School of Social Sciences
Indira Gandhi National Open University

BECC-108
INTERMEDIATE MICROECONOMICS - II

Partial Equilibrium

Equilibrium in only one market

→ Market A

General Equilibrium

Simultanious Equilibrium in all the markets

→ Market A, Market B, Market C

COMPETITION
- Perfect Competition
- Imperfect Competition

GENERAL EQUILIBRIUM
- General Equilibrium with Production
- Overall Efficiency and Welfare Economics

Imperfect Competition
- Monopoly
- Oligopoly
- Monopolistic Competition

Oligopoly → **Game Theory**

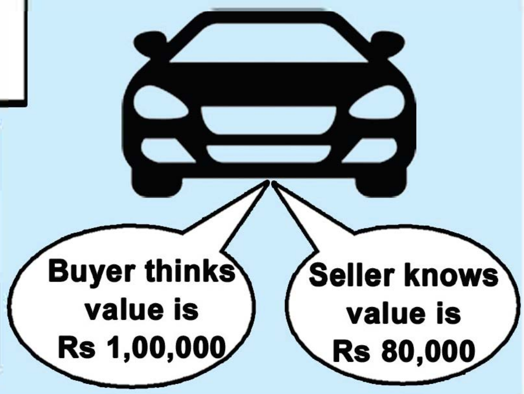
Modelling strategic interaction among rational agents

Elements of Game Theory:
1. Players
2. Strategies
3. Payoffs

MARKET FAILURE
- Externalities and Public Goods
- Asymmetric Information

	Rival	Non-Rival
Excludable	Private Goods Eg: House, Car	Club Goods Eg: Cable TV
Non-Excludable	Common Goods Eg: Fish in Ocean	Public Goods Eg: National Defense

Asymmetric Information



''शिक्षा मानव को बन्धनों से मुक्त करती है और आज के युग में तो यह लोकतंत्र की भावना का आधार भी है। जन्म तथा अन्य कारणों से उत्पन्न जाति एवं वर्तमान विषमताओं को दूर करते हुए मनुष्य को इन सबसे ऊपर उठाती है।''

– इन्दिरा गांधी

''Education is a liberating force, and in our age it is also a democratising force, cutting across the barriers of caste and class, smoothing out inequalities imposed by birth and other circumstances.''

– Indira Gandhi

BECC-108

Intermediate Microeconomics-II

School of Social Sciences
Indira Gandhi National Open University

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Course Contents

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COURSE INTRODUCTION: INTERMEDIATE MICROECONOMICS-II

The course 'Intermediate Microeconomics-II' is in continuation with the Intermediate Microeconomics-I course (BECC-101) covered in Semester 3. It builds up on the Introductory of Microeconomics course studied in Semester 1 and provides an analysis of how the economic theory developed can be directly applied to help economic agents in taking decisions pertaining to maximising utility, minimising cost, maximising profit, taking output or pricing decisions, etc. It achieves this through combining microeconomic theory with the application part using graphical analysis, algebra and calculus. In order to grasp this course well, a student is expected to have passed Introductory Microeconomics and Intermediate Microeconomics-I courses, and have some working knowledge of calculus (mostly derivatives), basic algebra and graphing skills.

The course structure is divided into 4 blocks. Each block is further sub-divided in a number of units. Each unit in itself is self-contained and has organic linkages with all other units. Throughout the course, in each unit, student will encounter a synchronised set of introductory theory, illustrative examples and check your progress exercises—designed to provide conceptual clarity to the student. In a way, allowing students to develop their abilities to evaluate, analyse and synthesise economic information.

The course extends the discussion of the General Equilibrium framework introduced in the previous Semester in the context of Exchange to the Production level. This in turn is further extended with the discussion on the Overall Efficiency and the Welfare Economics. An attempt is made to shed light on imperfect market structures, i.e., Monopoly, Monopolistic competition, and Oligopoly. In addition, the course also covers the Game theory and its applications, and the various conditions resulting in the market failure.

Block 1 deals with the issues relating to the General Equilibrium framework in the context of Production and the Overall Efficiency and Welfare Economics. Unit 1 discusses the production economy along with market equilibria and identifies the Pareto optimal production outcome. Unit 2 combines the General equilibrium in production and in exchange to reach the overall efficiency in the economy. It also covers the concept of welfare economics taking care of the fact that efficiency does not ensure equity. **Block 2 and 3** throw light on various forms of the markets under Imperfect Competition, namely, Monopoly, Monopolistic Competition and Oligopoly. These market structures do not meet the rigorous standards of a hypothetical perfectly or purely competitive market, in a way they are relatively a better representatives of real markets. Unit 6 of **Block 3** takes up the discussion on the Game theory topic. It covers a formal methodology and a set of techniques to study the interaction of rational agents in strategic settings. In real-life situations, market does not provide results as envisioned by the price theory. Such a market failure is observed in case there are externalities, Public goods and/or asymmetric information. These issues have been covered in **Block 4.**

Mathematical Symbols/ Notations used in the Course

Symbol	Symbol Name/Meaning Attached	Usage
$\succeq$	Weak Preference	A $\succeq$ B, alternative A is weakly preferred to B
$\sim$	Indifference	A $\sim$ B, consumer is indifferent between alternative A and B
$\succ$	Strict Preference	A $\succ$ B, alternative A is strictly preferred to B
$>$; $<$; $\geq$; $\leq$	Greater than; Less than; Greater than or equal to; Less than or equal to, respectively	A $>$ B, A is greater than B; A $<$ B, A is less than B; A $\geq$ B, A is greater than or equal to B; A $\leq$ B, A is less than or equal to B, respectively
$[a, b]$	Closed interval	[0, 2], an interval containing the set of real numbers that lie between numbers 0 and 2, including the numbers 0 and 2 themselves.
(a, b)	Open interval	(0, 2), an interval containing the set of real numbers that lie between numbers 0 and 2, and not the numbers 0 and 2.
$\in$	Element of	$t \in [0,1]$, t is an element of the closed interval [0,1]
Δ	Delta/Change in	ΔX, change in value of X
dx	Differential	dx, represents an infinitely small change in the variable x
$\Rightarrow$	Implies	A$\Rightarrow$B, if A is true, then B is also true
F(.) or f (.)	A function	F(x) or f (x), a function of x
F′(x) or y' or $\frac{dy}{dx}$	First-order derivative	Given y = F(x)—y a function of x, F′(x) or y' or $\frac{dy}{dx}$ represent first-order derivative of function F(x) with respect to x
F″ (.)or y'' or $\frac{d^2y}{dx^2}$	Second-order derivative	Given y = F(x)—y a function of x, F″ (.)or y'' or $\frac{d^2y}{dx^2}$ represent second-order derivative of function F(x) with respect to x
$\lim_{\Delta x \to 0} f(x)$	Limit	$\lim_{\Delta x \to 0} f(x)$, limit value of function $f(x)$ as x approaches 0.
$\frac{\partial f(x,y)}{\partial x}$ or $\frac{\partial y}{\partial x}$	Partial derivative	Given $y = f(x, y)$—y a function of x and y, $\frac{\partial f(x,y)}{\partial x}$ or $\frac{\partial y}{\partial x}$ represent partial derivative of function $f(x, y)$ with respect to x
ln	Natural log	lnx, log of x to the base e, where e = 2.718…
$\int_a^b f(x)dx$	Definite Integral	$\int_a^b f(x)dx$ = F(b) – F(a), where F′(x) = f(x)

Some Greek Alphabets (and corresponding symbols) you may encounter:

Symbol	Greek Alphabet	Symbol	Greek Alphabet
α	Alpha	θ	Theta
β	Beta	λ	Lamda
γ	Gamma	π	Pi
δ	Delta	σ	Sigma
ε	Epsilon	χ	Chi
Ψ	Psi	μ	Mu
ρ	Rho	ω	Omega

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Block 1
General Equilibrium

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UNIT 1 GENERAL EQUILIBRIUM WITH PRODUCTION

Structure

1.0 OBJECTIVES

After going through the unit, you will be able to explain:

- the meaning of 'Partial Equilibrium' and 'General Equilibrium';
- the concept of Edgeworth box in production;
- Pareto efficiency in production;
- optimal allocation of factors under perfect competition;
- first welfare theorem in production;
- second welfare theorem in production;
- limitations of welfare theorems in production; and
- derivation of transformation curve from general equilibrium in production.

1.1 INTRODUCTION

In Unit 8 of Intermediate Microeconomics-I course in Semester III, you were introduced to the concept of general equilibrium in a pure exchange economy. There we considered a case of two goods and two consumers endowed with some amounts of both the goods. The assumption of no production was also made, and general equilibrium resulted from mutual exchanges of the two goods between the two consumers till a Pareto efficient allocation was reached as a competitive equilibrium. We also came across the two most fundamental results of general equilibrium analysis—the first and second welfare theorems. Now we add production to this model. In other words, consumers will not just be exchanging goods to reach a Pareto efficient allocation; producers will be producing those goods as well—turning factors of production into final consumption goods. As it turns out, this adds some complexity to the analysis of general equilibrium.

In this unit we will focus on general equilibrium analysis wherein we will study a complex problem of attaining equilibrium simultaneously in all the markets where demand and supply in the markets of related goods interact to determine equilibrium prices and quantities. This is a more realistic view and a comprehensive analysis of the economic system as we always expect inter-relationships and inter-dependence among different markets for commodities and factors and the decision-making agents such as consumers, producers and resource owners.

1.2 MEANING OF 'PARTIAL EQUILIBRIUM ANALYSIS' AND 'GENERAL EQUILIBRIUM ANALYSIS'

Let us first revisit the concepts of partial and general equilibrium. In Economics a distinction is made between *Partial* equilibrium and *General* equilibrium analysis. Partial equilibrium analysis is a study of individuals, that is, it involves studying a single good market, a single factor market, a single consumer or a single producer in isolation. Under partial equilibrium analysis, we explain the determination of equilibrium price and quantity of a product or factor through its demand and supply ignoring the prices of and market conditions for other related goods. This is based on the assumption that the price of other products or factors does not change when there is some change in the price of the commodity under consideration.

