Urban job creation is an insufficient solution for the urban unemployment problem. Tadaro assumed that migration rates are respond positively to both higher wages and higher urban employment opportunities, it follows that for any given positive urban-rural wage differential, higher urban employment rates will widen the expected differential and induce even higher rates of rural- urban migration. For every new job created, two or three migrants who were occupied in rural areas may come to the city. Thus if 100 new jobs are created, here may be a policy designed to reduce urban unemployment may lead not only to higher levels of urban

unemployment but also to lower levels of agricultural output, due to induced migration.

3. Indiscriminate educational expansion will lead to further migration and unemployment. Tadaro theory also has important policy implications for curtailing investment in excessive educational expansion, especially at the higher levels. The influx of rural migrants into urban areas at rates much in excess of new employment opportunities has necessitated a rationing device in the selection of new employees. At any given wage rate, if the probability of success in securing a modern sector job is higher for people with more education, their expected income differentials will also be higher and they will be more likely to migrate to the cities.

4. Wage subsidies and traditional scarcity factor pricing can be counterproductive. The elimination of wage distortions through price adjustments or a subsidy system will encourage more labour- intensive modes of production. Although such policies can generate more labour- intensive modes of production, they can also lead to higher levels of unemployment. The overall welfare impact of a wage subsidy policy when both the rural and urban sectors are taken into account is not immediately clear. Much will be depending on the level of urban unemployment, the size of the urban-rural expected- income differential and the magnitude of induced migration as more urban jobs are created.

5. Programs of integrated rural development should be encouraged. Policies that operate only on the demand side of the urban employment picture, such as wage subsidies, direct government hiring, elimination of factor- price distortions and employer tax incentives are probably far less effective in the long run in alleviating the unemployment problem than policies designed directly to regulate the supply of labour to urban areas. Policies of rural-urban development are crucial for development. Investment in urban areas can accelerate migration to cities; investment in agriculture can raise productivity and incomes, making labour redundant and also accelerate migration. Thus rural areas need to retain their own autonomy and poverty programs need to be tailored to the needs of rural citizens.

<div align="center">**Self check exercise**</div>

Q6. Examine the role of social, economic and private factors in economic development?
Q7. How demand and supply of labourers creates imbalance in rural-urban migration?
Q8. Critically examine the Tadaro theory of rural-urban migration?

4.5   Summary

In this lesson we have discussed that how unlimited supply of labour is useful for economic development as told by Prof. Lewis. He explains that in less developed countries capital is scarce and labour is surplus. He has interpreted the various development parameters such as population growth, technical progress, role of government and bank credit etc. The Tadaro theory explains that the migration of workers from rural to urban areas is not only depend upon the urban employment opportunities which are available to them but some social, economic and private factors like level of education, government

policies, cost of living and transport cost are also effecting the migration decisions. Thus the above mentioned theories examined the role of migration in economic development.

4.6   Keywords

Pace of expansion	:	Speed at which increase is shown
Open economy	:	An economy in which international trade is going on
Dual economy	:	Two types of economies in a country.
Subsistence wages	:	Wages required for the survival of labour.

4.7   Short answer type questions

a.   Write down assumptions of the Lewis's theory?

b.   How unlimited supply of labour is useful for economic development?

c.   What is disguised unemployment?

d.   Write down assumptions of the Tadaro theory?

4.8   Long answer type questions

a.   Critically evaluate Lewis's theory of unlimited supply of labour?

b.   Explain how economic development is possible through surplus labour?

c.   Explain the Tadaro theory of rural-urban migration?

d.   Critically examine the Tadaro theory of migration?

4.9   Suggested readings

Economic Development with Unlimited Supply of Labour: W. A. Lewis Economic Development: Michael F. Tadaro & Stephen C. Smith

Leading issues in Economic Development: Geralad M. Meier & James E. Rauch

LESSON NO. 1.5   Author : Dr. KANWALJIT KAUR GILL

PROJECT EVALUATION AND INVESTMENT DECISION

Structure

1. Objective of the lesson
2. Introduction
3. Nature and Types of Investment Decision
   3.1 Types of Investment
4. Preparation of time profile of project
   4.1 Elements of Caste
   4.2 Elements of Benefits
5. Basic Principles of Project Evaluation.
6. Methods of Project Evaluation
   6.1 The Payback Methods.
   6.2 Average accounting rate of return methods.
   6.3 Net Present Value Methods
   6.4 The internal rate of return method
7. Appraisal of Public Sector Projects
8. Suggested Reading
9. Questions
   9.1 Long-Answer type questions.
   9.2 Short Answer type questions.

1.   Objectives- Dear Students after going though this lesson you will be able to-

.   Define the concepts related with project planning and project evaluation etc.

.   Know various methods related with project evalation

.   Evaluation critically these methods

.   decide investment decision.

2.   Introduction- By a 'project' we mean any scheme, or a part of a scheme, for investing resources which can reasonably be analysed and evaluated as an independent unit. In development planning the problem of allocating investment resources evolves several choices-the choice of how much investment is to be made within the various sectors in the economy, the choice among various projects within a sector, and the choice of techniques for a particular project.

The selection of sectors, projects and techniques is complicated by the existence of a number of development objectives. There are no simple technical criteria for the ranking of investment priorities; instead capital allocation is very much a matter of judgement, since the optimal allocation depends upon what objective is being

maximized and what discounting procedure will be necessary in order to maximise the present value of the target variables through which one judges the objectives. It is, therefore, not surprising that investment criteria are applicable, depending upon different objects to be achieved over different periods of time.

For continuous growth and prosperity of the country a high level of investment is needed. This depends upon sufficient availability of capital for investment. We know that investment is a function of saving; and savings of resources means sacrifice of an immediate and certain satisfaction in exchange for a future expectation. Therefore, any investment decision, whatever is taken, is important for the well being not only in a current period but in future also. The investment decision that takes care of all such elements of business planning, like timing, place and volume of investment on the project selected, involves top level management. Therefore, first of all it becomes necessary to discuss about the nature and types of investment decisions before going through selection and evaluation of any projects.

3.   The Nature and Types of Investment Decisions.

In order to understand the meaning of investment decisions, we must try to know what the terms 'capital' and 'investment' mean. Here the terms refer simply to the 'real' assets such as machines, factories, raw materials, stock of goods produced in the process of production. The distinction is only that capital is a stock of already produced inputs or assets while investment refers of the production or acquisition of any such real capital assest. To illustrate it with the help of time element, we can say that. $I_t = C_t = C_{t+1}$

Where 'I' refers to investment, C the capital stock and t is time. When any business is started, it will be just equal to C_t. The stock of capital assets C, which also indicates the productive capacity for a commodity, will be linked with the sale of that commodity in the market. The sales volume indicates the market demand for the commodity. According to the acceleration principle, if there is continuity in the sales then stock of capital assets will be adjusted to that through new additions in the form of new investment. This shows the demand for capital and thus, for investment. It is directly derived from the demand for the product in whose production the capital is committed. Thus while taking investment decision, a thorough assessment of benefits and costs will have to be made. The difference between benefits and costs will give net benefits to the firm. These net benefits are to be calculated for the entire life of the project. Then on the basis of these net benefits the decision will be taken whether or not a project is to be undertaken. And also if there is a choice then this will also be decided that which one is to be selected. Risks and uncertainty is involved in whole of this process. Yet they are to be discussed at the time of investment decision. It is a well established fact that

the realistic plans cannot be formulated in the absence of a great deal of project planning and without proper economic appraisal of the projects. But it is also sure that a good economic appraisal of projects often cannot be made without a plan.

Several investment criteria have been propounded; but the more important are minimum capital-output ratio, maximum social marginal productivity of capital, maximum surplus over wages available for investment and maximum employment absorption. The investment decisions are taken according to these different criteria. But whatever the case may be, one has to be accurate while doing calculations, and keeping in view its limitations.

3.   Types of Investment-   There are a number of categories of investment decisions each one showing a different objective in mind. They are as follows :

(a)   Replacement Investment : In this category the firm takes decisions about the replacement of worn out and obsolete assets by new ones. The firm can decide to replace a single asset or a group of assests together. When there is replacement of a single asset, then it is called as the 'senility effect' and when there is replacement of a group of assets, it is known as the "echo effect".

(b)   Expansion Investment : In this case the firm decides to expand the existing capacity. This is also known as 'Capital widening'.

(c)   Investment on a New Business of Product Line : In this case the firm decides to start a new business or diversify into new lines of product for which a new set of machines are to be purchased.

(d)   Modernization Investment Expenditure : When a firm decides to adopt a new & better technology in place of the old one for the sake of cost reduction, it is called modernization investment. This type of investment is also know as capital deepening process.

(e)   Inventory Investment : This type of investment is done to build stock materials which is an unavoidable act for smooth functioning of a business.

