Choice of Techniques of Production in Developing Countries

A choice between alternative techniques of production is a major problem in the planning for developing countries. This is because a particular choice of technique of production affects not only the magnitude of employment but also the rate of economic growth. Several alternative techniques of production are available to produce a commodity. The various techniques differ with regard to capital-intensity which is generally measured by the magnitude of capital-labour (K/L) ratio. Thus, the higher the capital-intensity, the more quantity of capital as compared to labour will be used to produce a given level of output.

Factor Price Ratios and Choice of Technique:

In economic theory based on the perfect competition model where the factor prices are given and constant for a firm and factor proportions are variable then, the choice of a technique or capital-labour combination is easily made by a firm. This however aims to minimize the cost for a given level of output through equating relative prices of factors to their relative marginal products. Consider Fig. 1, where curve q is an iso-quant which represents a given level of output. The slope of line PP' measures the relative prices of capital and labour. The firm will be minimizing cost by choosing capital intensity represented by the point E at isoquant q. At E the price line PP' is tangent to the isoquant q. The slope of the isoquant q at point E measures the ratio of marginal products of capital and labour which is equal to the slope of the price line representing factor price ratio.

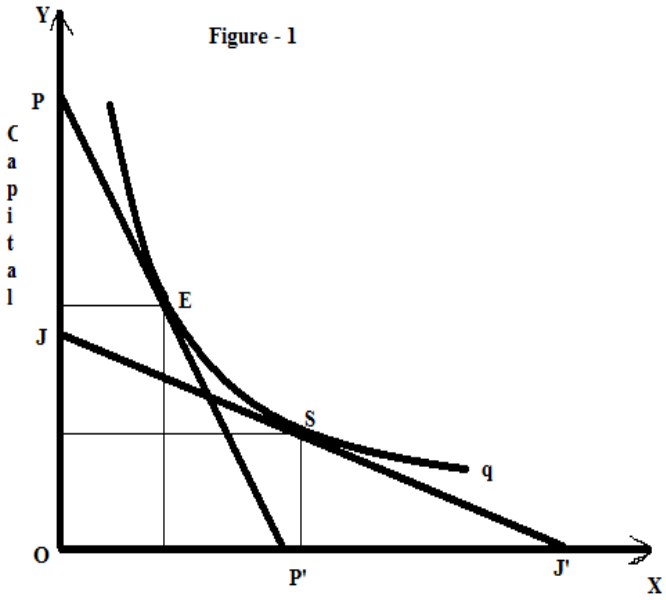


Figure - 1
Factor Prices and Choice of Techniques

However, if a country has abundant labour and shortage of capital, in the absence of any price distortions, labour will be relatively cheaper than capital and price

line representing this will be less steep, say it is J J'. As will be seen from Fig. 1 the new price line JJ' is tangent to the isoquant q at point S.

Accordingly, the capital-intensity chosen by a cost minimizing firm will be given by the point S. This technique of production is more labour-intensive than the technique corresponding to point E. However, it is worth mentioning that in a labour-surplus economy, labour-intensive technique may not be actually chosen by a cost-minimizing firm because of the existence of distortions of factor prices from their true scarcity values.

Choice of Techniques: Maximum Reinvestible Surplus Criterion:

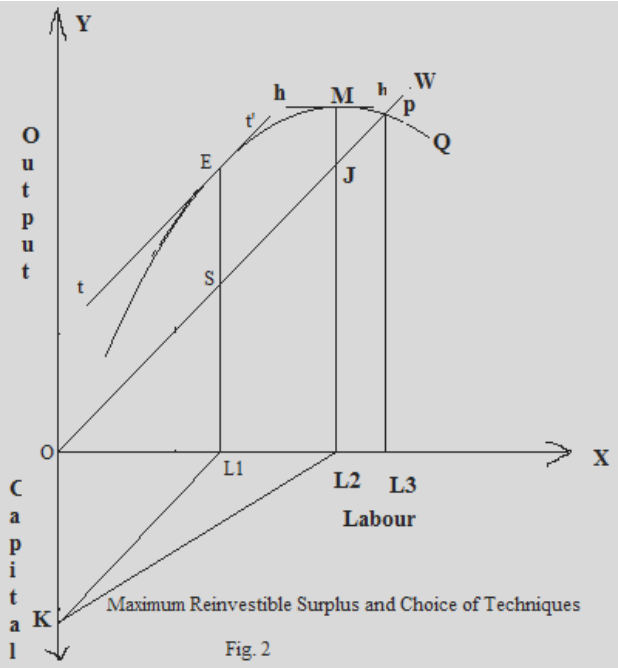
In the planning for developing countries, the choice of techniques is not to be decided from the point of view of private profit maximisation or private cost minimisation. In it the choice of capital intensity has to be decided keeping in view the problem of mass unemployment and the need for rapid economic growth to raise levels of living of the people.

The problem is made difficult because the achievements of the twin objectives of reducing unemployment and promoting rapid economic growth through a choice of technique clash with each other at least in the short run. For the optimum choice of technique of production or capital intensity two alternative criteria have been put forward. They are the **maximum output** and **maximum reinvestible surplus** criteria. To explain these criteria let us assume:

1. A single product model in which two factors, capital and labour, are used to produce a commodity.
2. There is a given amount of capital but the form it takes varies depending on the technique it embodies.

With a given amount of capital, output of the commodity becomes a function of labour. We represent this production function and explain the two alternative criteria with the help of Sen's diagram. In this Fig. 2, on the X-axis, labour input is measured and on the Y-axis (upward from the origin) output is measured and also on the Y-axis (downward from the origin) amount of capital is measured. OK is the given amount of capital available which takes different form according to different degree of capital intensity.

The line OW measures the wage bill, given a wage rate equal to the slope of the wage line OW. It should be noted that with increase in labour employed, given the stock of capital OK, capital-labour ratio falls (or labour-capital ratio increases). Thus, as we use more labour input, capital intensity will vary along the line OX. It should be further noted that given the wage rate as more labour is used total wage bill will be increasing. Thus with OL_1 labour employed L_1S is the wage bill and with OL_2 labour employed L_2J is the total wage bill.



Maximum Reinvestible Surplus and Choice of Techniques

Fig. 2

With capital stock equal to OK, output is a function of labour which is given by the production function curve Q. In drawing this production function we have assumed that as more labour is used with a given capital stock there occurs diminishing returns to labour and ultimately with increasing labour-intensity, total output declines, so that a certain labour-capital ratio corresponds to maximum output.

We are now in a position to explain the choice of technique on the basis of maximum output and maximum reinvestible surplus criteria. If the planner wants to choose capital-intensity (i.e., technique of production) to maximise output, then he will choose point L_2 where output is maximum (at OL_2 marginal product of labour is equal to zero).

With the given capital stock OK, capital-intensity chosen will be equal to the slope of the line L_2K i.e., OK/OL_2. With this choice of capital-intensity, OL_2 labour is employed. If maximization of employment in the present is desired, then, obviously, capital-intensity OK/OL_2 is the optimum choice.

However, maximization of present employment may not yield a satisfactory rate of growth. The surplus of output over total wage bill at OL_2 level of employment is MJ which is not the largest. If the maximum of surplus over wage bill is required, then the capital-intensity (or in other words, employment of labour with the given capital stock) at which the wage rate equals the marginal product of labour should be chosen.

From Fig. 2, it will be noticed that at OL_1 use of labour input or capital-intensity represented by L_1, the marginal product of labour (measured by the slope of the production function curve Q at point E) equals the wage rate (as measured by the slope of the wage line OW).

The surplus of output over the wage bill at capital-intensity at L_1 (which is equal to OK/OL_1) is ES which is the largest under the given circumstances. At L_1, the capital-intensity is higher but employment smaller than with capital-intensity at L_2. Thus, the largest surplus ES is obtained with a higher capital-intensity and lower labour employment at the present.