Therefore, the analysis in which we do not consider the inter-dependence of product and factor markets and the prices of other related commodities and factors is called *Partial Equilibrium Analysis*. Utility maximisation by an individual, cost minimisation by a producer, equilibrium analysis of tea industry or textile industry are all examples of partial equilibrium analysis. However this is not realistic scenario because markets are generally inter-related and inter-dependent, and change in the price of related goods has repercussions on the demand and supply of commodity under consideration. For instance, equilibrium analysis of automobiles market cannot be studied in isolation of the changes in petrol market.

A more appropriate analysis that takes into account the inter-relationship and inter-dependence between different markets and studies the determination of equilibrium simultaneously in all the markets is called the

General Equilibrium Analysis. General equilibrium analysis is a study of simultaneous equilibrium in all the markets and considers all prices as variable. Under it, an economy is studied as a closed system, with all prices being determined simultaneously. General equilibrium analysis takes into account the effect of change in price and market conditions in other goods' markets on the price of the good under consideration. For instance, it takes into account the effect of change in the price of petrol on the demand of automobiles, as change in price of petrol is expected to have a strong impact on demand for automobile— a link which is ignored under partial equilibrium analysis.

Check Your Progress 1

1) Distinguish between Partial equilibrium and General equilibrium analysis.

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2) General equilibrium takes into account inter-dependence and inter-relationship between different markets. Comment.

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1.3 GENERAL EQUILIRBIUM WITH PRODUCTION

General equilibrium is concerned with analysing all the markets, along with considering the mutual dependence between them. In Unit 9 of Intermediate Microeconomics-I course, we discussed the concept of General equilibrium in a pure exchange economy with the assumption of no production taking place. The consumers were actively trading to reach a general equilibrium where we discussed Pareto optimality (Pareto efficiency) and market equilibria and showed the crucial connection between Pareto optimality and market equilibria as captured in the first and second fundamental theorems of welfare economics. Recall that the first theorem broadly says that a market equilibrium is Pareto optimal and the second says that any Pareto optimal allocation can be achieved with the market mechanism. Now in this unit, we discuss the production economy along with market equilibria and identify the Pareto optimal production outcome in that economy. Just like before, the Edgeworth box is employed to capture the essential features of general equilibrium. In the pure exchange case without production, we assumed two consumers A and B, and two commodities X and Y. There general equilibrium entailed Pareto optimal allocation of commodities X and Y among consumers A and B (who were assumed to be endowed with some quantities of both the commodities X and Y). Now from the perspective of attaining general equilibrium with production, we consider two factors of production Labour (L) and Capital (K) that firms employ for the production of the commodities X and Y. To keep the analysis simple and to concentrate on the basic characteristics of general equilibrium with production, it is assumed that—

i) There prevails perfect competition in all the markets.

ii) Both Labour and Capital are available in fixed quantities in the economy.

iii) The technology is given.

Considering the above mentioned assumptions, in the context of General Equilibrium with production, we intend to solve the problem of *Production Efficiency*, that is to determine how much of the capital and labour factors to be used for production of each commodity. Thus, the task under general equilibrium here is to determine equilibrium relative prices and quantities of both the factors employed, labour (L) and capital (K), corresponding to the point at which all markets reach equilibrium simultaneously.

1.4 PRODUCTION EFFICIENCY

1.4.1 Edgeworth Box for Production

Similar to the Edgeworth box we drew for commodity exchange, we construct an Edgeworth box for production in order to visualise production efficiency diagrammatically. A rectangular Edgeworth box with fixed dimensions (given by total endowment of capital and labour) depicts all possible allocations of capital and labour employed for the production of commodities X and Y. Commodity X is represented by origin O_X at the lower-left corner, while commodity Y by O_Y at the upper-right corner. From origin O_X, height of the box (O_XK_0) represents total endowment of capital available in the economy, while its width (O_XL_0)represents total endowment amount of labour available. Similarly, the respective opposite sides from origin O_Y represents the total capital and labour available in the economy. Isoquants with respect to origin O_X (*i.e.*, X_0, X_1, X_2 such that $X_0 < X_1 < X_2$) represent different combinations of capital and labour required for producing a given level of output of commodity X, while those with respect to origin O_Y gives capital-labour production combinations producing a given level of output of commodity Y (*i.e.*, Y_0, Y_1, Y_2 such that $Y_0 < Y_1 < Y_2$). Reaching a final general equilibrium involves allocation of the two factors of production K and L among the production of two commodities X and Y.

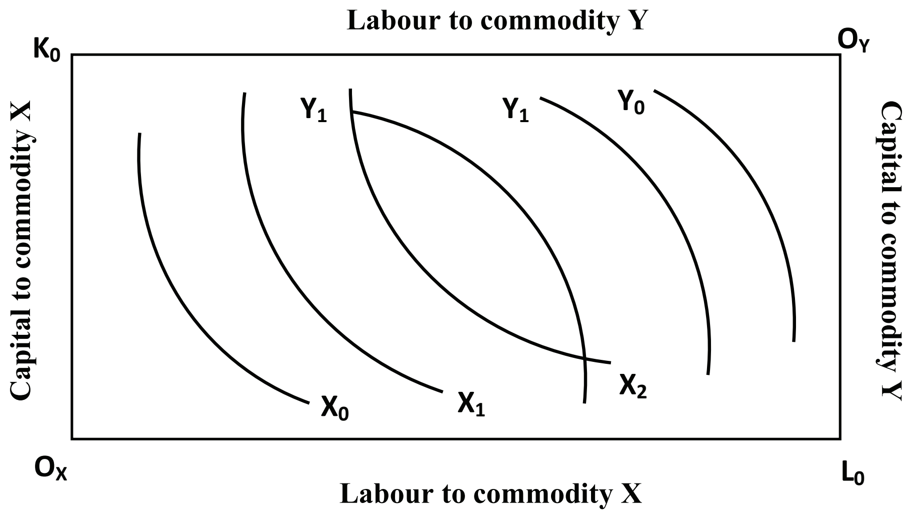

Fig. 1.1: Edgeworth Box with Production

1.4.2 Contract Curve or Efficiency Production Set

Now, consider Fig. 1.2 where point T represent the initial factor allocation among production of commodities X and Y. Here X_1 amount of commodity X is produced using $O_X L_1^X$ amount of labour and $O_X K_1^X$ amount of capital and Y_1 amount of commodity Y is produced with remaining amounts (*i.e.*$O_Y L_1^Y$ amount of labour and $O_Y K_1^Y$ amount of capital)of two factors of production. All other points also represent the similar allocation of total amount of both the factors of production. Isoquants representing input allocation for the production of commodities X and Y passing through the initial factor allocation point T form a lens-shaped area (shaded-region). The significance of this lens-shaped area is that every allocation of inputs identified by a point inside this area involves larger outputs of both commodities (called Pareto improvement) than at point T. For instance, point Q can be reached as improvement from point T by increasing production of both commodities. Movement from point T to Q involves shifting some labour from good X to Y industry and some capital from good Y to X industry, increasing outputs of both the commodities at no additional cost. Possibility for such an improvement exists in case of all the points where isoquants for both the commodities intersect.

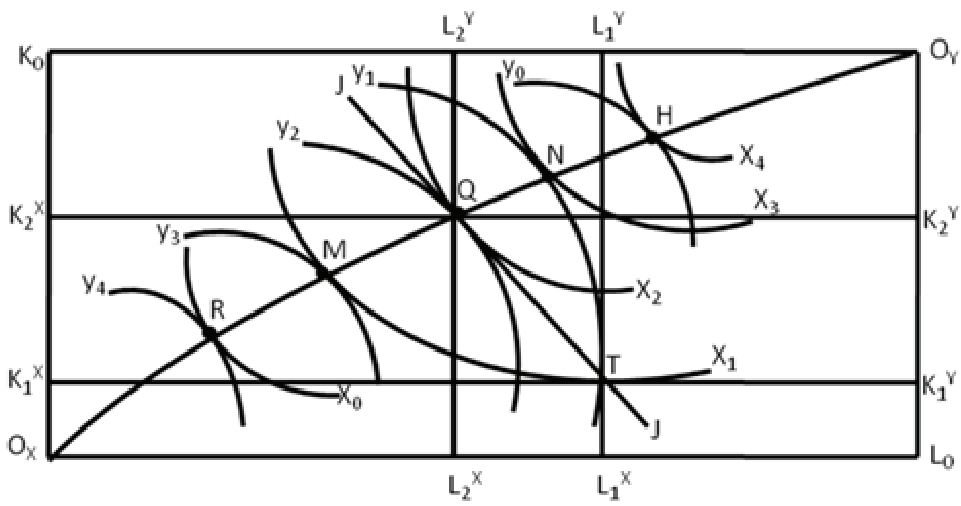

Fig. 1.2: General Equilibrium under Production

As you may notice, at point Q, possibility for further increasing the output of both or any of the commodity X or Y without incurring additional cost in terms of lower output of the other commodity ceases. Such a resource allocation is *efficient* in the sense that output of one commodity cannot be increased without decreasing the output of the other. Indeed, an efficient resource allocation occurs at the point of tangency of the isoquants representing respective commodities, else there exist scope for increasing the production of either or both the commodities through resource reallocation. If we take the locus of all the tangency points of the isoquants from the origins, we get a *contract curve* or an *Efficient Production Set*. In the figure the curve from O_x joining all the tangency points of the isoquants till O_y is the *contract curve*. The general equilibrium, that is, when all markets are simultaneously in equilibrium will lie somewhere on this contract curve. Any point other than the one on the contract curve cannot be a point of general equilibrium as there will always be a scope for improvement in terms of increased total output. Let us understand this by considering point T in Fig. 1.2. As one may notice in Figure 1.2, movement from point T to any point like N, M or Q will lead to increased production of commodity X, Y or both, respectively. Thus T cannot represent an efficient resource allocation.