4.   Preparation of Time Profile of Project

Preparation of Time Profile is a basic step in project appraisal. It is a statement of the benefits and costs occuring to a project, over its life time.

In principle, there are an infinite number of feasible projects and plans, only one of which is best of all. Thus, the division on investment between different projects in each sector should be assessed on a comparable basis.

In almost every sphere of economic activity, costs are relatively easy to estimate on a comparable basis. But it is not always sure for benefits. We must make calculations to have the broad ideas of the net benefits. This difference between benefits and costs is called net benefits.

Net Benefits = Benefits - Costs.

The series of the benefits for the entire life-span of the project is called time profile. It is also known as 'cash flow' or income-stream of a project. Such series summarise the economic benefit aspect of the project. To prepare the time profile each and every element of costs and benefits is to be accounted for in quantitative terms.

4.1   Elements of costs

There are two categories of costs for a project :

(i)   Establishment costs and

(ii)   Operating costs

1.   Establishment costs

Establishment cost shows that outlay or expenditure made by the firm for creating the capacity of production for establishing the plan and making it ready for operation. The major items of such cost would be as follows :

(a)   Preliminary or advance expenditure : The expenditure on technical and economic feasibility reports; plant design, licence fee and associated costs, cost of licence for water and power supply etc. come in this category. These costs vary from project to project and from time to time. For small scale projects many formalities like prior licence fee etc. to project are not needed and many other costs are not there. Similarly feasibility reports may not be needed in many projects like opening of a provision store.

(b)   Land and Site Development Expenditure : This includes the cost of purchasing land, expenditure done on the land for making approach roads, fencing etc.

(c)   Building and other construction costs : The expenditure on factory building, residential houses, roads, sewerage facilities supply etc. are included in this category. These costs also vary from one project to the other depending upon the nature of plants to be established, and work done inside them.

(d)   Machinery and Spare Parts : The cost of machinery includes all costs such as purchase price of machines, tax, duty, frieght charges, insurance, local transport cost and other costs associated with procurement of the machines. If a certain part of machinery is imported then cost of import licence and import duty will also be included in its cost. Sometimes, machinery is purchased on hire purchase basis. Then in order to prepare time profile, its cost will spread over the whole hire purchase period.

(e)   Tools and Equipment : In the process of production different sets of tools and equipment are needed. The value of all such tools at the plant site will be the cost of the equipment needed to carry on the business. We include tools and equipment like all types of stationery, furniture, storage shelves, uniforms and payment

to watchman if it is needed. The expenditure on all such items will be included in the establishment.

(f) **Advance Training of the Personnel** : Whenever a new plant is established and some machinery is purchased, prior knowledge to handle it is necessary, otherwise the expenditure done for the purchase of that machinery will be wasted, rather it can become a liability. For example if a computer is purchased by the statistical department then prior training will be given to the employees to handle it. This cost of training is included in the establishment cost.

(g) **Royalties** : The cost incurred in obtaining the right for the use of any asset from the government or party or a company is included in this establishment cost. Such amounts of cost are paid in two stages. Firstly, when the right to use that assest is taken and secondly, a fixed sum of proportion of sales revenue or profit is paid after certain specified intervals. Import of technology, use of brand name, or a patent right to use a market, transport-route etc. are examples of this cost.

(h) **Cost of Raising Finance** : Whenever the firm or industry is established, or when a project is planned, it needs sufficient amount of finances which any individual producer can't manage on its own. There are methods to get finance collected. Funds are raised from shares, debentures, bonds and through fixed deposits etc. Then a certain percentage from its profits are paid to the holder of all these various forms, (shares, debentures, bonds etc.). The expenses on publicity and the commission to the collecting agents etc. are included in establishment cost as "issue expenses".

(I) **Margin Money for Working Capital** : Sometimes there is a time lag between the supply of raw material and its use. Thus accordingly buffer-stocks are built and maintained. The value of such safety inventories is called margin money and is included in the establishment cost.

(II) **Operating Costs** : Once a plant is established and it is ready to be operated, the costs required to make the plant operational are called operating costs. We include the following costs in this category :

-        Raw material costs
-        Current repairs and maintenance charges
-        Labour costs
-        Rent on annual royalties
-        Fuel and power costs (operating)
-        Replacement costs
-        Taxes including excise duty and corporate income tax.

In addition to these costs there are depreciation provisions and interest charges. These costs are elemental for determining the tax-liability of the firm. To avoid double

counting normally these are excluded from the total cost stream.

4.2   Elements of benefits

In order to calculate benefits of a project one has to make estimates for the following items of benefits for every year of the project's life-span :

1. Value of products 2. Value of by-products, and   3. Other incomes

Value of products and value of by products is computed using the prices received by the firm, after making all necessary discounts. These prices taken are normally the current prices in order to account for the expected inflation and price controls by the government, but one may use constant product and input prices for computation of benefits and costs of the project for its entire life. It is just a matter of convenience that a particular method is being used. In the category of other incomes we include income earned by equipment sold, work done for consumers, and the salvage value at the end of the project.

Once benefits and costs are estimated for the entire life of the project, net benefit series, also known as cash flows or the income stream, can then be obtained by taking their difference i.e. total benefits minus total costs for every year. The cumulative series of the benefits will show the profile of the project.

5.   Basic Principles of Project Evaluation

Before discussing the methods, it will be better to mention something about the basic principles on which the techniques of project evaluation are normally based.

G. David Quirin has suggested two basic principles — 'the bigger the better' and 'the bird in hand'. Both these principles are self-explanatory and operate independently. First may not worry about the second, and vice-versa. Therefore, only one objective will be more important for any project i.e. the firm has to be very careful about its objective whether it wants greater profits or early recovery of invested capital from the proposed investment.

The investor faces two problems in project evaluation. They are :

(i)   whether a project is to be undertaken or not; and

(ii)   if there are many competing projects, then which one is to be preferred first.

6.   Methods of Project Evaluation

6.1.   The Payback Method : According to this method, decision about acceptance or rejection is taken on the basis of the length of time during which the intial investment on a project is recouped in the form of net benefits given by the project. "Pay back period" is defined as "the length of time required for the stream of net benefits produce by an investment equal to the initial capital' outlay. When a shorter payback period is being preferred over the longer one, then "the bird in hand" principle is being followed.

Method of calculating is that the payback period is computed by using undiscounted net benefits stream of a project. There is no specific provisions to take into account the time-value of the investment. Say Rs. 5,000 investment in the current period cannot be equated or compared with Rs. 5,000 after three years period. This limitation may be removed by

- taking the discounted stream as net benefits in computation of the payback period.

<center>or</center>

- adding annual interest charges on the initial investment at some appropriate rate while preparing the time profile.

Here fixed margin of return to the initial investment will also be taken over the life of the project.

There are certain advantages which make it a convenient method for project appraisal. They are :

(i)   It is easy to understand and compute. No special high-level skill is needed for making calculations. That is why sometimes it is known as layman's method of project appraisal,

(ii)   In this method all kinds of risks and uncertainties are taken into account and it is safer to recover initial investment as early as possible.

(iii)   For those firms which have high internal investment opportunities and whose sources of funds are limited, this method is most suitable. Shorter payback period will be preferred by firms with high internal investment opportunities. Similarly the firms whose cost of borrowing is high they would like to recover their investment earlier.

There are some **limitations** of this method like-

(i)   It takes no account of the time pattern of receipts e.g. earnings from an investment after the payback period are treated just as windfall gains. In fact, the worth of cash flows within the payback is over-estimated,

(ii)   This method gives no attention to discounting of future benefits and costs.

6.2.   The Average Accounting Rate of Return Method : The accounting rate of return may be defined as a percentage of profit (net of depreciation) to capital employed. There are several variations of the rate depending on the measurement of profit and capital-

-         profit may be net or gross of taxes and interest.

- capital may be taken as an initial investment or average investment during the life-span of the project or
- it may be the annual average of net book value of the project.

In order to illustrate the procedure we must take a hypothetical example shown in the following table :

Table-Accounting Return

S. No.	Item	Year 1 (Rs.)	Year 2 (Rs.)	Year 3 (Rs.)	Year 4 (Rs.)	Year 5 (Rs.)	Average for all (Rs.)
1.	Net benefits	5,000	7,500	10,000	12,500	15,000	
2.	Depreciation	6,000	6,000	6,000	6,000	6,000	
3.	Net income(-) (1) - (2)	1,000	1,500	4,000	6,500	9,000	4,000
4.	Book value of net investment as on						
	(a) Jan. 1	30,000	24,000	18,000	12,000	6,000	
	(b) Dec. 31	24,000	18,000	12,000	6,000		
5	Average net book value for the year = (a+b/2)	27,000	21,000	15,000	9,000	3,00	15,00

In this hypothetical example let us assume that an initial investment on the project is Rs. 30,000 (Row 4) and annual depreciation charges are Rs. 6,000 (Row 2). Let us assume that taxes are zero. The accounting rate of return for the project under different forms would be :-

1.   The average rate of return = $\dfrac{Rs.4,000}{Rs.15,000} \times 100 = 26.66$

The average net income and average net investment for the entire life-span of the project are used to compute this return.

