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For the students of M.com (Applied Economics) Semester IV

Subject: Public Economics

Topic: Pareto Optimality or Efficiency Theory

Pareto optimality argues with general welfare of the society. In broader sense, the welfare of a society is measured on the basis of satisfaction levels of all the consumers. So, any changes in the economic state of the society will have better off some members of the society and worse off others.

The Italian economist Vilfredo Pareto (1848-1923) argued that it is impossible to make any one better off without making someone worse off, is called Pareto optimal or Pareto efficient. Thus, in the Pareto optimum situation the welfare of any individual of the society cannot be increased without decreasing the welfare of another member. Before explaining the conditions of achieving Pareto optimality, we shall explain Pareto criterion of evaluating changes in social welfare because the concept of Pareto optimality or maximum social welfare is based upon Pareto criterion of welfare.

Pareto Criterion of Social Welfare:

The concept of Pareto optimum or economic efficiency is based on ordinal utility instead of cardinal utility. Pareto criterion states that if any reorganization of economic resource does not worse off anyone and makes someone better off, it indicates an increase in social welfare of the economy. In other words, if any reorganization or change makes everybody better off in a society, it will, according to Pareto, increase social welfare.

According to Prof. Baumol ñany change which harms no one and which makes some people better off, this state of change must be considered to be an **improvement**.ò Pareto criterion can be explained with the help of Edgeworth Box diagram which is based on the assumptions of ordinal utility and non-interpersonal comparison of utilities.

Suppose there are two persons A and B in a society and consume two goods X and Y. The various levels of their satisfaction by consuming various combinations of the two goods have been represented by their respective indifference curves.

In Figure 39.1, O_a and O_b are the origins for the utilities of two persons A and B respectively. I_{a1}, I_{a2}, I_{a3}, I_{a4} and I_{b1}, I_{b2}, I_{b3}, I_{b4} are their successively higher indifference curve. Suppose the initial distribution of goods X and Y between A and B is represented by point- K in the

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Edgeworth Box. Here K can be assumed as equilibrium point for both the persons in the initial stage.

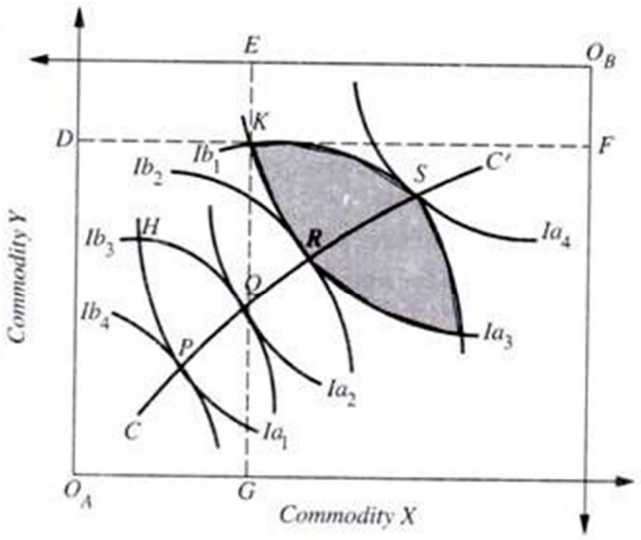

Fig. 39.1 *Pareto Criterion and Pareto Optimality.*

Accordingly, individual A consumes O_AG quantity of X + GK quantity of Y and is at the level of satisfaction represented by indifference curve I_{a3}. Similarly, individual B consumes KF quantity of X+ KE quantity of Y and gets the satisfaction represented by indifference curve Ib_1. Thus the total given quantity of goods X and Y is distributed between A and B. In this distribution, individual A consumes relatively large quantity of good Y and individual B consumes more of good X. Now, it can be shown with the aid of Paretoôs welfare criterion that a movement from the point K to a point such as S or R or any other point in the shaded region will increase social welfare.

As shown in the diagram any change in the distribution pattern of two goods will definitely increase the satisfaction level of at least one person. If we move from K to S through redistribution of two goods between two individuals, it increases the level of satisfaction of A without any change in the satisfaction of B. Here A has been able to increase his satisfaction by moving to a higher indifference curve I_{a4}, whereas B remains on the same indifference curve I_{b1} because K and S lie on same indifference curve I_{b1} associated to B. Thus, as a result of the movement from K to S, individual A has become better off whereas individual B is no worse off.