1.4.3 Pareto Efficiency in Production

Pareto efficiency in production implies factors of production should be so allocated that through any reallocation it will not be possible to increase the output of any one commodity without decreasing the output of the other commodity or to increase the production of both the commodities together. Such an allocations lies on the contract curve where slopes of the isoquants representing resource allocation possibilities of commodities X and Y are equal, that is where the isoquants are tangent to each other. Slope of an isoquant is given by the Marginal rate of technical substitution between capital and labour for production of a good ($MRTS_{LK}$), hence at an efficient resource allocation point

$$MRTS^X_{LK} = MRTS^Y_{LK}$$

The above condition reads— *marginal rate of technical substitution between capital and labour for production of good X is equal to marginal rate of technical substitution between capital and labour for production of good Y.* Given an initial resource allocation between commodity X and Y (here point T), a reallocation of factors for the production of both the goods to reach a tangency condition of isoquants (like point Q) exhausts all Pareto improvements possible over the initial allocation condition. Allocation like Q represents *Pareto efficiency* in production.

However, on the contract curve you cannot tell which point is best as all are Pareto efficient. Which point would be the final equilibrium will depend directly on the initial allocation of resources and other factors like demand and preferences for the final goods, as well as indirectly on the ownership of factors of productions and their relative prices. Also if the initial production occurs somewhere on the contract curve then there is no scope for Pareto improvement. Hence, depending upon the initial allocation, the final equilibrium allocation would vary and is not unique.

Check Your Progress 2

1) Explain the construction of Edgeworth box and show how General equilibrium is attained in production.

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2) What is a Contract curve? How is it the locus of efficient outcomes?

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3) What does determine the final general equilibrium outcome on the contract curve?

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4) Can there be a Pareto efficient allocation where someone is worse off than the initial endowment which was Pareto inefficient?

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5) True or False

   a) Someone can be made better off by moving from one Pareto efficient point to another Pareto efficient point.

b) Someone can be made better off by moving from one Pareto efficient point to another Pareto efficient point without making anybody else worse off.

c) We know the final trading outcome if we know the initial endowment and the contract curve.

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1.5 GENERAL EQUILIBRIUM WITH COMPETITIVE INPUT MARKETS

When there exists perfect competition in factor markets, a point on the production contract curve, that is, the efficient production set will be attained as general equilibrium. This results from the fact that firms in a perfect competitive industry face the same input prices. Here, this tendency means that the wage rate earned by labourers will be the same in the production of commodity X and Y, and similarly for the rental price of capital. Furthermore, every firm will minimise cost by employing inputs in quantities so that $MRTS_{LK}$ equals the ratio of input prices (cost minimising condition requiring equality between slope of isoquants and isocosts). For a wage rate of *w* and a rental price of capital of *r*, the condition for cost minimisation will be:

$$\frac{w}{r} = MRTS_{LK}$$

Geometrically, this equality is shown by the tangency between an isocost line (with a slope of $\frac{w}{r}$) and an isoquant (with the slope $MRTS_{LK}$).In a competitive equilibrium, each producer of commodity X operates at a point where the slope of its isoquant equals the ratio of input prices. Also, each producer of commodity Y operates at a point where the slope of its isoquant also equals the *same* input price ratio. Hence, slopes of the isoquants representing commodities X and Y must equal one another since both are equal to the same input price ratio. That is, in a competitive equilibrium

$$\frac{w}{r} = MRTS^X_{LK} = MRTS^Y_{LK}$$

Consequently, the competitive equilibrium must lie on the contract curve, which identifies resource allocations where the slopes of isoquants of the two commodities are equal to the factor price ratio. In Fig. 1.2, line JJ passing through the tangency point Q of the two isoquants and the initial allocation point T has slope equal to the factor price ratio ($\frac{w}{r}$).Mathematically, the condition can be established as follows:

Under perfect competition, price of labor (*w*) and capital (*r*) is assumed as given and same for all the producers. Producers tend to minimise the cost given by *wL* + *rK* (where L and K stands for the units of labour and capital employed to produce output level $\bar{Y}$ respectively) for producing a given level of output $\bar{Y}$ = *f* (*L*, *K*) (output as a function of factor inputs L and K). The constrained optimisation exercise is given by:

$$\text{Min} \qquad wL + rK$$

$$\text{Such that} \qquad f(L,K) = \bar{Y}$$

To solve this, we write down a Lagrangean function ($\mathcal{L}$)

$$\mathcal{L} = wL + rK - \lambda(f(L,K) - \bar{Y})$$

The first-order condition is to differentiate $\mathcal{L}$ with respect to L, K and λ and put the resultant equal to zero.

$$\frac{\partial \mathcal{L}}{\partial L} = 0 \Longrightarrow w - \lambda \frac{\partial f(L,K)}{\partial L} = 0$$

$$\frac{\partial \mathcal{L}}{\partial K} = 0 \Longrightarrow r - \lambda \frac{\partial f(L,K)}{\partial K} = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = 0 \Longrightarrow f(L,K) - \bar{Y} = 0$$

Rearranging the above equations, we get

$$\frac{\frac{\partial f(L,K)}{\partial L}}{\frac{\partial f(L,K)}{\partial K}} = \frac{w}{r}$$

$$MRTS_{LK}^{Y} = \frac{w}{r}$$

Similarly for output *X* $\qquad MRTS_{LK}^{X} = \frac{w}{r}$

Therefore, we get

$$MRTS_{LK}^{X} = MRTS_{LK}^{Y} = \frac{w}{r}$$

Hence, perfect competition ensures optimum allocation of resources in the production of two commodities X and Y.

We already discussed the first and the second welfare theorems in Unit 8 of the Intermediate Microeconomics-I course of Semester III. Let us briefly recall them here from the perspective of the general equilibrium with production.

1.5.1 Production and the First Welfare Theorem

The first welfare theorem ensures that any perfectly competitive equilibrium allocation is Pareto efficient. When all producers act rationally to maximise profits under perfect competition, the competitive equilibrium is Pareto efficient. The conditions for the theorem are quite restrictive, as the result holds only if perfect competition prevails. Thus this theorem takes away the possibility of increasing returns to scale. Perfectly competitive equilibrium exists for non-increasing returns to scale. We also assume convex isoquants and concave transformation curves as this assumption is required to fulfill the second order condition of equilibrium. Thus the existence of perfect competition does not confirm the fulfillment of second order condition of equilibrium.

It also assumes that there is no production externalities (that is — one producer's decision does not affect the production possibilities of other firms) as well as, consumption externalities — as this theorem has nothing to do with the impact of production on distribution of income and thus on consumption. It also completely ignores the concept of equity in distribution and ensures only efficiency. In other words, a factor allocation where one producer is allocated with all the factor inputs, could be a Pareto efficient factor allocation (since no other producer can be made better off without harming the producer with all the factor inputs), but definitely not equitable. Further, one important condition for Pareto optimality is the existence of general equilibrium. If all markets are not simultaneously in equilibrium there would always exist a possibility for Pareto improvement. From welfare point of view perfect competition will not result in Pareto optimality if income distribution is not optimal. Also if there exists unemployment or underutilisation of resources, Pareto optimality will not be achieved as any point inside the PPC cannot be Pareto optimal. So Pareto optimality is ensured if and only if there exists full employment of all resources. Therefore, it can be claimed that perfect competition is a necessary but not a sufficient condition for Pareto optimality.

1.5.2 Production and the Second Welfare Theorem

Second welfare theorem states that any Pareto efficient allocation can be rationalised as competitive market equilibrium under certain assumptions. In other words, any socially desirable efficient allocation can be reached by way of the market mechanism (or as a competitive equilibrium) beginning from the endowment modified with the help of lump-sum transfers. This is in response to the distinct issues of efficiency and equity that are not addressed by the First welfare theorem. For instance, a Pareto efficient factor allocation where one producer is allocated with all the factors is inequitable from society's point of view. A redistribution of endowment among different producers will result in a different Pareto optimal allocation which can be relatively more socially desirable depending on the redistributed endowment and can be achieved through the use of competitive markets. However it involves a lot of practical difficulties in redistributing the endowment among different economic agents of the economy.

In an economy any Pareto optimal combination which is considered fair on distributional grounds can be achieved through perfectly competitive markets. So the endowment can be redistributed first and then relative prices can be used to reflect the scarcity. This leads to a policy intervention on equity grounds and is easily done through taxation which involves transfer of purchasing power from one hand to another without physically altering the initial endowment. However if taxation alter the decision of the agents (as happens when labour income is taxed and there is resulting fall in labour supply) then taxes are distortionary in nature. A lump-sum tax is non-distortionary in nature and any Pareto optimal allocation that is considered just by the society can be achieved by imposing such lump-sum tax. Therefore, the important implication of second welfare theorem is that prices must be used to reflect relative scarcity and a lump-sum tax could be in place to achieve just distribution in the society.

1.6 TRANSFORMATION CURVE

A Transformation curve (also called the Production Possibility Frontier) shows the maximum amount of different combinations of the two goods that an economy can produce by fully utilising all its resources. It basically shows the transformation of one good into another by transferring resources between the productions of two goods. The Edgeworth box depicts isoquant map of two commodities in the factor-space. To depict a clear picture in the output-space we need to derive the production possibility curve from the Edgeworth box.

We derive the transformation curve from the contract curve by bringing down the various combinations of the output of two goods produced from fixed endowments of factors of production from the input-space to the output-space. To derive the Transformation curve, consider the contract curve RH in Fig. 1.2. Now refer Fig. 1.3 where we plot point Q' in the output space (Transformation curve) corresponding to point Q on the contract curve that depicts X_2 amount of good X and Y_2 amount of good Y. Next consider point N on the contact curve and the corresponding to that the point N' on the transformation curve depicts the production combination X_3 and Y_1. Similarly, consider point M' corresponding to point M on the contract curve RH. We can, in this manner, capture each point in output space for the corresponding points in the input space along the contract curve. Joining all such points in the output space we obtain the transformation curve TT in Fig. 1.3.