2.   The accounting rate of return = $\dfrac{Rs.4,000}{Rs.30,000} \times 100 = 13.33$

Here we have taken the initial investment of Rs. 30,000 instead of using average investment for all years of the project's life span.

Similar calculations are done for different projects. The project which shows the highest rate of return would be preferred.

This method is based on the principle of 'bigger the better' ignoring the second

principle for the time being. But this method is not very popular because of some limitations :

Firstly, in this method time value of money is not taken into account which makes the method rough and crude.

Secondly, there is conceptual problem of the measurement of profit and capital.

Thirdly, this method is not suitable for ranking the projects with different life span.

6.3. Net Present Value Method :- This method involves the following steps while computing net present value of the project.

First of all we measure current cash flow i.e. gross profits before depreciation. Secondly, we measue all the investment expenditure including replacement etc.

Then we add up all the positive and negative terms. The sum gives the net cash flow. In this method time value of money is taken into consideration. Time value of money means changes in the value of money over time, because Rs. 100 today will be having a different value after say 25 years of time. It can be because of changes in the rate of interest or changes in the price. It is the power or ability of money to earn interest that changes its value over time.

Now suppose that the investor can borrow any sum of money required at fixed rate of interest. Using this market rate of interest the next step is to discount all the net current receipts, and investment expenditure back to the present and add up. The result is known as present value. It can be put as

$$\sum_{t=1}^{25\,x} = \frac{x_t}{(1+r)^t}$$

Where x is the cash flow in year t, and r is the rate of interest, Σ indicates summation of the values from one to 25, discounting compound interest backward, e.g., if rate of interest is 10% then Rs. 100 after two years will have the value equal to Rs. 121. And while Rs. 121 are discounted at 10% for two years its value will be Rs. 100.

A closely linked but not different procedure is to experiment, unit one has found that rate of discount which makes the present value equal to zero, symbolically,

$$\sum_{t=1}^{25\,x} \frac{x_t}{(1+y)^t} = 0$$

The solution for y will give us the 'internal rate of return. The feasible solution will be to make investment when y is greater than r i.e. if the internal rate of return exceeds the rate of interest. The present method is technically superior over all the other methods.

6.4.   The Internal Rate of Return (IRR) Method : This method takes into account the amount of time value, of money by discounting the future benefits and costs. It is also known as the marginal efficiency of capital. It is defined as that rate of discount at which the sum of the present value of future net benefits generated by a project during its life-span equals its initial investment cost. In other words IRR is that rate of discount at which the total present value of future benefits equals the total present value of cash outlay' on the project. This means the net present value of the project is equal to zero.

But finding the algebraic solution of IRR is somewhat difficult and complicated. In practice whenever this method is used for computations it is determined on trial and error basis by finding the net present value at different rate of discount.

7.   Appraisal of Public Sector Projects : Social Cost Benefits Criterion

Aims and objectives are different in public sector and private sector undertakings. Somethings hold good for project appraisal in public and private projects. Therefore, some modification will have to be made while making investment decision for public projects.

Public projects are evaluated on the basis of social cost benefit analysis which takes into account not only the private costs and benefits but the social costs and benefits also. In other words the contribution made by a public project to national economy etc. will be the basis for judging it, rather than its commercial profitability. This is based on the cost of Social Marginal Productivity (SMP). Two main proposals for applying this social cost benefit analysis have been advanced. One is the 'national product' criterion suggested by J. Tinbergen and the other is social marginal productivity criterion suggested by A. B. Khan. National product criterion is based on an assessment of the project's direct, indirect and secondary consequences, all values being calculated at accounting prices. On the other hand SMP criterion attempts to allocate resources in such an efficient way so that with the maximisation of the values of national product, social marginal productivity of capital is approximately equal in different uses.

All the techniques discussed above for judging the applicability are equally applicable for this also but with some modification. These modifications are :

(i)   The benefits and costs associated with a public project will be assessed from society's point of view rather than from a private investor's point of a view. There can be some aspects which may be relevant from private point of view but they may be least important for the social benefit.

(ii)   The valuation of benefits and costs in the case of public projects will be entirely different. A private project will have to use the opportunity costs or shadow prices.

(iii)   The discount rate used for public project will also be different from that used for a private project. Now instead of using market rate of interest, or any other rate, we will be using the social rate of discount.

The existing techniques of social cost-benefit analysis are more theoretical in nature, this is why they are easy to understand. Also, many simplifying assumptions are made to make them operational. But there are certain limitations also.

(i)   The various parameters particularly the shadow prices for commodities and factors of production including social discount rate, are difficult to measure.

(ii)   There is a lack of classification of the influence of political value judgement on the result of evaluation.

(iii)   The over-burdening of the project evaluation mechanism with higher levels of policy decisions on social objectives, priorities etc.

(iv)   The failure to consider other important evaluation criteria besides the economic efficiency criterion.

8.   SUGGESTED READING

1.   M.D. Little and J.A. Mirlees :   Project Appraisal and Planning
                                               for developing countries.

9.   QUESTIONS.

9.1   (i)   Discuss various methods of Project evaluation.

       (ii)   What is need of project evaluation. Discuss and baisc principles of Project evaluation.

9.2   Short questions.

       (i)   Define investment decisions.

       (ii)   Bring out various elements of cost

       (iii) What is pay back methods of Project evaluation.

       (iv)   What is criteria of project evaluation in public sector.

Investment Criteria

The Classical Economic Theory assumes perfect competition in the goods market as well as factor market. The automacity present in the system would automatically plan the investment in an optimal manner. Each factor of production, as per the marginal productivity theory, would be employed upto the point where marginal productivity of a factor of production equals its price. At the macro level factors of production go on moving from one use to another till the marginal productivities in all the uses are equalised. Under this condition, accordings to classical economists, the output produced in the economy would be optimum. Thus the investment is an endogenous variable which is planned by the internal economic forces and is not planned from outside the system. If the important assumptions of classical economics, such as perfect competition and no state intervention are met in the economic system. The classical economists were of the opinion that the system ensures that the resources would be allocated in the most efficient manner and the welfare of the society would also be optimum.

The classical economic theory of resource allocation has its own limitations in the investment planning in an economy. 'First, when resources are distributed among different uses, wealth and income also redistributed. Therefore with resources redistributed, the output may be maximised but income distribution among various uses may not be derivable from the point of society. The second weakness of the classical theory of resources allocation is that it does not provide an answer to the problem of difference between social cost and private cost, and social benefit and private benefit. For example, it may cause pollution, which is a social cost get excluded from the accounting procedure of the firm.

In the light of above mentioned difficulties in the classical criterion of investment, the developing countries seek to look for some alternative criteria which could suit to their investment planning process. During last fifty years, a number of investment criteria have been suggested in the context of planning in developing countries of the world, the main debate centres around the fact whether the planners wished to maximise current output, some future output, output overtime or employment? The other issue in this regards is whether capital as an

exclusive resource be considered by the investment planners or a broader view of scarce resources be considered. However, some of the important investment criterion are :

     (I)   Capital turonver criterion.

     (II)   Social marginal productivity criterion.

     (III)   Marginal per capita reinvestment quotient criterion.

     (IV)   Time Series criterion.

(I)   **Capital Turover Criterion :** The capital turover criterion is also known as capital output ratio criterion. This investment criterion has been suggested by J. J. Polak[1] and N.S. Bachanan[2]. The economists are of the opinion that the only way for the developing economies to come at par with the developed economies is to adopt the modern technology which is capital intensive in nature. The developing nations, which are on the path of development can come out of "cow dung and bullock cart age" only through the implementation of capital intensive technology.

     The capital turnover means the increase in output resulting from a unit investment in a project. In other words, it is ratio of increase in national output to investment made in a particular project. In symbols : the capital turnover $-\Delta Y/I$, where ΔY is the increase in national output and I is investment or increase in capital stock. The incremental capital output ratio (ICOR) is defined as $I/\Delta Y$, therefore the capital turnover is the reciprocal of incremental capital output ratio. It is also known as capital output ratio criterion.

     The developing countries are always deficient of capital and that is why these countries are sometimes also called "Capital Poor Economies" In such countries not only the stock of capital is low but the average rate of capital formation is low. The main reasons for low capital base are : low family incomes, the smallness of thrifty middle class, poorly organized capital markets, poorly organised saving institutions, conspicuous consumption among the well-to-do classes, etc. Even the social customs and expenditure on socio-religious functions also become the cause of capital deficiency in such countries.