Now, If it is assumed, as is done by the exponents of maximum reinvestible surplus criterion that the whole surplus is reinvested and the whole wages are consumed, then this larger surplus on being reinvested would yield a higher rate of economic growth. On the other hand, with lower capital-intensity at L_2, though the level of present employment is larger, surplus MJ is smaller which when reinvested would yield a lower rate of growth.

Thus, with a higher capital- intensity and higher rate of growth, the rate of growth of employment will be higher, though the level of present employment will be less. On the contrary, with a lower capital-intensity the surplus is smaller and consequently rate of growth of output and employment will be smaller, though the present level of employment will be large.

Hence, the choice of capital-intensity implies the choice between the higher levels of present employment and output on the one hand and the higher rates of growth of employment and output on the other. Thus, it is argued if you are interested in maximising the current level of employment (and production) choose a lower capital-intensive technique such as the one represented by L_2. On the other hand, if you want a higher rate of growth of employment and output choose a higher capital-intensive technique such as the one represented by L_1. Thus we find that there is a conflict between maximising present employment (or consumption) and maximising employment or consumption at some future date.

Amartya Sen's Time Series Criterion and Choice of Technique:

To resolve the above conflict or dilemma, Prof. Sen in his famous work 'Choice of Techniques' has proposed what is called Time Series Criterion. According to it, choice of technique depends upon the time horizon of output or employment generation, the time preference and social welfare function. To make an optimum choice of technique, alternative time series of

employment and output following the adoption of different techniques have to be obtained. This is illustrated in Fig. 3. Let the vertical axis measure labour-employment and output of consumer goods and the horizontal axis measure time. The steeper curve AK represents growth of output or employment over time with using capital-intensive technique K whereas the less steep curve BL shows the growth of output and employment over time with adopting labour - intensive technique of production L.

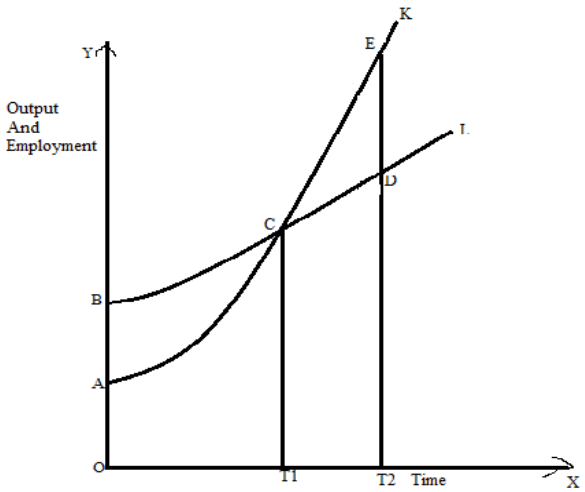


Fig. 3, Amartya Sen's Criterion of Choice of Technique

Till time T_1, labour-intensive technique generates more output and employment as compared with the capital-intensive technique. But, since the growth of output or employment is greater in case of capital-intensive technique due to its yielding larger surplus and reinvestment, beyond time T_1 the output or employment is greater in case of capital-intensive technique K.

And on account of higher growth of output and employment the capital-intensive technique fully compensates for the initial loss of output (or employment) by the time T_2. Note that the area CED equals the area ABC in Fig. 51.3).

After time T_2, the society would have higher levels of output and employment by choosing capital- intensive technique. Thus though the choice of labour-intensive technique yields higher levels of output and employment in the present it yields lower rate of growth due to smaller reinvestible surplus. On the basis of this time series criterion, Amartya Sen argues that if social welfare function of a society is such that it is prepared to wait up to time T_2, (say thirty years) output and employment sacrificed at present could be fully compensated and after T_2, the society would enjoy higher levels of consumption and employment by choosing capital-intensive technique. However, if social welfare function is such that society prefers present output (consumption) and employment to future consumption and employment, then it may choose labour-intensive technique.

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