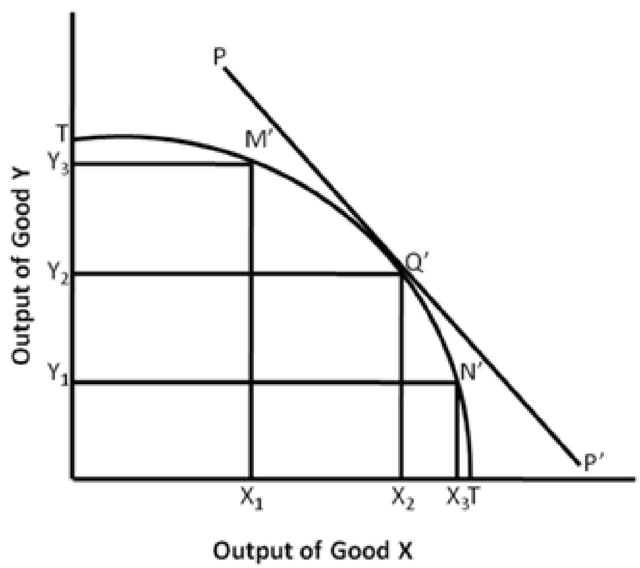

Fig.1.3: Transformation Curve

Important Features of the Transformation Curve

i) The transformation curve represents a set of technically efficient combinations of two final goods that can be produced with fixed endowment of factor inputs. The points inside the curve are feasible but are technically inefficient or in other words, factor inputs are not efficiently employed when such output combinations are produced. Similarly, points outside this curve might be technically efficient and are certainly more desirable than the points on the curve but are not feasible.

ii) Slope of the transformation curve measures the rate of technical transformation from one good to the other (at the margin) known as the marginal rate of product transformation between two goods X and Y ($MRPT_{XY}$). It simply equals the amount of good Y sacrificed by releasing resources from its production to produce additional units of good X. It equals:

$$MRPT_{XY} = \frac{MC_X}{MC_Y}$$

Where

MC_X is marginal cost of production of good X

MC_Y is marginal cost of production of good Y

iii) Transformation curve is concave to the origin because the amount of Y that has to be given up for increasing the production of good X increases as one produces more of good X. This in turn may result from several reasons including:

Diminishing returns, that is, fall in the efficiency with increase in the scale of production. But this might not be true in aggregate.

Differing factor intensities of the products: If we assume, Good X to be capital intensive and good Y to be labour intensive, then marginal productivity of the sector producing good X will decline as more and more labour gets shifted to that sector, and vice versa for the sector producing good Y as more and more capital gets allocated to it. So, even if there is no diminishing returns in each sector, we will get diminishing returns as we force a sector to use a comparatively less technically productive mix of inputs.

All points on the transformation curve are the points of general equilibrium in production as it is a mapping of points from the factor space to the output space. If technology exhibits constant returns to scale then production possibility curve will be a linear function. Suppose Raj can produce 60 chairs in an hour when he produces only chairs. Whereas, when he devotes his time to producing only tables, he produces 30 tables in an hour; though he may produce combinations of both chairs and tables simultaneously as well. On plotting these production possibilities we get the production possibility curve given by the Fig 1.4 (a). The curve is straight-line and downward sloping indicating a linear and a negative relationship between the productions of the two goods. The negative slope indicates the scarcity of the factor resources. Producing more tables require shifting of factor resources out of chair production and thus fewer chairs. Slope of this curve equals $-2\left(=-\frac{60}{30}\right)$, giving the rate at which Raj must give up production of chairs to produce an additional table.The absolute value of the slope measures the opportunity cost of producing an additional unit of table measured in terms of the quantity of chairs that must be forgone.

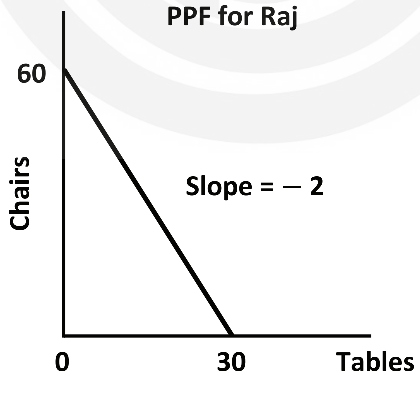

Fig. 1.4 (a): Production Possibility Frontier

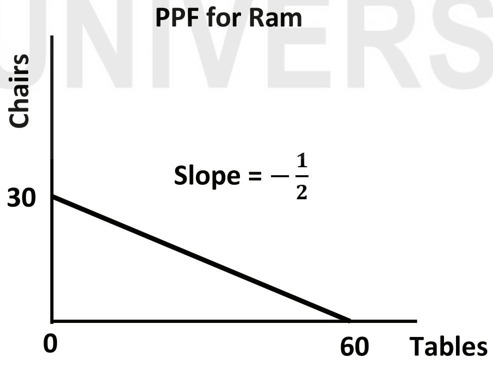

Fig. 1.4 (b): Production Possible Frontier

There is another individual Ram who can produce either 30 chairs or 60 tables in one hour's time. The corresponding PPC is given in Fig. 1.4 (b) with slope $-1/2$.Clearly Raj has a comparative advantage in producing chairs and Ram has a comparative advantage in producing tables. By comparative advantage it means opportunity cost for producing a chair is lower for Raj (for every extra chair that Raj produces, he has to produce 0.5 units less of table) as compared to Ram (for every extra chair that Raj produces, he has to produce 2 units less of table), and similarly opportunity cost for producing a table is lower for Ram when compared to Raj.

Let us now consider the maximum output of the two individuals combined. If they produce one of the two commodities, then together they can produce either maximum of 90 tables or 90 chairs. In Fig. 1.5 point A represents total chairs produced in one hour when both Ram and Raj produce only chairs and no table. Similarly, point C represents total tables produced when they both produce only tables and no chair. However if they both specialise in producing the good in which they have a comparative advantage (with Raj producing 60 chairs and Ram, 60 tables) a combination represented by point B will be reached. The combined transformation curve will now have a kink with Marginal rate of transformation changing from −1/2 to −2 (see Figure 1.5).We see that in the region above the kink, more than 60 chairs (the maximum amount produced by the expert in producing chair, namely Raj) could be produced. So in this region above the kink Raj spends all day on producing chairs while Ram produces the rest. In the region below the kink, more than 60 tables (the maximum amount produced by the expert in producing table, namely Ram) could be produced. So in the region below the kink Ram spends all day on producing tables while Raj produces the rest. This way of dividing up the work between them is the most efficient possible in the sense that it leads to the highest possible combined production possibility frontier.

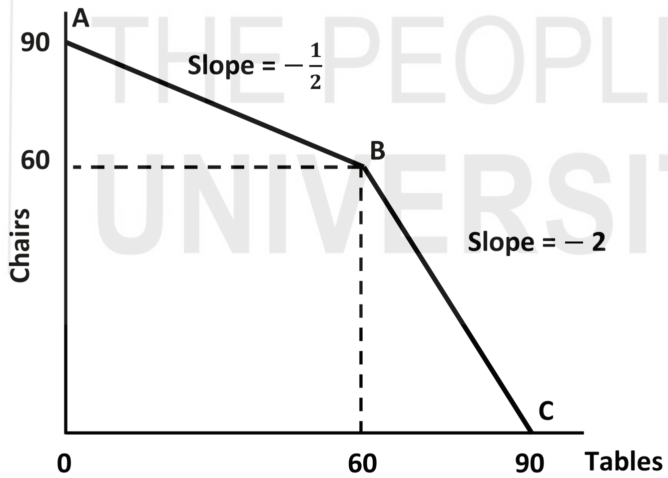

Fig. 1.5: Combined Production Possibility Curve

Check Your Progress 3

1) Define marginal rate of product transformation. Explain why marginal rate of product transformation of one good into another equals the ratio of their marginal costs.

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2) Derive the transformation curve using the concept of general equilibrium in production.

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3) Suppose in an economy there are two individuals, Robinson and Friday who can produce using only one factor of production i.e. labour. Answer the following:

   i) Robinson using all his labour can produce either 5 units of food or 10 units of clothing per day and Friday can produce either 10 units of clothing or 15 units of food a day. Derive the production possibility frontier for such an economy using the information.

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1.7 LET US SUM UP

In this unit we have studied the difference between partial equilibrium analysis and general equilibrium analysis. Partial equilibrium analysis is a study of a single market whereas general equilibrium is concerned with equilibrium in all the markets simultaneously. We learnt how the Edgeworth Box can be used to study general equilibrium in production and reach the condition of Production Efficiency. Such a condition involves efficient allocation of two factors of production (labour and capital here) for the production of two goods (good X and Y here).

The concept of Pareto optimality is an important condition for optimal allocation of factor resources in a general equilibrium. It allows us to reach the condition of general equilibrium where all markets are simultaneously in equilibrium. It eliminates all the possibilities of Pareto improvements. Each party involved exploits maximum possible gain by efficiently allocating factor resources for the production of an efficient output combination given the initial factor allocation among them. A condition is given by the tangency of the isoquants of both the parties involved where the factor price ratio is equal to the slope of the line passing through this tangency point the initial endowment point. We further learnt about the first and the second welfare theorem and its applicability and limitations in general equilibrium with production. We finally derived the transformation curve (or the PPF) using the concept of general equilibrium in production and the concept of comparative advantage.

1.8 SOME USEFUL REFERENCES

- Hal R. Varian (2006), *7th edition Intermediate Microeconomics*, Chapter (31-33), East – West Press.
- C.Synder and W.Nicholson (2010), *Indian edition Fundamental of Microeconomics*, Chapter 13 , Cengage Learning India.
- A.Koutsoyiannis (1985), *2nd edition Modern Microeconomics,* Chapters 21-23, English language book society/Macmillian (ELBS).

1.9 ANSWERS OR HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Refer Section 1.2 and answer.
2) Refer Section 1.2 and answer

Check Your Progress 2

1) For construction of Edgeworth box in 2x2 model for production refer Section 1.4.
2) Contract curve is the locus of tangency points of the isoquants in the Edgeworth box for production. It depicts all Pareto optimal points reaching which eliminates all the possibilities of Pareto improvements. Any factor allocation point on the contract curve is efficient in the sense that no producer can be made better off with any possible factor reallocation without harming the other producer in terms of lower output production.
3) Initial endowment determines the final general equilibrium on the contract curve.
4) No
5) a and c true, b false

Check Your Progress 3

1) Marginal rate of product transformation is the rate at which resources from one good is taken away to produce additional unit of another good.
2) Check the derivation in Section 1.6
3) a) Production possibility curve is kinked.

   b) Individually: 12 hrs, 6.6 hrs. Combined: 8 hrs and 5.2 hrs

   c) Equilibrium at the kink of the PPC.