     Since in the developing economies there is scarcity of capital, it is desirable that the investment planners should base their decision regarding investment planning on the criterion which is based on the economy of capital use. The capital turnover criterion advocates to make a choice among those investment projects which maximise rate of capital turnover. In other words, those projects be selected which minimise ICOR.

1.   J.J. Polak : Balance of payment problems of countries. Reconstruction with the help of foreign loans. Quarterly journal of economics, Feb. 1943.

2.   N.S. Bachanan : International and domestic welfare (New York, 1945).

Under capital turnover criterion a list of projects on the basis of capital turnover is prepared and then those projects are ranked in an ascending order on the bases of the values of capital turnover. In other words these projects are ranked in an ascending order of their ICOR. Then the projects with higher turnover or lower ICOR would be included in investment budget. If this criterion is followed in making selection of the investment projects, it is argued, that the objective of maximization of output and employment in the economy would be achieved.

Capital turnover criterion besides maximizing output and employment, would also help in checking the inflationary rise by increasing the production of consumer goods in the short period. Even the foreign exchange of the developing countries, which is generally scarce, will be saved by following this criterion because the projects with high turnover rate are generally import light. This investment criterion will help the developing countries to ensure equitable distribution of income and wealth, which may be one of the criterion of economic policy of these countries.

Capital turnover criterion has its own limitations. Some of the limitations are as below :

(1)   It ignores the element of time. The quick yielding projects having low capital output ratio in the short run may have high capital output ratio in the long run.

(2)   The criterion is not dynamic in nature. The problem arising on account of dating of investment relates to the difference in life of investment projects being considered for implementation. The criterion is suitable in static conditions but if the life of the investment projects is also considered then this criterion fails to give identical results. This is so because the present value of out of two projects with different vintage will be different. It may be possible that the present value of the projects with longer life may be lower than that of the projects with smaller life. In such a situation, it may be justified to select a project even with a lower incremental capital output ratio in preference to those projects with higher incremental capital output ratio.

(3)   Constancy of the incremental capital-output ratio being the basic assumption of this criterion is in itself a limitation of this project. It is well known that incremental capital output ratio is subject to change over time.

(II)   The Social Marginal Productivity Criterion

The productive capacity, the potential of an economy to produce goods and services, is exploited to produce goods and services so as to satisfy present as well as future consumption. To expand the productive capacity, the machines and capital

goods industry, along with plants and buildings are built in advance. To initiate the production process, the raw materials and even labour are arranged. The expenditure incurred on machinery, plants and building is known as investment. Therefore, to increase the productive capacity of an economy the investment becomes essential. For steady growth and prosperity, a high level of investment which depends upon the cumulative savings by individuals, business and others.

Generally, the business goes in for investment with a single objective to maximize its profitability. The returns to business from a capital asset are generally spread over the life span of the capital asset. The society also gets an opportunity to have more goods and services to staisfy the demand. Thus investment not only provides an opportunity to the firm to get the returns in terms of profit, power, prestige, etc. but also helps the economy to expand its productive capacity.

The act of investment is the selection of the most profitable project keeping in mind the financial constraint, the timing, place and volume of investment on the project selected are some of the basic issues on which the firm has to take decision is generally a difficult affair. The investment decision which takes care of all the elements of business planning is very complex. Investment decision is also called by the financial manager as capital budgeting.

The social marginal productivity criterion, is due to A.E. KAHN, H.B. CHENERY and HAGGAN[1]. It is also known as national economic profitability criterion. The maximization of current national output can be achieved, according to this criterion, by allocating investment resources in such a way that the social marginal productivity in different uses is equalized. Kahn pointed out that the correct criterion for getting maximum returns is social marginal productivity. In words of Kahn,

> "The correct criterion for obtaining the maximum return from limited resources is the social marginal productivity, taking into account the total net contribution of the marginal unit to national product and not merely that portion of the contribution (or its costs) which may accrue to the private investor."

The social marginal productivity criterion is similar to "Law of equi-marginal utility given by Marshall. Here in place of marginal utility, it should be marginal productivity. More over the social marginal productivity criterion is applicable to the whole economy and not to an individual project.

A.E. KAHN : "Investment criterion in development programmes" quarterly journal of economics, Feb. 1951. pp. 38-61 and H.B. Chenery, "The Application of investment criterion," quarterly journal of economics, Feb, 1953, pp. 76-96, and E. Haggan. "The allocation of investment in under developed countries, IAE volume reprinted 1964, Asia.

The social marginal productivity can be measured with the help of shadow prices. The shadow prices of materials and machinery can be worked out as follows :

$$\text{Shadow price of material} = \frac{\text{(Opportunity cost of the material)} \quad \text{(Rate of utilisation of the material)}}{\text{(Rate of replacement of the material)}}$$

If the difference between rate of utilisation of the material and rate of replacement of the material equals zero the shadow price of the material will be equal to opportunity cost.

If the rate of utilisation of the material is greater than the rate of replacement of the material, then its shadow price will be more than its opportunity cost.

If the rate of replacement of material is greater than the rate of utilization of the material then its shadow price will be less than its opportunity cost.

According to HOLLIS B. CHENERY the shadow price of material can be calculated by using the following formula :

$$\text{SMP} = \frac{X+E-(L+M+O)}{K}$$

Where SMP stands for social marginal productivity, X is the increased market value of output, E stands for added value of output due to external net economics. Thus, (X + E) is the value added of output. On the other hand, (L+M+O) is the cost of output. Here L is the cost of labour, M is the cost of materials, and O is the over-head cost including capital consumption allowance. In the denominator K stands for capital funds invested.

Thus, the formula to calculate social marginal productivity clearly shows a relationship between social marginal productivity and the ratio of net value added to capital funds invested. Social marginal productivity is directly related to the net value added and inversely to the capital funds invested. Higher the ratio of net value added to capital funds invested, higher will be social marginal productivity of investment and vice-versa.

The above formula to evaluate social marginal productivity is a formula to be used in a closed economy. In an open economy the foreign exchange is involved in an investment project. Therefore the balance of payment effects of an investment project must be accounted for while calculating social marginal productivity. Thus the net effect of import and export earnings can be incorporated into the formula as below :

$$\text{SMP} = \frac{X+E-(L+M+O)+Br}{K}$$

or

$$\text{SMP=}\frac{\text{V-C}}{\text{K}}+\frac{\text{Br}}{\text{K}}$$

In the above formula Br is the net effect balance of payment, V is the social value added and C is the total cost of factors. For example, if the capital is imported, then there is servicing of the debt. On the other hand the goods produced by the project if sold abroad will bring foreign exchange. Thus there can be a surplus if the cost of the imported project is lesser than the value of goods produced by the project sold abroad. Similarly if the former is greater than the latter then, the value of Br can be negative. Thus, Br can be positive or negative depending upon the surplus or deficit effect of a project.

With the help of the above mentioned formula Chenery has computed the social marginal productivity in case of number of investment projects in Italy and Greece.

The social marginal productivity criterion is of immense use towards decisions regarding investment in education, public health and areas relating to skill formation to rural areas. The criterion is also very useful for building rural development programmes because in these areas the immediate returns to investment may be low or even negligible.

Critical evaluation of the social marginal productivity criterion

In spite of the fact that the criterion is of great importance in case of investment projects related to social sectors of the economy, the criterion is not free from difficulties. The first criticism levied against this criterion is that the social productivity is not easy to measure. The International labour organisation is of the opinion that "The more extensively one adjusts market prices upwards or downwards to allow the social factors is the more one uses shadow or the accounting prices in calculating social marginal productivity. The farther one gets from the realm of objectives and more heavily one relies on subjective value judgements." Moreover many times it becomes difficult to withdraw the investment from any project even if it is found that the investment is more than desired.

The other difficulty encountered while using this criterion is related to the calculation of costs and benefits which normally are subject to change over time.

When an investment project is initiated it has linkage effects which are generally not taken into account because the social marginal productivity criterion considers the direct and once for all benefits of an investment scheme.

Further it will be wrong to assume that the marginal productivity of capital is exactly equal in all uses. At the most, it can be nearly equal, because some investments may be very large while others very small. The size of investment in fact depends upon the technology.

III.   The Marginal Per Capita Reinvestment Quotient Criterion :

W. Galenson and Harvey Leibenstein in 1955 presented an investment criterion in their paper "Investment criterion, productivity and economic development" published in Quarterly Journal of Economics. The criterion developed by Galenson and Leibenstein is called Maximization of Marginal per Capital Reinvestment Quotient'.

The objective of this criterion is that the investment resources are allocated in such a way that the marginal per capita investment becomes equal in all uses.

Factors determining size of marginal per capita investment Quotient

The size of the marginal per capita investment quotient is determined by the following factors :

(1)   the gross productivity for worker.

(2)   the amount of wage goods consumed for worker.

(3)   the replacement and repair of capital.

(4)   improvement in the skills and efficency of workers, which are not related to accumulation of capital.

(5)   a decline in mortality rate.