Similarly, the movement from K to R is also desirable from the point of view of social welfare because in this individual B becomes better off without any change-in-the satisfaction of individual A. Therefore, both the positions S and R are better than K. The tangency points of the

various indifference curves of the two individuals of the society are the Pareto optimum points and the locus of these points is called ócontract curveô

Marginal Conditions of Pareto Optimality:

Pareto concluded from his criterion that **competition** leads the society to an optimum position but he had not given any mathematical proof of it, nor he derived the marginal conditions to be fulfilled for achievement of the optimum position. Later on, Lerner and Hicks derived the marginal conditions which must be fulfilled for the attainment of Pareto optimum.

These marginal conditions are based on the following assumptions:

1. Each individual has his own ordinal utility function and possesses definite amount of each product and factor.
2. Production function of every firm and the state of technology is given and remains constant.
3. Goods are perfectly divisible.
4. A producer tries to produce a given output with the least-cost combination of factors.
5. Every individual wants to maximize his satisfaction.
6. Every individual purchases some quantity of all goods.
7. All factors of production are perfectly mobile.

Given the above assumptions, the applicability of Pareto optimality in an economy requires three marginal conditions which must be satisfied;

1. Marginal condition for efficiency of distribution of commodities among consumers: Efficiency in exchange
2. Marginal condition for efficiency in the allocation of factors among firms: Efficiency in production
3. Marginal condition for efficiency in the allocation of factors among commodities: Efficiency in product mix

1. **Marginal condition for efficiency of distribution of commodities among consumers: Efficiency in exchange ($MRS_X = MRS_Y$)**

The marginal rate of substitution of one good for another is the amount of one good necessary to compensate for the loss of a marginal unit of another so as to maintain a constant level of satisfaction. So long as the marginal rate of substitution (MRS) between two goods is not equal for any two consumers, they will enter into an exchange which would increase the satisfaction of both or of one without decreasing the satisfaction of the other.

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This condition can be explained with the help of the Edgeworth Box diagram. In Figure- 39.3, goods X and Y, which are consumed by two individuals A and B composing a society, are represented on the X and Y axes respectively. O_A and O_B are origins for A and B respectively. la_1, Ia_2, Ia_3 and Ib_1, Ib_2, lb_3 are the indifference curves showing successively higher and higher satisfaction of consumers A and B respectively. CC is the contract curve passing through various tangency points Q, R, S of the indifference curves of A and B.
The marginal rates of substitution between the two goods for persons A and B are equal on the various points of the contract curve CCô. Any point outside the contract curve does not represent the equality of MRS between the two goods for A and B individuals.

If we take alternatively point K, where indifference curves I_{a1} and I_{b1} intersect each other instead of being tangential, marginal rate of substitution between two goods X and Y (MRS_{XY}) of individual A is not equal to that of B.
With the initial distribution of goods as represented by point K, it is possible to increase the satisfaction of one individual without any decrease in that of the other or to increase the satisfaction of both by redistribution of the two goods X and Y between them. A movement from K to S increases the satisfaction of A without any decrease in Bôs satisfaction.

Similarly, a movement from K to Q increases Bôs satisfaction without any decrease in Aôs satisfaction. The movement from K to R increases the satisfaction of both because both move to their higher indifference curves. Thus, movements from K to Q or to S or to any other point on the segment SQ of the contract curve will, according to Pareto criterion, increase the level of social welfare.