UNIT 2 OVERALL EFFICIENCY AND WELFARE ECONOMICS

Structure

2.0 OBJECTIVES

After going through the unit, you will be able to explain:

- general equilibrium of production and exchange;
- perfect competition and general equilibrium in production and exchange;
- the Pareto optimality criterion;
- the concept of welfare economics and value judgements;
- social welfare functions, viz. Bergson-Samuelson, Classical Utilitarian or Benthamite, Weighted sum of utilities, Minimax or Rawlsian; and
- maximisation of social welfare using the tools like Isowelfare curve and grand utility possibility frontier.

2.1 INTRODUCTION

A General equilibrium in production and in exchange together builds up the overall efficiency in the economy. It results in an overall Pareto efficient outcome in the economy where producers maximise their profit earnings and simultaneously consumers maximise their satisfaction levels. In this unit we will study the concept of simultaneous equilibrium in all the markets i.e., factor as well as commodity markets. For this we will make use of the concept of general equilibrium in exchange with no production we came across in Unit 8 of Intermediate Microeconomic-I course and the condition of general equilibrium in production we discussed in Unit 1 of the present course of Intermediate Microeconomics-II course.

Efficiency in production and exchange does not always guarantee maximum social welfare because efficiency is independent of equity. To address this shortcoming of the concept of Pareto efficiency, we will study the concept of welfare economics that explicitly make use of value judgements. Thus, we will learn about how to account for the social welfare and how it can be maximised. In this regard we will study different welfare functions and the associated welfare indifference curves and combine it with the grand utility possibility frontier to arrive at the constrained bliss or the maximum social welfare point.

2.2 GENERAL EQUILIBRIUM OF PRODUCTION AND EXCHANGE

In the first unit we derived the production possibility curve (PPC) or transformation curve using the concept of general equilibrium in production. All points along the transformation curve (refer points E′, F′ and G′ in Fig. 2.1) correspond to the points on the contract curve (points E, F and G, respectively) where the isoquants of two goods (X_1, X_2, X_3 for good X and Y_1, Y_2 and Y_3 for good Y) are tangent to each other. Each point corresponds to a different output mix. In Fig. 2.1, for instance, point E correspond to the output mix given by (X_1, Y_3), point F correspond to (X_2, Y_2) and point G to (X_3, Y_1).

Now we come to the question— where on PPC the economy should operate? In other words, what combination of good X and Y should be produced? An efficient output-mix results when there is general equilibrium of production and exchange, that is, when subjective wants (or preferences) of consumers are balanced with the objective conditions of production.

Recall from Unit 8 of Intermediate Microeconomics-I of Semester 3 and refer Fig.2.2, given the initial endowment bundle (point W) and preferences of consumers A and B, general equilibrium of exchange with no production occurs at a point (here, point E) where marginal rate of substitution (MRS) between two goods (X and Y) is equal among the two consumers.

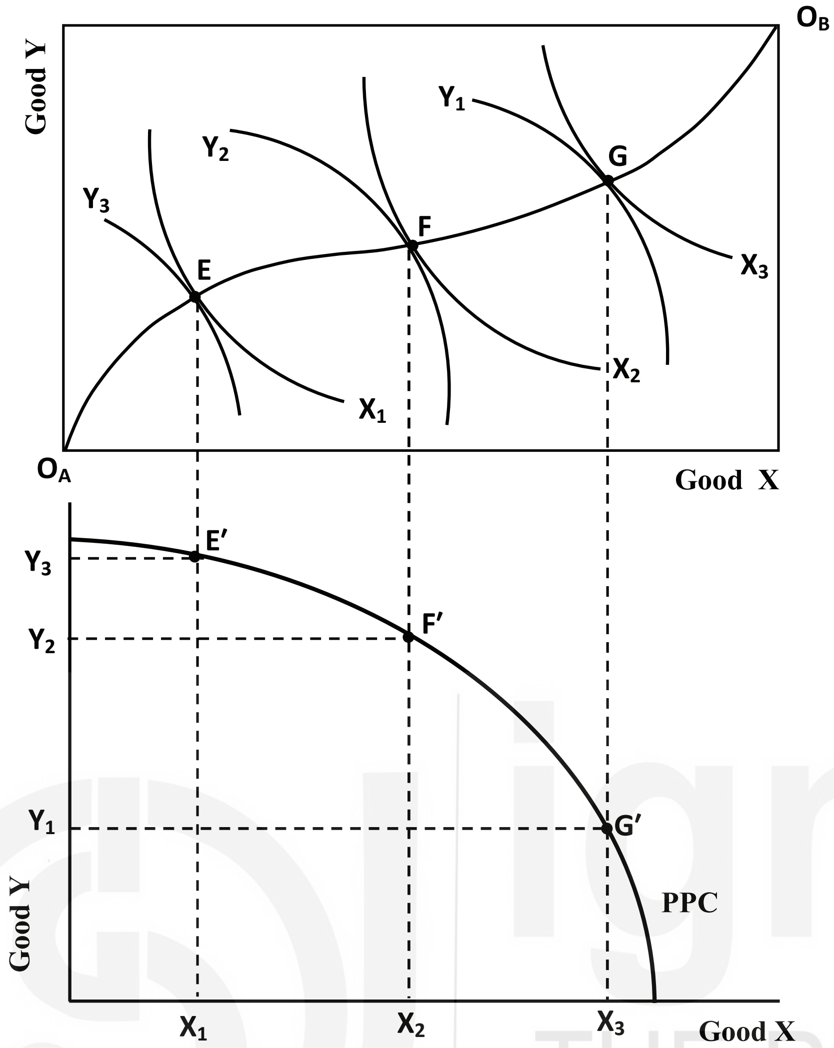

Fig. 2.1: General Equilibrium in Production and PPC

This is the point of tangency between their respective indifference curves (IC_A and IC_B) and the budget line (PQ) passing through the initial endowment point. At point E, $MRS^A_{XY} = MRS^B_{XY} = \left(\frac{P_x}{P_y}\right)^*$, where $\left(\frac{P_x}{P_y}\right)^*$ represent equilibrium price ratio of the two goods.

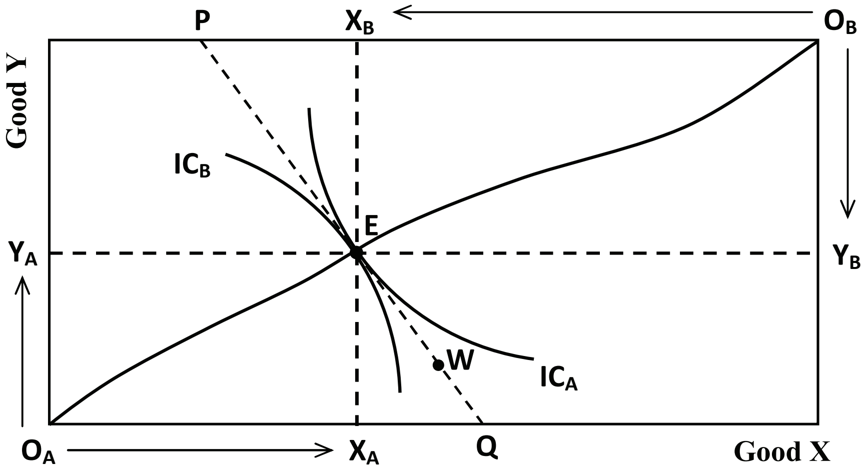

Fig. 2.2: General Equilibrium of Exchange with no Production

The general equilibrium of production and exchange will be represented by the output mix on the transformation curve— where producers maximise their profit earnings and simultaneously consumers maximise their utilities. The equilibrium occurs at a point where MRS_{XY} equals MRT_{XY}.

More specifically, general equilibrium in exchange and production occur at a point where the rate at which consumers are willing to exchange one good for another (MRS_{XY}) equals the rate at which (on the production side) one good can be transformed into another (MRT_{XY}). We locate such an equilibrium condition in Fig. 2.3. Let us select any point (here E′) on the transformation curve TC so that the total outputs of commodities X and Y are OX_1 and OY_1, respectively. These output levels determine the volume of the two commodities available to consumers A and B, and thus form the dimensions of an Edgeworth box diagram for exchange. Drop perpendiculars from E′ on the two axis. Now imagine O as the origin of consumer A, similarly, point E′ becomes the origin of consumer B.

Indifference curves of A and B are drawn in the exchange box. Curves A_1, A_2 and A_3 represent A's indifference curves, and B_1 B_2 and B_3 are B's ICs. The locus of tangencies of the indifference curves of A and B are E, F and G. By joining these points, we get a consumption contract curve OFEGE′. This curve is the locus of the various Pareto-optimal allocation of two commodities between the two consumers where $MRS_A = MRS_B$. Among these various efficient allocation points, point E represents a condition of general equilibrium in exchange which is consistent with the condition of general equilibrium in production. Point E and E′ together ensure the condition of general equilibrium of production and exchange as slope of the tangents to both these points are equal.