(6)   a decline in fertility rate.

(7)   the direction of investment.

Thus, the marginal per capita investment quotient is determined by economic as well as demographic factors.

Assumptions

The marginal per capital investment quotient criterion is based on the following assumptions :

(1)   the society is divided into two parts : (a) Labour and (b) Capitalists

(2)   the workers do not save and spend all of their wages on consumption.

(3)   the capitalists save all of their profits.

(4)   the profits are reinvested.

The reinvestment Quotient

The investment quotient is defined as below

$$r = \frac{p - ew}{k}$$

where p is the value added or output coming from the investment; e is the number of workers attached to investment; w is the real wage; and k is the cost of investment. The rate of growth is given by r.

Reinvestment criterion and the Harrod Model

The per capita reinvestment criterion is defined as

$$r = \frac{p - ew}{k}$$

$$= \frac{p}{k} - \frac{ew}{k}$$

$$= \frac{p}{k}\left[1 - \frac{ew}{p}\right]$$

$$= s/c$$

where $1 - \dfrac{ew}{p} = s$ and $\dfrac{k}{p} = c$

Thus the reinvestment formula given by Galenson and Leibenstein is equavalent to formula given by Harrod growth model. Since the Harrod's growth model is dynamic model, the per capita reinvestment quotent is also dynamic in nature. The criterion states that the growth rate will be maximized by concentrating on building of the means of production for greater volume of output and consumption in the future.

The marginal per capita reinvestment quotient

We can also desire the per capita marginal per capita reinvestment quotient as below :

$$r = \frac{p - ew}{k}$$

Dividing both sides by number of workers

$$\frac{r}{e} = \frac{\dfrac{p - ew}{e}}{\dfrac{k}{e}} = \frac{\dfrac{p}{e} - \dfrac{ew}{e}}{\dfrac{k}{e}}$$

$$= \frac{\dfrac{p}{e} - w}{\dfrac{k}{e}}$$

where $\dfrac{r}{e}$ is the marginal per capita reinvestment quotient; $\dfrac{p}{e} = $ productivity

per worker; $\dfrac{k}{e}$ is the capital labour ratio and w is the real wage rate, $\dfrac{k}{e}$ is also called capital intensity per worker.

Thus, we can define the per capita marginal reinvestment quotient as the ratio of productivity per workers $\left(\dfrac{p}{e}\right)$ minus consumption per worker to capital per workers. Where is considered as consumption per worker because all the wages are to be spent on consumption.

The above relationship clearly state that for accelerated rate of development, the developing countries should prefer the capital-intensive projects, even though capital is scarce in these countries thus the developing countries even with high pressure of population should go in for more capital per worker so as to increase the productivity per worker, otherwise the capital formation in these countries will be adversely affected. In other words, the criterion suggests for capital intensive projects rather than adoption of labour intensive projects in the developing countries.

The criterion of marginal per capita reinvestment also suggests that for maximizing growth and income in the developing economiecs the available capital should be distributed among various uses in such a manner that per capita marginal reinvestment quotient is equalised.

The Galenson and Leibenstin criterion is built to consider the influence of projects on the rate of capital formation. The criterion is also to take into consideration the effect of choice of projects on the distribution of these income among those who save and these who spend. The criterion suggests the choice of capital intensive projects in which the use of labour is minimum and hence wage-fund in terms of wages is also minimum. The level of per capita output is believed to be determined by the capital-labour ratio. The amount of capital available per worker, on the other hand, depends upon the level of profits generated from the original investment. The level of profits, has been defined as the surplus over wages. These profits are reinvested into the economy of the developing countries for capital formation. Consequently, development takes place in the developing countries.

Critical Evaluation

The investment criterion suggested by Galenson and Leibenstein is though an improvement over the other criterion it seems to have failed to consider the present consumption and welfare and concetrates only on building up such capital projects which would generate a greater volume of output and consumption in the future. In the developing countries the most of the people are living at the subsistence level.

For them the present level of income and hence consumption is more relevent than that of future income or consumption. When people have a high time preference for the present consumption over future consumption the planning authorities of the developing countries are expected to adopt less capital intensive pattern of investment. It clearly implies that the adoption of marginal per capital reinvestment quotient criterion may fail in the developing countries where the objective function is to maximize the present consumption.

Galenson-Leibenstein criterion of investment, it is pointed out, is not different from the static neo-classical optimising criterion of private firm because as per this criterion the point of maximium surplus is where the marginal product of labour is equal to the wage.

Moreover, the most of the developing countries are labour surplus and capital deficient. The marginal per capita reinvestment quotient criterion suggested by galenson and Leibenstein is contrary to the real position of resource endowment in most of the developing countries.

No doubt in the initial period of development and economic planning the developing countries are required to build their capital base by importing machinery and capital goods, but this have an adverse affect on the balance of payment position of the developing countries. The marginal per capita reinvestment quotient criterion fails to consider such an effect.

This criterion is based on the strong assumption that labour as a class do not save and spend whole of the wages on consumption. On the other hand, it is assumed that by the capitalist as a class all the profits are saved. If this assumption is violated i.e. if the marginal propensity to consume of these engaged in production increases then the saving which ultimately are for investment is bound to be affeded adversely.

The critics have also pointed out that the maximization of current rate of investment for future growth would certainly have an adverse effect on the distribution of income and employment. Most of the developing nations have one of the important objective of development planning to reduce income inequality and unemployment. Therefore the reality prevailing in the developing countries may not allow the application of marginal per capita reinvestment quotient criterion.

IV.   The Time Series Criterion :

The Time Series criterion has been put forward by M. Dobb and A.K. Sen. According to this criterion the investment planners have to adopt a finite time horizon because the increase in output, consumption and employment can not be indefinitely postponed. The time horizon depends upon waiting capacity of the community to realise the reward of their present investment. Here comes the assessment of the planners about the waiting capacity of the community. After fixing the time horizon, the total return to society from different projects are listed. The project which gives the highest

sum total of returns over the time horizon decided by the planner is selected.

Obviously the returns will be lower in the initial period in case of project A, which is capital intensive. This is so because of long gestation period of such project. The breakeven point in project A will be reached late. In contrast the returns in initial period in case of project B which is labour intensive is high and the breakeven point reaches fast. After the breakeven point the output of capital intensive techniques goes up and remains high. The costs and output in case of both projects can be projected over the entire life span of the project. The project which is less costly and more revenue generating in the time horizon selected by the planners will be taken up.
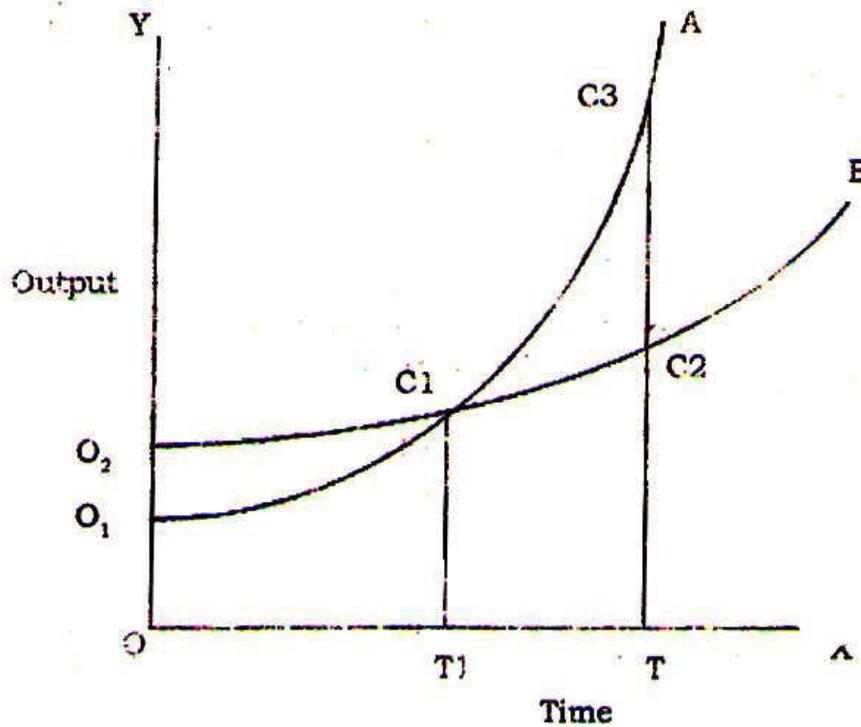
Figure–1

To illustrate let us consider two projects A and B having same cost, but the former is a capital intensive project. Since the project A is capital intensive the annual returns in the first few years is less than that of the project B. But after the break even point where the annual returns of both the projects are equalised the annual returns of project A exceeds the annual returns from project B. If the time horizon is of n years, in which the sum of annual output flows of both projects is equal, then the time series flow of output of consumer goods from projects A and B respectively can be shown through the following diagram which is reproduced from Sen.

