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Lecture 6

Factor – Factor Relationship



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Factor – Factor Relationship

Factor-factor relationship is concerned with the possibilities of substituting one input/factor (X_1) for another input/factor (X_2) for producing a given level of output. It answers the crucial question of finding out the optimum or least cost combination of two or more resources in producing the given amount of output.



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The two fold object of factor-factor relationship is

- (i) Minimization of cost at a given level of output.
- (ii) Optimization of output to the fixed factors through alternatives resources combinations.

The functional relationship is $Y = f (X_1, X_2/X_3---X_n)$ what amounts of X_1 & X_2 should be used to give the lowest cost for producing fixed y_0 , when $X_3- ----- X_n$ are held constant.



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Isoquant (Iso-product curve):

It is defined as the locus of various combinations of two inputs yielding the same level of output.

Each point on an isoquant represents the maximum output that can be attained with these input combinations. Isoquant is a convenient device for compressing the 3-dimension picture of a production process into two dimensions. $X_1 = f(X_2, Y_0)$.



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Properties of Isoquants

1. Isoquants have a negative slope,
2. Isoquants to right indicate higher output level,
3. Isoquants do not intersect each other,
4. Isoquants are convex to origin showing diminishing MRTS.



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Types of Factor-Factor Relationship

- (1) Fixed proportion combination of inputs,
- (2) Constant rate of substitution
- (3) Varying rates of substitution



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Fixed proportion combination

These represent such products that can be produced if inputs are added in fixed proportion at all levels of production. In this case there is no substitution between inputs and thus there is strict complementarity between the two inputs. Such an isoquant implies that one exact combination of inputs will produce a particular level of output. The inputs which increase the output only when combined in a fixed proportion are known as complementary inputs, e.g. One tractor and one man (driver). No problem in economic decision making. Also called Leontief isoquants.



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Constant rate of substitution:

- Such type of a factor-factor relationship gives linear isoquants. The substitution occurs at constant rate i.e. the amount of one input replaced by the other input does not change as the added input increases.

$$\frac{\Delta X_{21}}{X_{11}} = \frac{\Delta X_{22}}{X_{12}} = \dots = \frac{\Delta X_{2n}}{X_{1n}}$$



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3. Varying Rate of substitution:

- In this there can either be increasing rate or decreasing rate of substitution. In this $MRTS_{X_1X_2}$ varies over iso-product curve. It means that the amount of one input (X_1) required to substitute for one unit of another input (X_2) at a given level of production
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- increases or decreases as the amount of X_1 used increases. Substitution at decreasing rate is common in agriculture (N & P or K & L)
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Marginal rate of technical substitution (MRTS or MRS):

- MRTS is defined as the negative of the slope of the isoquant at any point. It is the rate at which two factors of production can be exchanged at a particular level of output and consequently that of the levels of inputs used



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Iso-cost line:

- Locus of all possible combination of two inputs which can be purchased with a given outlay or budget.



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Iso-cline:

- A line or curve connecting the least cost combinations of inputs for all output levels is known as isocline.
- Isocline passes through all isoquants at points where they have same slope. It shows how the relative proportion of the factors changes as the output is increased. It shows that resources should be used along this line as long as $MVP > MC$ of resources used.



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Ridge lines:

- Represent the points of maximum output from each input, given a fixed amount of the other input. On the ridge lines MPP is zero. Ridge lines represent the economic relevance within the ridge lines MPPs of both the inputs is positive but decreasing.



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Expansion Path: -

- There can be numerous isoclines for different possible combinations of input prices. All these sets of prices of inputs do not prevail at any particular given time. A farm manager has to be consider only one set of input prices that is most appropriate for the planning period. The isoclines depending upon this set of prices (most appropriate) is called expansion path. At any particular time there is only our expansion path possible.



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- Thus, the line or curve connecting the points of least cost combination for different levels of output is called expansion path. Expansion path is an isocline on which slope of isoquant (MRTS) equals the slopes of isocost line (price ratio). The expansion path indicates the best way of producing the different levels of output given the input prices & the technology



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- . If expansion path is a straight line through origin, it means inputs will be used in the same proportion at all output levels and hence it is called scale line. It is curved; it implies the inputs will be used in various proportions.