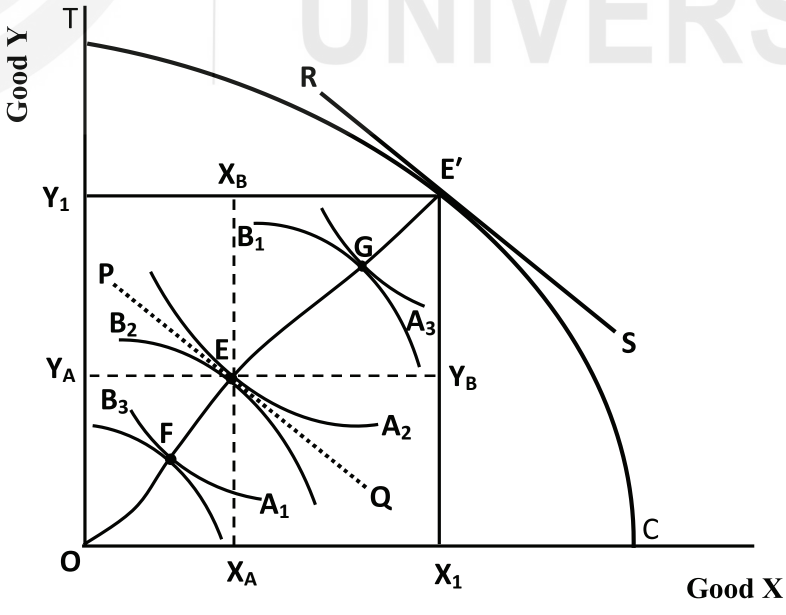

Fig. 2.3: General Equilibrium of Production and Exchange

General equilibrium of production and exchange requires

$$MRS^{A}_{XY}= MRS^{B}_{XY}= MRT_{XY}$$

as given by the slopes of tangents PQ and RS, respectively. Here, general equilibrium of production occurs at point E′ where producers produce OX_1 units of good X and OY_1 units of good Y as an output mix; and General equilibrium of exchange occurs at point E where A_2 (the indifference curve representing consumer A) is tangent to B_2 (the indifference curve representing consumer B) with the individual A consuming OX_A units of good X and OY_A units of good Y and consequently, the individual B consuming $E'X_B$ units of good X and $E'Y_B$ units of good Y.

If $MRS_{XY} \neq MRT_{XY}$ then the rate at which consumers are willing to exchange two goods will be different from the rate at which one good is transformed into another in the production process. For instance, if MRT_{XY} is 4Y /1X and MRS_{XY} is 2Y/1X then this is a state of disequilibrium. Here, in the production process 4 units of good Y needs to be given up for producing an additional unit of good X, whereas consumers are ready to sacrifice only 2 units of good Y for an additional unit of good X. This implies consumers place higher valuation on good Y, and as a result consumers can be made better off by moving along the PPC to a point where more of good Y and less of good X is produced. As production of good Y increases, MRT_{XY} falls, and consumers consume more of good Y and less of good X, MRS_{XY} tend to rise or in other words, their valuation of good Y begins to fall until the two rates MRT_{XY} and MRS_{XY} become equal. In perfect competition the market forces bring up such equalisation which ensures maximum satisfaction for the consumers and profit maximisation for the producers. Therefore, any disequilibrium between marginal rate of substitution and marginal rate of transformation will lead to change in the output mix and thus the final equilibrium substitution or transformation rate between the goods.

To summarise, the general equilibrium condition for overall efficiency is:

$$MRS_{XY}^{A} = MRS_{XY}^{B} = MRT_{XY}$$

2.2.1 General Equilibrium of Production and Exchange and Perfect Competition

If the market structure is characterised by perfect competition then we can obtain a unique general equilibrium of production and exchange. However the equilibrium definitely depends on the initial allocation of factors between the production of two goods and the initial endowment of two goods among two individuals. The equilibrium changes with the change in these initial two conditions. The condition for general equilibrium of production and exchange is given by:

$$MRS_{XY}^{A} = MRS_{XY}^{B} = MRT_{XY}$$

Now, the slope of the transformation curve MRT_{XY}, which measures the rate of transformation of one good into another, is equal to the ratio of their respective marginal costs:

$$MRT_{XY} = \frac{MC_X}{MC_Y} \quad (1)$$

Under the conditions of perfect competition in the market, price of a commodity is equal to the marginal cost of production of that commodity, that is, we have:

$$MC_X = P_X \text{ and } MC_Y = P_Y \quad (2)$$

Therefore, from (1) and (2), we get

$$MRT_{XY} = \frac{MC_X}{MC_Y} = \frac{P_X}{P_Y}$$

In Fig. 2.3, slope of the tangent (RS) drawn to the transformation curve at point E' is the ratio of price of good X to price of good Y, *i.e.* $\frac{P_X}{P_Y}$. The point of general equilibrium of production is shown as point E' in the diagram where OX_1 amount of good X and OY_1 amount of good Y will be produced. So given the perfect competition in goods market, there is a unique general equilibrium in production at a point where the marginal rate of transformation is equal to ratio of the prices of goods.

This output mix obtained as the general equilibrium of production is then distributed among the consumers. Consumers maximise their satisfaction subject to their respective budget constraint. The condition for utility maximisation under perfect competition is:

$$MRS_{XY}^A = \frac{P_X}{P_Y}$$

$$MRS_{XY}^B = \frac{P_X}{P_Y}$$

From above we know that general equilibrium in exchange is achieved at a point where the indifference curves are tangent to each other and under perfect competition the MRS equals the price ratio. So the perfect-competitive equilibrium condition under general equilibrium in exchange is:

$$MRS_{XY}^A = MRS_{XY}^B = \frac{P_X}{P_Y}$$

Since under perfect competition, both consumers and producers are price-takers, the general equilibrium condition for the optimum output mix under perfect competition will be given by:

$$MRT_{XY} = MRS_{XY}^A = MRS_{XY}^B = \frac{P_X}{P_Y}$$

2.2.2 Pareto Optimality Criterion

Pareto efficiency implies a condition where no one can be made better off without making someone else worse off. When we consider overall efficiency in context of general equilibrium in production and exchange, it implies a state where all possibilities of gain from trade and all possibilities of efficient allocation of resources are fully exhausted. This means a condition where marginal rate of substitution between two goods is equal to the marginal rate of transformation so that consumer satisfaction is maximised and goods in the economy are produced as per the consumer preferences. That is, Pareto efficiency requires satisfaction of the following three marginal conditions:

a) Efficiency in Exchange— requiring efficient distribution of commodities among consumers.

b) Efficiency in Production— requiring efficient allocation of factors among firms.

c) Efficiency in Output mix— requiring efficient allocation of factors among commodities.

Check Your Progress 1

1) Show that the condition for overall efficiency is $MRS_{XY}^{A} = MRS_{XY}^{B} = MRT_{XY}$.

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2) Define general equilibrium in product mix in an economy with perfect competition in product and factor market. Clearly state all the conditions for existence of such an equilibrium.

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3) True or False: Pareto efficiency requires that each individual's Marginal rate of substitution be equal to Marginal rate of transformation.

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2.3 WELFARE ECONOMICS: THE CONCEPT

Till now we have confined ourselves to Positive economics, that is, we have answered the question "How it is?" We discussed the concept of efficiency in production and exchange using the Pareto optimality criterion. The idea of Pareto optimality rests on the given distribution of income or the underlying allocation of resources. Any redistribution of income will result in a new optimum, a new product mix and allocation of factors among production of commodities. An allocation in which a person is holding everything in the economy and the other gets nothing is also a Pareto efficient allocation (as any sort of reallocation to benefit some other individual will surely hurt the individual possessing everything), but surely it is not the desired allocation from the welfare point of view. That is, Pareto optimality criterion does not guarantee maximum social welfare. Hence to check on the maximum social welfare, one has to think beyond the Pareto optimality concept. Moreover, this criterion does not embrace those changes in the economic state which make some persons better off and others worse off.

To address such shortcomings, the concept of value judgement needs to be introduced in respect to income distribution and initial factor employment in production of different commodities. This is because, Pareto efficiency works independent of how the income is initially distributed. In place of *Positive* economics that deals with "how it is", we will study about *Normative* economics which deals with "what ought to be". From normative point of view we attach a value judgement to different economic allocations. Under this we talk about how we judge and establish norms to judge different allocations on the basis of not just economic efficiency (as in the case with Pareto efficiency) but also the social welfare. Thus, in welfare economics attempt is made to establish criteria or norms with which to judge or evaluate alternative economic states and policies from the viewpoint of welfare of the society.

2.3.1 Value Judgements

Value judgement means belief of people about what is good or bad. Value judgement plays a crucial role in evaluating different economic policies on welfare grounds. These judgements are developed in a society on the basis of values prevailing in the community which is under study. Measuring social welfare is not an easy task as it involves interpersonal utility comparisons and value judgements. The study of welfare economics is concerned with policy-making to promote social welfare. Value judgements and ethical norms cannot be ignored in such welfare analysis where the goal is to maximise welfare or happiness of the economy.

In welfare economics we claim an allocation to be efficient or optimal if it results in maximum social welfare. Various economists have developed different concepts for measuring social welfare. One such concept of measuring social welfare is the *paternalist* one. Under this, social welfare is said to be affected only by the change in the welfare of the dictator or the paternalist. The individual preferences of all other consumers are ignored and the dictator's idea of welfare dominates. This did not gain much acceptance among economists. The other one is the *Paretian* concept which states that welfare increases if someone is made better off and none worse off and welfare decreases if someone is made worse off and none better off. However in practical situations we usually find that with any economic change some are made better off and some are made worse off. Therefore even the Paretian concept has limited applicability to real economic problems. Another criterion on evaluating change in social welfare is the *Compensating* principle developed by Kaldor and Hicks. They claimed that their criterion does not involve value judgement and interpersonal comparisons and can still evaluate the situation where few are made better off and others worse off. They claimed that with any economic change the overall welfare is said to increase if those who gain can compensate those who are worse off and are still in a better position as compared to the initial economic allocation. The fourth one is the concept that involves interpersonal comparison of individual preferences and utility. This involves value judgement. This is the theory of *social welfare functions* and it overcomes the limitation of judging the situations where few people are made better off and some other worse off.

In this section we will concentrate on the concept of maximization of social welfare employing the tools like social welfare function (which reflects social preferences by aggregating individual preferences)and grand utility possibility frontier(derived from the Pareto optimality criterion).

2.3.2 Social Welfare Function

A social welfare function is a mathematical representation of the combined welfare of all economic agents in a society. It is simply a rule for aggregating individual welfare levels to obtain welfare of the society as a whole. The aggregation process itself depends upon an explicit value judgement about social value of individuals' welfare levels, in other words, the aggregating process involves some value judgement regarding how much does an individual's welfare contribute to social welfare.