It is seen from the above diagram-1 that A and B curves show the annual flow of real output during a given time horizon with the projects A and B, which are respectively capital intensive and labour intensive. Technique B gives higher output in the begining years of the project but the rate of growth of annual output falls below the rate of growth of annual output of the project A. Up to the time period T_1, the output of technique B is more than output of technique A. After time T_1, the technique A's output becomes more than the output produced by Technique B. At the point of time T, the project with Intensive Technology makes up its deficiency by producing C_1, C_2, C_3 more than the project B which is labour intensive. The period from T_1 to T is called by Sen, "the period of recovery". During this recovery period the sum total of output measured by the area $O_1O_2O_3$ = area $C_1C_2C_3$.

Now the question arises how to make a selection between the investment project A and B ? For selecting a project the period of recovery is compared with the period of Time horizon. If the time horizon chosen by the planners on the basis of community expectations is E, then the choice of project will be as follows :

(a)   If E > T, Capital intensive project A will be selected.

(b)   If E < T, Labour intensive project B will be selected.

(c)   If E = T, The planner will be indifferent and either of the two projects can be selected.

(d)   If E = 1, It will be equivalent to capital turnover criterion and project B will be favoured because the community has shown interest in maximization of current output.

(e)   If E = α, then the project A will be selected because the community is interested in maximization of output at some future point of time.

In the above example we have considered the two projects with same cost. The Time series criterion can also be applied if the costs of two projects also differ. In case of the capital intensive projects the initial cost is generally larger but the operating cost is lesser than the labour intensive project. In such case the decision to select the project is made as below :

(a)   If the excess of initial cost of the capital intensive project is less than the saving in the operating cost after the recovery period, then the capital intensive project A is to be preferred to labour intensive technique.

(b)   If the excess of initial cost of project A is greater than the saving in its operating cost in the recovery period then the project B is to be preferred to project - A a capital intensive technique.

The Time series criterion of investment planning is also not free from criticism. Since the whole of the analysis of selecting project depends upon the time horizon, it may be possible that time horizon may not be correctly known. This criterion suggested

by A.K. Sen is of limited importance.

In this lesson, you have read that the investment decisions are among the most difficult decisions. For a firm to make such decisions not only influence the growth of the firm in the long run but also affect the risk of the firm. Investment decisions involve commitment of large amount of funds which are irreversible or reversible at substantial loss. Thus in modern times the allocation of resources in an efficient manner becomes the most important function of a firm. For allocation of scarce resources in an efficient manner so as to maximise the national income becomes so important for the capital deficient developing countries. That the public authorities can take decisions on allocating scarce resources by making a choice between capital intensive and labour intensive techniques. The economists have given a number of investment criteria, some of which are :

(a)   Capital - Turnover criterion
(b)   Social Marginal Productivity Criterion
(c)   The Reinvestment Criterion
(d)   The Time Series Criterion

The above mentioned investment criteria have been propounded for planning in the developing countries of the world. Each criterion has its own limitations. The basic issue for consideration of the planners is what should be maximised ? Either the present output or the future output is to be maximised. The choice between output over a period of time or employment maximisation remains.

The capital-turnover criterion suggests that the planners should select projects with low capital output ratio so that the scarce capital resources could be saved for reinvestment into other projects. The advocates of this criterion are of the opinion that following this criterion the inflationary tendencies in the developing countries could be checked because the capital light and quick yielding projects will increase the supply of consumer goods in the shortest possible time. Further such projects may also ensure equitable distribution of income and wealth in the LDC's. Besides the projects with light import contents may not put pressure on the scarce foreign exchange reserves of LDC's.

The social marginal productivity criterion laid stress on equalisation of social marginal productivity of capital in different uses so as to maximise the current national output. According to this criterion, while planning investment in LDC's, the various projects considered are to be ranked in an ascending order of their social marginal products and only those projects are to be selected which have higher social marginal productivity. This criterion, though having many practical difficulties, is most suitable for investment in social infrastructure building, especially in rural areas of LDC's, where the immediate economic returns are low.

The marginal per capita reinvestment quotient criterion takes a dynamic

view of the allocation of resources in LDC's. It considers the maximisation of output and consumption at some later date rather than maximising the current national output. This criterion also suggests that to achieve this objective the rate of saving and investment in the economy is also to be maximised. Infact this criterion advocates capital intensive techniques of production which have the benefits of long life of capital assets. Such projects may be creating lesser employment in the short period but are capable of creating more employment in the long run.

The Time series criterion considers that the returns of investment depends on techniques alone. But it is well known that external economies, the performance in the related sectors also affects the return which the criterion has completely ignored. Moreover, forecasting the future flow of output over time is very difficult in the presence of uncertainty in the wage rate, MPC, etc. Thus the costs/returns may not be judged correctly for the entire time period.

QUESTIONS FOR YOUR PRACTICE

1. Which type of investment criteria do you find suitable for underdeveloped countries ?

2. What are the difficulties in the application of the rate of turnover criterion and the social marginal productivity criterion ?

3. Critically examine Sen and Dobb's investment approach called the Time Series Criterion.

4. Critically Evaluate "The Marginal Per-Capita Reinvestment Quotient Criterion."

5. Discuss in detail the use of the marginal per capita reinvestment Quotient criterion in the development process of developing economices.

Suggested Readings

1. Meier, Gerald M (ed.) , Leading Issues in Economic Development (New York : Oxford University Press, 1970).

2. W.Galenson and Harvey Leibenstein, "Investment criteria, productivity and Economic Development Quarterly, Journal of Economics, Aug. 1955."

3. A.P. Thirlwall, "Growth and Development with special reference to Developing Economies."

LESSON NO. 1.7   AUTHOR : DR. VIPLA CHOPRA AND MS. JYOTI

CHOICE OF APPROPRIATE TECHNOLOGY AND EMPLOYMENT

STRUCTURE

I.   Introduction :

The problem of choice of appropriate technology refers to the type of combinations for any particular project or enterprise. A combination chosen in any particular case gives the type of technique.

Choice of technique may take different forms in different fields. It is easy to see why it is- so important to discover the implications of choosing one technique rather than another. "Different techniques give different strategies of economic development with varied effects on the performance of the economy."

The ultimate objective is to choose that technique which is more efficient than another technique keeping in view the existing factor proportions. An efficient technique is one that minimizes the cost of output or maximizes the output from given inputs.

The choice of appropriate technique in a country is a difficult and complex problem. In underdeveloped countries there is scarcity of capital and abundance of labour. The two major factors pose the problem of choice of techniques- that of using the traditional or the modern methods of production.

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1.   A.K. Sen, Choice of Techniques, p. 11.

These countries are faced with an urgent problem of accelerating the rate of economic growth which require a higher level of productivity for which the use of modern capital intensive technique is a must. But their capacity for adopting capital intensive technique is severely limited due to paucity of capital resources, inadequate supply of modern equipment and scarcity of technical skills. Moreover, these countries are faced with the problem of providing employment to their huge and rapidly growing manpower. Labour intensive techniques are obviously more employment generating and hence they are said to be more suitable for these countries. But the adoption of labour intensive techniques may slow down the rate of progress because it is likely to hamper the growth of productivity. So there is always a conflict between the objectives of these two techniques.

II.   Objectives :

One of the major problems of development planning is that of choosing between alternative techniques of production. These techniques of production are mainly labour intensive technique, capital intensive technique, intermediate technology. The present lesson examines these techniques of production alongwith factors determining the choice of techniques and appropriate technology for under developed countries.

III.   Factors determining the Choice of Techniques

According to Meier and Baldwin "there are no simple criteria for deciding on capital intensive versus labour-intensive project. The criteria depends ultimately on broad economic and social objectives. It is necessary to consider not only the existing amounts and quality of factor supply but also various repercussions of the project - the effect on national income over different time periods, conditions of market demand, ability to realize economies of scale, length of gestation period, the effects on the distribution of income and level of per capita income and balance of payments requirements."[2] The important factors determining the choice of technique are as follows :

a.   Broad Economic and Social Objectives

The social and economic objectives of development programme are the most important determinants of the type of technique to be adopted. The probable objectives can be economic growth, an immediate increase in the supply of consumption goods and creating employment potential. If the objective is to have an immediate increase in output then labour-intensive technique must be selected. On the other hand if acceleration of the long-term rate of economic growth is the main consideration then capital-intensive

2.   G.M. Meier and R.E. Baldwin, Economic Development : Theory, History and Policy, 1964.

techniques must be favoured. If the objective is to create immediate employment opportunities for the people then labour-intensive technique must be preferred. But the difficulty arises because of the conflicting objectives in under-developed countries.

b.   Factor Endorsement

The production techniques to be adopted by a country must be such as to fit into its resource pattern. Labour-intensive techniques must be adopted by the countries having abundance of labour and scarcity of capital while capital-intensive technique will be suitable for the countries having scarce labour supply and abundance of capital.

c.   Technological Level Already Attained

If the economy is operating at a primitive level of technique it will be difficult for it to switch-over highly modern capital intensive techniques and hence it will have no other alternative but to adopt less capital-intensive techniques in the beginning and change over to more capital intensive techniques gradually. On the other hand, if the country has attained a sufficiently high level of technology, it will be easier and more suitable for it to adopt highly capital-intensive techniques.