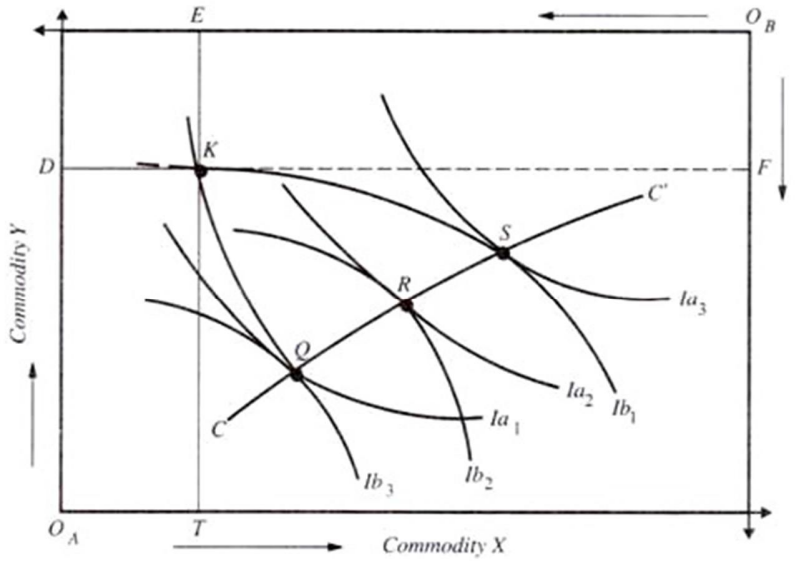

Fig. 39.3. *The Optimum Distribution of Goods.*

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Since the slope of an indifference curve represents the marginal rate of substitution (MRS_{XY}) at any point of the contract curve, hence at tangency points of the indifference curves MRS_{XY} of the two individuals are equal. Therefore, points on the contact curve represent the maximum social welfare.
However, a movement along the contract curve in either direction will make one individual better off and the other worse off since it will put one individual on his successively higher indifference curves and the other on his successively lower indifference curves. we cannot say anything about the best of them with the help of Pareto criterion.

2. Marginal condition for efficiency in the allocation of factors among firms: Efficiency in production ($MRTS_L = MRT_K$)

The second condition for Pareto optimum assumes that the factors of production available in an economy should be utilized in the production of goods in such a manner that it is impossible to increase the output of one firm without a decrease in the output of another or to increase the output of both the goods by any reorganization of factors of production.

This state of equilibrium would be achieved if the marginal rate of technical substitution (MRTS) between any pair of factors are the same for any two firms producing two different products and using both the factors to produce the goods.

This condition too can be explained with the help of Edgeworth Box diagram relating to production. This is depicted in Fig. 39.4. Let us assume two firms A and B producing the same product by using two factors labour and capital. The available quantities of labour and capital are represented on X and Y axes respectively. O_A and O_B are the origins for firms A and B respectively.

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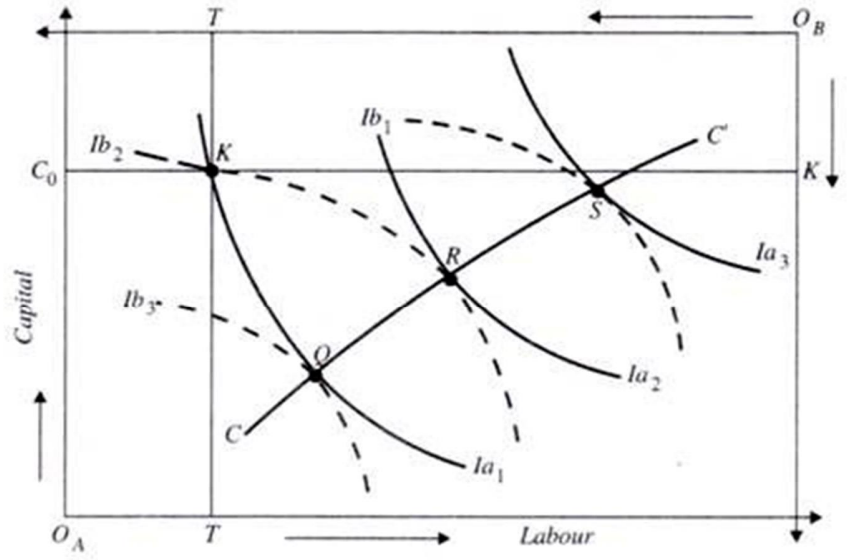

Fig. 39.4. *The Optimum Allocation of Factors.*

Isoquants I_{a1}, I_{a2}, I_{a3} and I_{b1}, I_{b2}, I_{b3} of firms A and B respectively represent successively higher and higher quantities of output which they can produce by different combinations of labour and capital. The slope of the isoquants, which are convex to the origin, represents the marginal rate of technical substitution (MRTS) between two factors.
MRTS of one factor for another is the amount of one factor necessary to compensate for the loss of the marginal unit of another so that the level of output remains the same. So long as the MRTS between two factors for two firms is not equal, total output of a product can be increased by transfer of factors from one firm to another.