2.3.2.1 Bergson-Samuelson Social Welfare Function

As per the Bergson-Samuelson social-welfare function, collective well-being depends on the utilities of the individuals that constitute that society. The individual utility functions (U_i) are ordinal and are a function of whatever it may be that provides individuals with utility or satisfaction. A social welfare function (SWF) of a society of *n* individuals will be given by

$$SWF = W(U_1, \ldots\ldots U_n).$$

Recall from Unit 1 of Intermediate Microeconomics 1 course, a utility function represents and preserves a complete, transitive, reflexive, and continuous preference relation of an individual. Or in other words, it can be said that an individual *i* prefers allocation X to Y if $U_i(X)$>$U_i(Y)$. Here it is assumed that aggregated utility function are monotonically increasing in each individual utility to ensure that if all individuals prefer X to Y then a society of *n* individuals also prefers X to Y. In other words, a social welfare function is an increasing function of each individual's utility.

Let us consider some examples of the functional form of the social welfare functions.

2.3.2.2 Classical Utilitarian or Benthamite Welfare Function

Thus, social welfare is the sum of utilities obtained by all the *n* members of the society. The function is given by

$$W(u_1, \ldots \ldots, u_n) = u_1 + u_2 + \ldots + u_n = \sum_{i=1}^{n} u_i$$

where *W* represents the social welfare and u_i with *i* = 1…*n* represent utilities of the individual *n* members of the society. The goal of a society is to maximise social welfare, that is, the aggregate of utilities of the individuals comprising the society. The assumption of the law of diminishing marginal utility of money income requires that maximum social welfare is achieved when income is so distributed that marginal utility of income is equal for all individuals in the society. The further assumption that individuals have the same utility functions ensures that maximisation of social welfare is achieved only with equal distribution of income.

2.3.2.3 Weighted sum of Utilities Welfare Function

When Utilities of each individual in the society are given equal weight, we get a Classical Utilitarian or Benthamite welfare function that we just discussed. A more generalised form of this function involves giving different weight ($a_{i,}$) to different individuals in a way to reflect the importance of members of the society. The functional form then becomes:

$W(u_1, \ldots \ldots, u_n) = \sum_{i=1}^{n} a_i u_i$; where a_i> 0

2.3.2.4 Minimax or Rawlsian social welfare function

A welfare function that cares of the welfare or utility level attained by the worst off individual in the society is given by the following form:

$$W(u_1, \ldots \ldots, u_n) = min\,\{u_1, \ldots \ldots, u_n\}$$

In this case, maximisation of social welfare will involve maximisation of the welfare of the least well-off individual in the society. In other words, the function describes an equity seeking behaviour in the distribution of utility by choosing allocations that maximises the minimum utility level in the society. Thus it implies that improvements in the utilities of the richest do not improve the social welfare.

2.3.3 Maximisation of Social Welfare

The problem of welfare maximisation involves the objective of maximising the welfare of the society as a whole using the SWF subject to the constraint that any allocation must be Pareto efficient. If not, then there exist some allocation that gives strictly greater utility to someone, with all others getting the same utility, as in this given allocation. But since by construction welfare function is increasing in utility it must then give higher social welfare with this new allocation which contradicts that we originally had a welfare maximum.

2.3.3.1 Isowelfare Curves

An Isowelfare curve (similar to an individual indifference curve) is a locus of all the allocations of individual utilities in the utility space with identical levels of social welfare. For a society of two individuals, social welfare function can be represented with the help of isowelfare curves as is shown in Fig. 2.4.

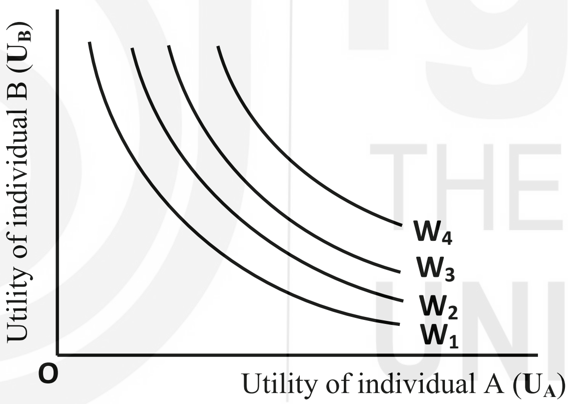

Fig. 2.4: Isowelfare Curves

Individual A and B are represented on the horizontal and vertical axis, respectively. W_1 W_2 W_3 and W_4 are the three isowelfare curves representing successively higher levels of social welfare. An isowelfare curve is a locus of various combinations of utilities received by individuals A and B which results in equal level of social welfare. The form of the social welfare function (SWF) reflecting different value judgements determine the shape of the isowelfare curves. For instance, Fig. 2.5 A represent isowelfare curves of a Utilitarian social welfare function, whereas Fig. 2.5 B represent isowelfare curves of a Rawlsian social welfare function of a society.

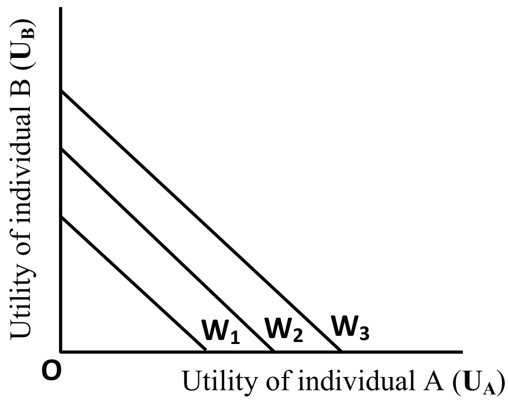

Fig. 2.5A: Isowelfare Corves

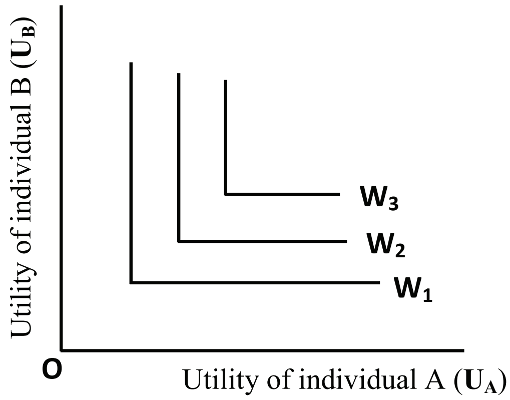

Fig. 2.5B: Isowelfare Curves

2.3.3.2 Utility Possibility Curve (UPC)

For every Pareto efficient output-mix that lie on the production possibility curve (PPC), there exist an exchange locus— which is nothing but the contract curve in an Edgeworth box defining a set of Pareto optimal allocations of the output-mix among the consumers of the goods (OE′ in Fig. 2.6 A). On plotting this exchange locus on the utility space, where we measure utility of individual A on horizontal axis and utility of individual B on vertical axis, we get a Utility Possibility Curve (UPC) for the output-mix (OX_1, OY_1) (Refer Fig. 2.6 B).

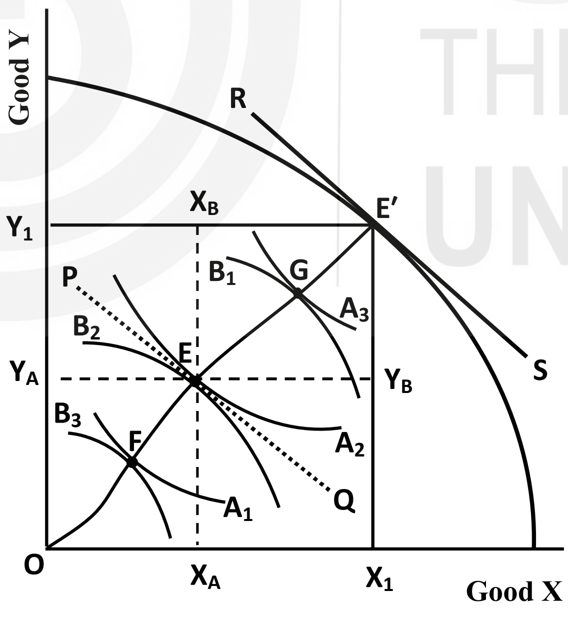

Fig. 2.6(A):*General Equilibrium of Production and Exchange*

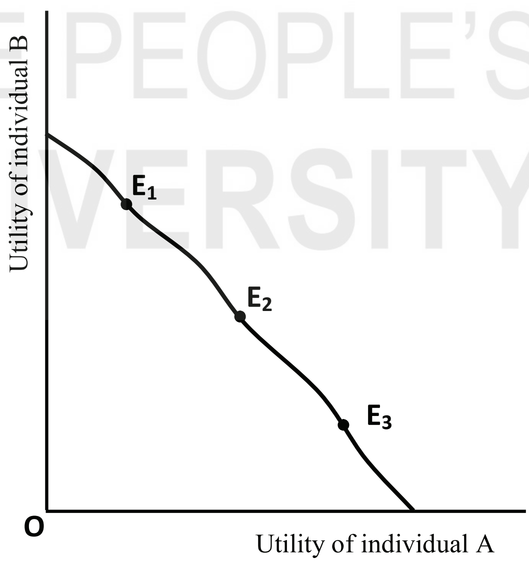

Fig. 2.6(B): ***Utility Possibility Curve (UPC)***

Here, an attempt is made to map the exchange contract curve from the output space of the PPC to a utility space. For instance, we plot efficient allocations F, E and G on the contract curve in Fig. 2.6 A to the utility space in Fig. 2.6 B as points E_1, E_2 and E_3, respectively. Utility level attained by consumers A and B at the tangency point F of their respective indifference curves A_1 and B_3 is represented by point E_1 in the utility space. Similarly, points E_2 and E_3 represent utility levels at the tangency points E and G, respectively. The negative (downward) slope of the UPC implies— given the factors and the output-mix, it is not possible to increase the utility of one individual unless the utility of the other individual is reduced.

For any given output-mix, there exist a large number of Pareto optimal allocations of that output-mix between the consumers (as is represented by the exchange contract curve OFEGE' in Fig. 2.6 A). Among these efficient allocations, there exist only one allocation which is compatible with the given output-mix as is represented by point E on the exchange contract curve (where MRS = MRT) and the corresponding point E_1 on the utility space. That is, point E and E' represent Pareto efficient outcome for economy as a whole, and corresponding point E_1 on utility possibility curve gives the utility combination received by the two individuals when economy reaches an overall Pareto optimal resource allocation pattern given the resources, technology, tastes and preferences.