IV.   Labour-Intensive Technique

A technique of production in which more labour is combined with less capital is called labour-intensive technique. With this technique of production it is possible to increase output by using the same amount of capital but greater amount of labour. Fig. 1 explains the impact of labour-intensive techniques on output.

Fig–1
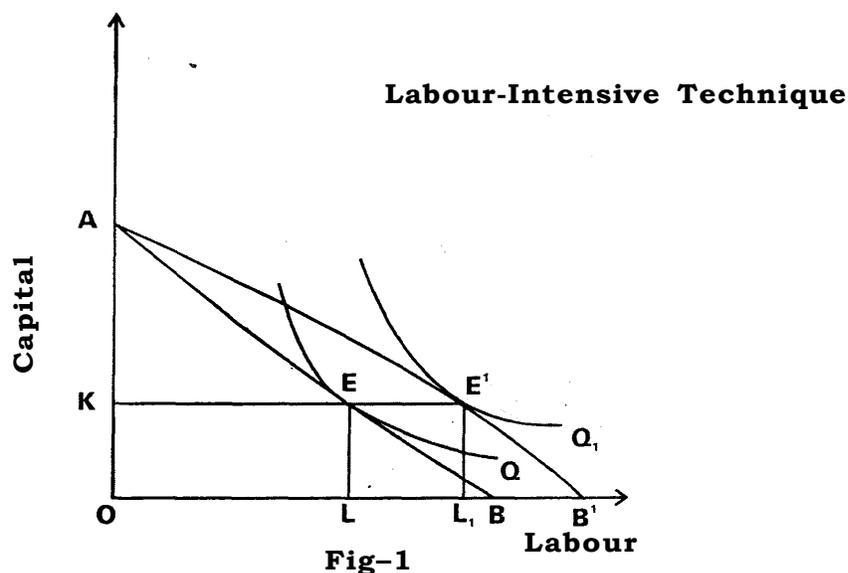
Isoquant Q represents initial level of output which is being produced in the economy by employing OK amount of capital and OL of labour. Now with the new technique the same amount of capital OK helps in producing a large output represented by a higher isoquant Q_1, and it uses more labour LL_1.

Though Professor Nurkse holds the view that underdeveloped countries should adopt labour-intensive technique of production in the early stages of industrial development, majority of economists favour the adoption of capital-intensive techniques in such countries.

Arguments in Favour of Labour-intensive Technique

The arguments usually advanced in favour of labour-intensive technique are the following :

1. Labour-intensive techniques are more employment generating. It is only by using labour-intensive techniques that increasing employment opportunities can be provided to the idle or under employed labour force in under-developed countries.

2. Under-developed countries suffer from acute shortage of capital and entrepreneurial resources. By adopting labour-intensive techniques of production, these countries release the scarce capital resources for other important uses.

3. Labour-intensive technique provides the cheapest way of raising output in economically less developed countries. In a poor country the social price of labour is likely to be low or even zero compared with the high price of capital.

4. The labour intensive techniques spread out the employment and hence the income is thus generated more widely and pave the way for an egalitarian structure of society.

5. The labour-intensive technique will ensure a higher level of consumption of the working classes by raising the level of wages.

6. Labour-intensive techniques require simple tools and implements which are available within the country and thus economise the use of precious foreign exchange resources.

7. Labour-intensive techniques are useful in combating inflation because the time-lag between investment and yield of goods is short.

8. The use of labour-intensive techniques is usually found in the villages and small towns and hence there is not necessity of spending large amounts on the buildings or houses, development of roads and other means of transport and providing civic amenities.

9. The use of labour-intensive techniques will confer the benefits of

decentralisation and avoid the evils of factory system.

10.   These techniques avoid emergence of monopolies and concentration of economic power in a few hands.

Limitations of Labour Intensive

Warren Robinson points out a number of potentially negative consequences that may follow from a labour intensive strategy of development, including :

1.   Labour intensive technique, if the marginal product of labour is very low, the necessary wage level for full employment may be at or below the subsistance level.

2.   Labour intensive technique will create more employment in the under developed countries causing high fertility levels, thus further postpoing development.

3.   Labour intensive development will reduce the need for skilled labour, thus weakening incentives for those who have or seek to acquire skills.

4.   A Labour-intensive strategy may direct the economy in to producing goods that will not provide the basis for an industrial take-off.

5.   Labour-intensive strategies will lower product quality and thus lower export potential.

6.   Labour incentives techniques, no doubt increases immediate employment opportunities but will likely slow the prospects of long term development and eventual prosperity for all.

7.   It large scale projects are undertaken with large number of workers then coercive or semi-militaristic methods of labour control will be necessary.

V.   Capital-intensive Technique

The capital-intensive technique is that which uses comparatively larger amount of capital and smaller amount of labour. The effect of capital intensive technique on output can be illustrated with the help of the Fig. 2

In Fig. 2, isoquant Q represents the initial level of output which is being produced in the economy by using OL amount of labour and OC amount of capital. Now with a new technique a higher level of output represented by the isoquant Ql can be produced with the same amount of labour i.e. OL and with a greater amount of capital i.e. OC_1 This technique is capital-intensive because it is using more capital with the same amount of labour. Leibenstein, Paul Baran, Hirschman and Maurice Dobb are the chief advocates of capital-intensive technique. The important arguments advanced in favour of capital-

intensive technique are shown in Fig. 2.
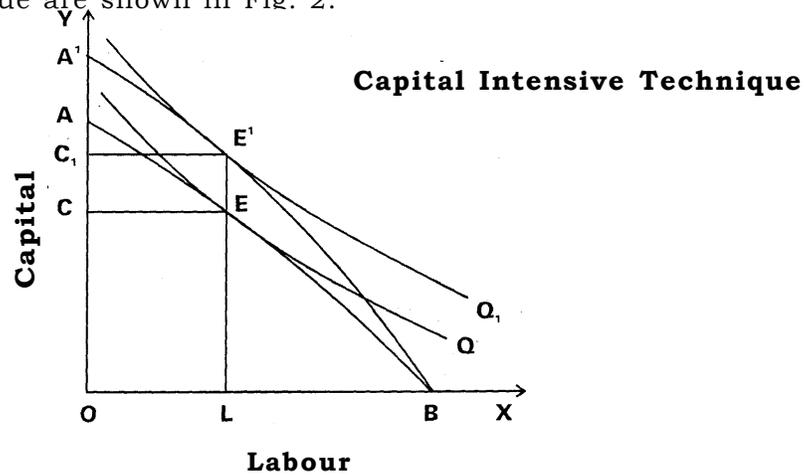
Fig.2

Arguments in Favour of Capital-intensive technique

1. The use of capital-intensive technique results in much quicker and more rapid economic growth than what is possible with the help of labour-intensive technique. Introduction of capital intensive technique raises the share of income going to the entrepreneurial class and lowers the share going to the working class resulting in quicker rate of capital formation.

2. Capital-intensive techniques enable production of superior quality goods at low prices. This helps in raising the standard of living of the people. Availability of cheaper goods also enables people to save more and thus larger investible resources become available.

3. Rising productivity per worker is an index of economic development because it makes possible a higher rate of capital formation and also higher levels of living. And it is capital-intensive technique which leads to a fast rise in productivity per worker.

4. Capital-intensive techniques are essential for the development of economic and social over-heads in under-developed countries. The development of infrastructure is a pre-condition for their rapid economic growth and these projects are generally highly capital intensive.

5. Labour - intensive technique may ultimately prove to be more capital-intensive than the capital-intensive techniques themselves. According to Prof. Baran If you use labour-intensive techniques, you will withdraw

the disguised unemployed labour from the rural areas; their transfer to the industrial centres calls for a certain outlay on housing, communal services, hospitals, schools etc. If this outlay is taken into account, the labour-intensive techniques may well involve a large outlay of capital per unit of output than the capital-intensive alternatives."[3]

6.   Since capital-poor countries cannot afford to waste capital through depreciation These countries must adopt capital-intensive techniques that do not become obsolete ever soon.

7.   Capital intensive techniques have a far-reaching effect on the process of economic growth. A few capital-intensive projects would cause a greater impact on the economy than a number of labour-intensive projects.