In terms of the above diagram any movement from K to S or to Q raises the output of one firm without any decrease in the output of the other. The total output of the two firmôs increases when through redistribution of factors between the two firms, a movement is made from the point K to the point Q or S on the contract curve.

A glance at Figure 39.4 will reveal that movement from point K outside the contract curve to the point R on the contract curve will raise the output of both the firms individually as well as collectively. Therefore, it follows that corresponding to a point outside the contract curve there are some points which will ensure greater total output of the two firms.

As the contract curve is the locus of the tangency points of the isoquants of two firms, the marginal rate of substitution of the two firms is the same at every point of the contract curve CC. thus we can say that on every point of the contract curve, where MRTS between the two factors of two firms is the same, the allocation of factors between the two firms is optimum.

But it is worth mentioning that there are several points on the contract curve and each of them represents the optimum allocation of labour and capital as between the two firms. But which one of them is best cannot be said on the basis of Pareto criterion because movement along the contract curve in either direction represents such factor reallocation which increases the output of one and reduces the output of another firm.

3. Marginal condition for efficiency in the allocation of factors among commodities: Efficiency in product mix (MRS = MRT)

This condition relates to the pattern of production. The fulfillment of this condition determines the optimum quantities of different commodities to be produced with the given factor endowments. This condition states that ñthe **marginal rate of substitution** (MRS) between any pair of products for any person consuming both must be the same as the **marginal rate of transformation** (MRT) (for the community) between them.ò According to this condition, for the attainment of maximum social welfare goods should be produced in accordance with consumerôs preferences. Let us explain this with the help of Fig. 39. 5.

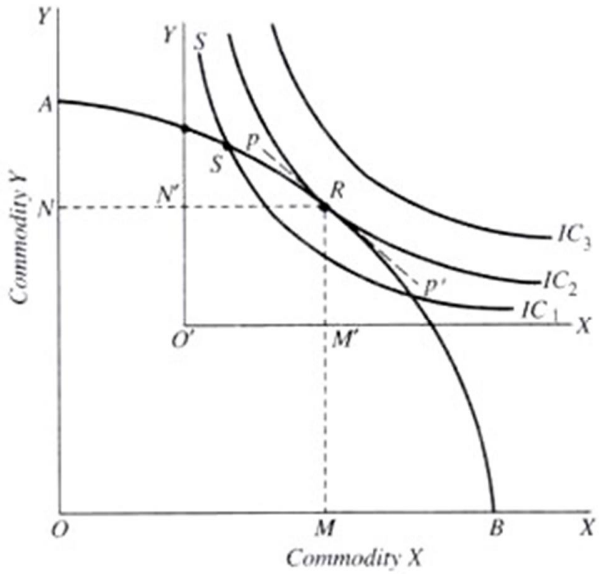

Fig. 39.5. *Optimum Direction of Production :Optimum Product Mix.*

In Fig. 39.5 commodities X and Y have been represented on the X and Y axes respectively. AB is a communityôs transformation curve between any pair of goods X and Y. This curve represents the maximum amount of X that can be produced for any quantity of Y, given the amounts of other goods that are produced and fixed supplies of available resources.

IC_1 and IC_2 are the indifference curves of a consumer. Its slope at a particular point represents the marginal rate of substitution between the two goods. The MRTôof the community and MRS

of the consumer are equal to each other at point R at which the communityôs transformation curve is tangent to the indifference curve IC_2 of a representative consumers, Point R represents optimum composition of production in which commodities X and Y are being produced and consumed in OM and ON quantities.

This is because of all the points on the communityôs transformation curve, point R lies at the highest possible indifference curve IC_2 of the consumer. For instance, if a combination of goods X and Y represented by S is being produced and consumed, the consumer would be at a lower level of welfare because S lies on his lower indifference curve IC_1 which intersects the communityôs transformation curve instead of being tangential to it.

As a result, at point S, MRS_{XY} of the consumer is not equal to the MRT_{XY} of the community. With the situation at S there is a possibility of moving the consumers to a higher indifference curve by changing the direction (i.e. composition) of production i.e. by increasing the production of X and reducing the production of Y. Thus, the optimum direction of production is established at point R where communityôs transformation curve is tangent to the indifference curve of a consumer in the society.