2.3.3.3 Grand Utility Possibility Curve (GUPC)

For any given output-mix on PPC, a utility possibility curve indicates different combinations of utility levels of the two consumers. Among those various utility combinations, only one as we saw is compatible with the overall Pareto efficient outcome for economy. While deriving UPC, we considered E' as the initial output-mix. A production possibility curve is nothing but the mapping of Pareto optimal factor allocation for the production of two commodities from the Edgeworth box in to an output space. Hence, there could be varying output-mix possibilities to begin with.

Corresponding to each output-mix, by fitting an Edgeworth box, corresponding exchange contract curve is determined, which in turn fix a particular UPC in the utility space. Thus, there will be as many exchange contract curves and the corresponding UPCs as there are points on the PPC; and on each UPC, there will be one point which will represent the Pareto efficient outcome for the economy as a whole. Grand Utility Possibility Curve (GUPC) is nothing but the locus of all such points, representing the utility combinations attained by the two individuals when economy reaches an overall Pareto optimal resource allocation pattern for a given factor endowment, state of technology and preference order of the individuals. In other words, every point on the grand utility possibility curve represents the position of Pareto optimality or economic efficiency with regard to the allocation of the products among the consumers, allocation of factors among different products and the direction of production.

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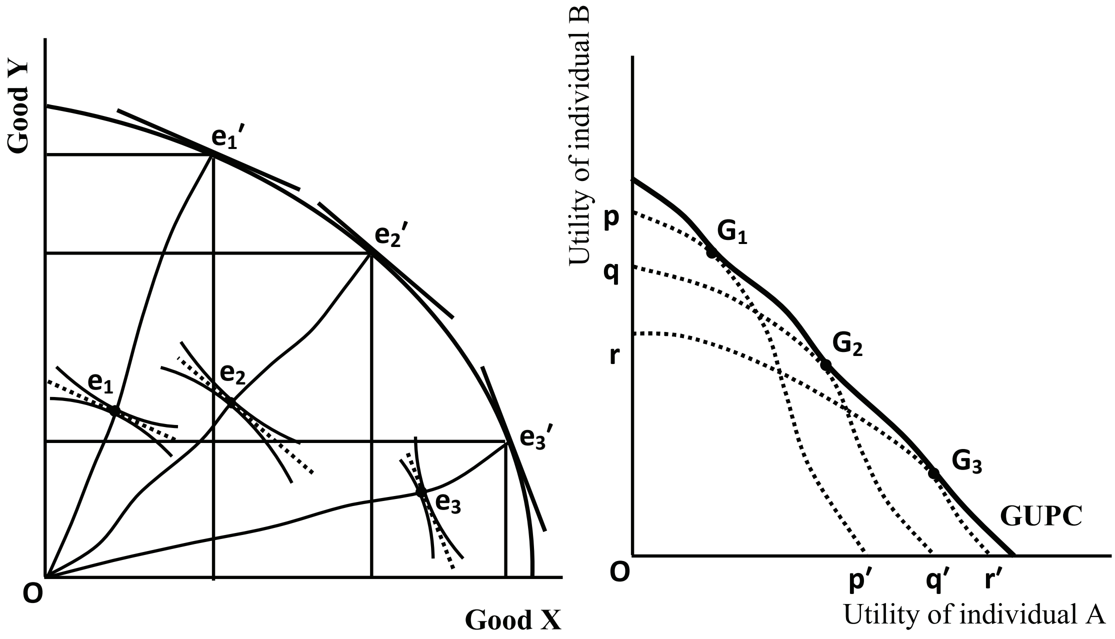

Fig. 2.7:Grand Utility Possibility Curve (GUPC)

In Fig. 2.7 on the left we have a production possibility curve with three possible output-mix given by points e_1', e_2' and e_3'. Oe_1', $Oe_2'$and Oe_3' represent the corresponding exchange locus which are plotted in the utility space on the right as respective utility possibility curves pp′, qq′ and rr′. Overall Pareto optimal points e_1, e_2 and e_3 on the exchange contract curves are plotted in the utility space as points G_1, G_2 and G_3, respectively. Points like G_1, G_2 and G_3 show the utility combinations attained by two individuals when Pareto efficient outcome for economy as a whole (that is when MRS = MRT) is reached starting from output-mix e_1', e_2' and e_3', respectively. An envelope curve of all such points which represent utility combinations corresponding to the Pareto optimal outcome for economy as a whole is what is known as the Grand Utility Possibility Curve (GUPC). It is called so, as it envelopes a family of utility possibility curves corresponding to each point on the PPC with each UPC represented by only a single point on GUPC where MRS = MRT. This is also known as utility possibility set. It consists of all Pareto efficient allocations which means at the boundary of the curve there does not exist any other feasible allocation that can give higher utility to both the individuals together. The grand utility possibility frontier satisfies all Pareto efficiency criteria *i.e*. efficiency in production, product composition and distribution. It gives the maximum utility that an individual can attain given the welfare of other individual when economy has attained Paretian outcome.

2.3.3.4 How Does Society Maximise Social Welfare?

As discussed above, every point on the grand utility possibility curve is Pareto optimum. Also, isowelfare curves depict social welfare function obtained on the basis of some value judgement regarding distribution of welfare. Thus welfare analysis combining grand utility possibility frontier with the concept of social welfare function results in a solution of maximum social welfare.

In Fig. 2.8, W_1, W_2 ,W_3 and W_4 represent four isowelfare curves and UU' depict the grand utility possibility frontier. Social welfare will be maximised where the grand utility possibility curve is tangent to an isowelfare curve, that is, at point W*with individual A deriving a utility of U_A^* and individual B deriving a utility of U_B^*. This is known as the point of "constrained bliss" because a movement away from point W* along the GUPC will reduce total social welfare. For instance, consider point P or Q on the GUPC. They represent a lower level of welfare because they are on the lower isowelfare curve W_2. Moreover, all points above the W* such as point R on the W_4 curve are beyond the reach of the society given the factor endowment and technology. Thus point W* represent maximum social welfare where the general equilibrium conditions of production and exchange are simultaneously satisfied.

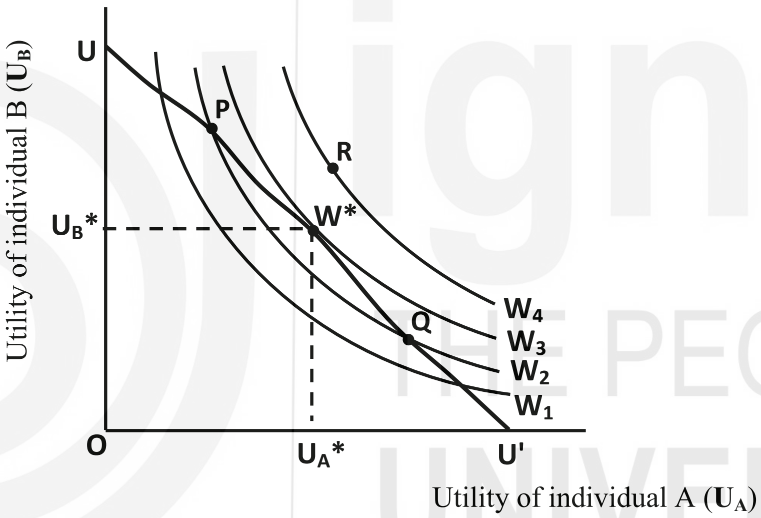

Fig. 2.8: Social Welfare Maximisation

Check Your Progress 2

1) What is a Social Welfare function? Elaborate on different types of social welfare functions.

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2) What is meant by value judgements? Explain their role in welfare economics.

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3) Prove that allocation under welfare maximisation is also a Pareto efficient allocation.

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4) With the help of a diagram, derive a grand utility possibility curve and mark the point of "constrained bliss"

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5) Rawlsian welfare function states that the societal welfare depends on the utility of worse off agent. Construct the welfare function that counts the society welfare in terms of the welfare of the best off agent.

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6) Explain how a society attains maximum social welfare.

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2.4 LET US SUM UP

The unit began with the derivation of the concept of overall efficiency, in other words, the condition of general equilibrium in production and exchange. This occurs at a point where marginal rate of substitution of consumers equates marginal rate of transformation under production. General equilibrium in production and exchange results in a Pareto optimal outcome for the economy as a whole, where both, the producers as well as the consumers optimise. Also, association of the overall equilibrium condition with the perfect competition was analysed. A Pareto efficient outcome does not guarantee maximum social welfare; this further led to some discussion on the aspect of the welfare economics. Value judgment is imperative and plays an important role in welfare economics, which basically aims at developing economic policies to increase social welfare. We discussed some examples of social welfare functions, viz. Bergson-Samuelson, Classical Utilitarian or Benthamite, Weighted sum of utilities, Minimax or Rawlsian. Towards the end we discussed the equilibrium condition of welfare maximisation which occurs at the point of tangency between the grand utility possibility curve and the isowelfare curve.

2.5 SOME USEFUL REFERENCES

- Hal R. Varian (2006), *7th edition Intermediate Microeconomics,* Chapter (31-33), East – West Press.
- C.Synder and W.Nicholson (2010), *Indian edition Fundamental of Microeconomics,* Chapter13 , Cengage Learning India.
- A.Koutsoyiannis (1985) ,*2nd edition Modern Microeconomics,* Chapters 21-23, English language book socity/Macmillian (ELBS).

2.6 ANSWERS OR HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) See Sub-section 2.2.2.
2) See Section 2.2.
3) True.

Check Your Progress 2

1) Social welfare function is an aggregation of individual preferences. Briefly write about Bergson and Samulseon, Benthamite and Rawlsian social welfare function.
2) Refer Sub-section 2.3.1
3) Refer Section 2.2 and 2.3 and write.
4) Welfare maximisation allocation must be Pareto efficient. If not then there exist some allocation that gives strictly greater utility to someone and all other get the same utility as in this given allocation. But since by construction welfare function is increasing in utility it must then give higher social welfare than the given allocation which contradicts that we originally had a welfare maximum.
5) $W(u_1, \ldots\ldots, u_n) = \max\{u_1, \ldots\ldots, u_n\}$
6) Refer Section 2.3 and answer

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