Limitations of Capital-intensive Technique

The wisdom of using the capital-intensive techniques can be legitimately doubted in the early stages of economic development. Serious doubts have been expressed by various economists about the feasibility of using capital-intensive techniques in under developed countries. Meier and Baldwin observe in this connection that the experience shows that the more advanced technologies of the industrialized nations cannot be transplanted without considerable modification and adaptation to the particular economic, technical and social needs of the poor countries.[4] The main arguments against the use of capital-intensive techniques are as follows :

1.   Capital-intensive techniques are not accordance with the factor endorsement of under-developed countries. These countries are usually labour surplus economies and so highly capital-intensive techniques do not suit them as they require huge capital which is beyond their capacity.

2.   The use of capital-intensive technique will require huge import of machinery, tools, implements and technical know-how.
     This will entail a number of difficulties with regard to repairs, maintenance and availability of spare parts. Heavy imports also lead to balance of payment difficulties.

3.   The capital-intensive techniques are possible only if power, transport and communication facilities and trained personnel are available. But these facilities are largely absent in poor countries and hence these techniques are not suitable for under-developed countries.

4.   Capital-intensive techniques involve a wasteful use of meagre capital

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3.   Paul Baran, The Political Economy of Growth, p. 149.
4.   G.M. Meier and R.E. Baldwin, Economic Development 1964, p. 424.

resources of the under-developed countries. Kindleberger feels that it is an attempt to run before one can walk.

5.   The possibility of introducing capital-intensive technology will, however, depend on "The technological spread'-the gap separating the techniques already in vogue in the less developed country and those imported from abroad. The larger the gap between the local and the imported techniques, the greater will be the social discontent and unrest following industrialization through the introduction of an advance technology.

On the basis of above discussion, it can be concluded that both types of techniques must be suitably utilized in underdeveloped countries. These countries are entrapped in the vicious circle of poverty and a rapid rate of economic growth is their immediate need. It is not possible to attain rapid rate of growth with technically inferior and obsolete methods of production and hence capital-intensive methods are to be given a definite place in the planning of these countries. But at the same time unemployment and disguised unemployment is their major problem. These unemployed persons will have to be provided with employment and for that labour-intensive technique becomes a necessity. The best way for these countries is to have such a combination of the methods of production which would ensure a high rate of growth of income on the one hand, and a rise in the level of consumption and employment on the other.

VI.   Intermediate Technology

Some of the economists are of the opinion that the underdeveloped countries should neither use highly capital - intensive techniques nor the primitive labour-intensive techniques but they should follow intermediate technology. Prof. Schumacher has tried to build a case for the use of middle course in underdeveloped countries. The technology adopted in underdeveloped countries must be technology of the advanced countries modified and adapted to the conditions of these countries. It must be suitable to economic and social structure and technology-absorbing capacity of the country. The technology adopted by these countries must be more capital-intensive than the prevailing technique but less capital intensive as compared to production techniques of industrially advanced countries.

VII.   Choice of appropriate Technology for developing countries

The most important controversy that has attracted increasing attention over the years is wheter the developing countries should opt for capital intensive techniques or labour intensive techniques. The choice often depends upon the time-horizon one has in view. In the short runs, the labour

intensive techniques generate more output and consumption while in the long run the capital intensive techniques generate more output and consumption. Therefore of the policy objective is the maximisation of the growth rate, capital intensive techniques are to be preferred than when it is the maximisation of immediate output per unit of investment. The conflict between employment and saving can be depicted by using a production function diagram first used in this context by Maurice Dobb and A.K.
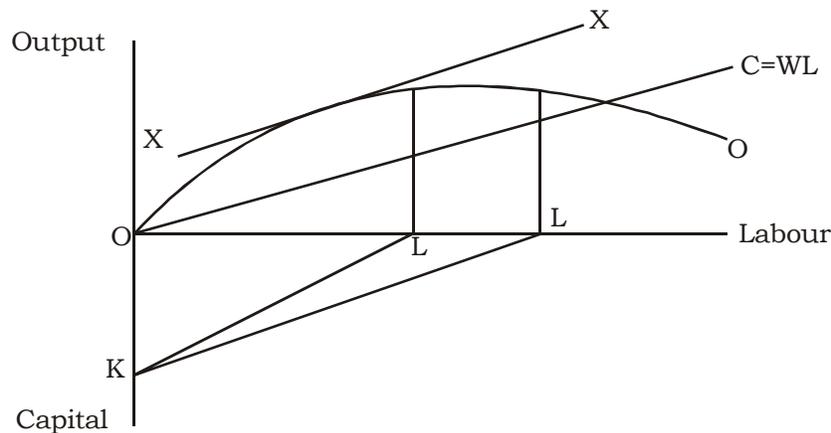
Labour Fig. 3

In the given fig.3 OK is the investible (capital) resource with different levels of labour to produce output. OO is the production function showing diminishing returns to labour. Let us assume that labour is paid a fixed wage w, which is all consumed then a ray OC with a constant slope depicts the wage bill and the difference between OO and OC is profit. If we further assume that all profits are saved, this difference will also show savings. Now sawing will be maximised when a line drawn parallel to OC is tangent to the production function. This happens at the employment level OL. Beyond this point, further employment generation will diminish the level of saving and investible surplus.

Thus there is conflict between savings and employment maximisation. So, economies need to adopt appropriate technology for their development.

According to yali Brozen "The appropriate technology for an area depends on its resources, patterns and its markets. "It is, therefore defined as "an amalgam of skills, methods, techniques appliances and equipment that can contribute towards solving the basic socio-economic problems of the concerned communities." The massive importation of capital-intensive technology of western countries during the past few decades has failed to yield the desired results. According to Austin Robinson, the cost of each additional job created

by adopting the western technology is very high. It is appropriate technology for the rich societies having developed infrastructure but not for the developing countries facing accute shortage of investment resources to create infrastructure and build industries, insufficient foreign exchange resources to provide for the high import-content of western type capital investment.

Before adopting technology countries should keep in mind that it should be economically viable, technically feasible and should fit in the socio economic fabrics of local communities. It should be able to produce some surplus so as to encourage capital formation and stimulate further growth. It should be labour-intensive and capital saving. It should encourage production by masses rather than mass production. It should not be static but dynamic and should be able to absorb innovation, thus promoting to improve efficiency and productivity. Finally, it should neither be based on traditional technology nor reject modern technology. In advanced countries also from the US to Japan, there is adoption of low capital intensity equipments in small industrial units and agricultural areas. In certain cases, much simpler modern techniques involving small capital may bring about large increments in output in the case of small industries.

For developing countries which have just started on the path of development, it is better to adopt well tried capital saving labour intensive productivity-raising technology originating from the developing countries for instance. India manufactures a large numbers of farm implements indigenously designed, such as the medianical, plough, irrigation equipments, hand tools, irrigation equipments and dairy farm equipts. by adopting appropriate technology. Other countries can also adopt the same for their development and prosperity.

According to Vakil and Brahman and, "each country has to work out its own salvation and particularly to find out which production methods are feasible for it.

They recommend the following techniques for use in developing countries :

(a)   those which can be easily learnt in a short time
(b)   those which reduce the gestation period of investment
(c)   those which require small initial investment
(d)   those saving scarce resources rather than labour
(e)   those requiring less investment in specialized and skilled labour and
(f)   those which raise the level of production and increase supply & minerals or electricity.

VIII. Summary

After studying both the techniques i.e., Labour-intensive and capital-intensive along with their merits and demerits, it can be concluded that it will be unwise to adhere to any of these-techniques. The best course open for developing countries is to have a combination of the methods of production which would ensure higher rate of economic growth on one side and a rise in level of consumption employment and standard of living on the other side. In other words, these two techniques will have to be judiciously combined to secure the conciliation of two conflicting objectives i.e. more employment and more total output.

IX.   Questions

1.   Short Questions

      a.   What do you mean by 'Labour-intensive' technique ?

      b.   What is the meaning of 'Capital-intensive' technique ?

      c.   State two limitations of capital-intensive technique.

      d.   What is 'intermediate technology ?

      e.   Give two examples of light industries.

      g.   State two limitations of labour intensive technique.

2.   Long Questions

      a.   Explain various types of techniques of production. What are the main factors which detremine the choice of technology in a economy.

      b.   Discuss the concept of apppropriate technology with special reference to developing countries.

      c.   "In an economy where labour is abundant and capital is scarce, the technique of production should be labour-intensive." Discuss

      d.   Write notes on :

            (a)   Intermediate technology.

            (b)   Arguments in favour of labour-intensive technique.

            (c)   Give meaning of capital-intensive technique. Discuss the main arguments in support of this technique.

X.   SUGGESTED READINGS

1. Meier, G.M. and Baldwin, R.E.   : Economic Development
2. Dewett, K. K. and Satish Wadhawan : Economics of Growth and Development
3. Misra, R.S.   : Economics of Development
4. Jhingan, M.L.   : The Economics of Development and Planning
5. Goel, R.L.   : Economics of Growth and Planning
6. Aggerwal, R.C.   : Economics of Development and Planning