UNIT 16 WELFARE: ALLOCATIVE EFFICIENCY UNDER PERFECT COMPETITION

Structure
16.0 Objectives
16.1 Introduction
16.2 Efficiency – Definition and Concepts
   16.2.1 Productive Efficiency
   16.2.2 Technical Efficiency
   16.2.3 Efficient Allocation of Resources among Firms
   16.2.4 Efficiency in Output Mix
16.3 Efficiency in a Perfectly Competitive Market Firm
16.4 Efficiency in a Perfectly Competitive Market Economy
16.5 Competitive Prices and Efficiency: The First Fundamental Theorem of Welfare Economics
16.6 Departing from the Competitive Assumptions
   16.6.1 Imperfect Competition
   16.6.2 Externalities
   16.6.3 Public Goods
   16.6.4 Imperfect Information
16.7 Let Us Sum Up
16.8 References
16.9 Answers or Hints to Check Your Progress Exercises

16.0 OBJECTIVES

After studying this unit, you will be able to:

- clearly state the concept of economic efficiency (Pareto efficiency);
- identify various types of efficiencies and their interrelationship to achieve the Pareto Efficiency;
- distinguish between Pareto efficient and inefficient situations;
- describe the Production possibilities frontier and the marginal rate of transformation;
- appreciate that a perfectly competitive market will exhibit the ‘Productive’ and ‘Allocative’ Efficiencies;

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• describe the conditions for economic efficiency in a simplified perfectly competitive market economy;

• explain the essence of the relationship between perfect competition and the efficient allocation of resources also known as First Fundamental Theorem of Welfare Economics;

• describe the conditions under which perfectly competitive markets will fail to achieve the efficient allocation of resources;

• explain that efficient outcome of a perfectly competitive market may not necessarily be socially desirable; and

• briefly explain the policy implications of efficient outcomes reached under the perfectly competitive markets.

16.1 INTRODUCTION

The fundamental problem of a society, that led the ‘Economics’ discipline to emerge and take the driver’s seat, is scarcity of resources. The scarcity, which is the originator of ‘efficiency’, calls for the optimal production, consumption and distribution of these scarce resources. In a general sense, an economy is efficient when it provides its consumers with the most desired set of goods and services, given the resources and technology of the economy. One of the most important results in economics is that the allocation of resources by a perfectly competitive market is efficient. This important result assumes that such a perfectly competitive market does not have externalities like pollution or imperfect information. In Unit 9, we have studied the basic characteristics of such a market and how the firms determine their equilibrium level of output given the price of the product. It is a widely accepted view that perfect competition is an idealised market structure that achieves an efficient allocation of resources.

This unit will focus and elaborate in detail this aspect of perfectly competitive market structures which ensure economic and allocative efficiency and maximising profit in the perfectly competitive industries. Our analysis of a close correspondence between the efficient allocation of resources and the competitive pricing of these resources will however be based on the definition of economic efficiency in input and output choices, as given by Vilfred Pareto during the 19th century. The unit will also bring out the situations where operation of a perfectly competitive market structure breaks down and thereby loses its property of achieving the efficient allocation of resources.

16.2 EFFICIENCY – DEFINITION AND CONCEPTS

We begin with Pareto’s definition of economic efficiency:

Pareto efficient allocation: An allocation of resources is Pareto efficient if it is not possible (through further re-allocations) to make one person better-off without making someone else worse-off.

It is, however, important to note that the achievement of Pareto efficiency in resource allocation requires efficiency in production which is possible only with technically efficient allocation of resources and technical efficiency could
be achieved with efficient allocation of resources amongst the firms. Further to ensure overall Pareto optimality, efficiency in production needs to be tied up with the individual preferences. These concepts are systematically developed in subsequent sub-sections.

### 16.2.1 Productive Efficiency

An economy is efficient in production if it is on its production possibility frontier (Fig. 16.1). In terms of Pareto’s terminology, an *allocation of resources is efficient in production* (or “technically efficient”) if no further reallocation would permit more of one good to be produced without necessarily reducing the output of some other good. It seems easier to grasp this definition by studying its converse — an allocation would be inefficient if it were possible to move existing resources around a bit and get additional amounts of one good and no less of anything else.

![Fig. 16.1 : Production possibility frontier of an economy](image)

Suppose resources were allocated so that production was inefficient; that is, production was occurring at a point inside the production possibility frontier (point C in Fig. 16.1). It would then be possible to produce more of at least one good and no less of anything else. This increased output could be given to some person, making him or her better-off (and no one else worse-off). Points A and B being on the production possibility curve are productively efficient. It is impossible to produce more goods without producing less service. Point C is inefficient because you could produce more goods or services with no opportunity cost. *Hence, inefficiency in production is also Pareto inefficiency.* The trade-offs among outputs necessitated by movements along the production possibility frontier reflect the technically efficient nature of all of the allocations on the frontier.

Productive efficiency will also occur at the lowest point on the firms average costs curve. Thus, Productive efficiency is concerned with producing goods and services with the optimal combination of inputs to produce maximum output for the minimum cost. This point is elaborated in Section 16.3 of this unit.

### 16.2.2 Technical Efficiency

Technical efficiency is the effectiveness with which a given set of inputs is
used to produce an output. A firm is said to be technically efficient if a firm is producing the maximum output from the minimum quantity of inputs, such as labour, capital and technology. **Technical efficiency** is thus a precondition for overall Pareto efficiency.

### 16.2.3 Efficient Allocation of Resources among Firms

In order to achieve technical efficiency, resources must be allocated correctly among firms. Intuitively, resources should be allocated to those firms where they can be most efficiently used. More precisely, the condition for efficient allocation is that the marginal physical product of any resource in the production of a particular good is the same no matter which firm produces that good.

Although equality of marginal productivities will ensure the efficient allocation of resources among firms producing any one good, that condition is not enough to ensure that inputs are allocated efficiently among firms producing different goods. The additional condition for such efficiency is that the rates of technical substitution (RTS) among inputs must be the same in the production of each good if production is to be on the production possibility frontier. For better understanding of this condition, we have shown it graphically in Fig. 16.2.

Figure shows technically efficient ways to allocate the fixed amounts of $k$ and $l$ between the productions of the two outputs. The line joining $O_x$ and $O_y$ is the locus of these efficient points. Along this line, the RTS (of $l$ for $k$) in the production of good $x$ is equal to the RTS in the production of $y$.

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Technical efficiency however, does not guarantee a situation of a Pareto efficiency. For instance, an economy can be efficient at producing the wrong goods — devoting all available resources to producing left shoes would be a technically efficient use of those resources, but surely some Pareto improvement could be found in which everyone would be better-off.
of good x. The upper right-hand corner of the box represents the origin for resources devoted to y. Using these conventions, any point in the box can be regarded as a fully employed allocation of the available resources between goods x and y. We have now introduced the isoquant maps for good x (using Ox as the origin) and good y (using Oy as the origin). In this figure it is clear that the arbitrarily chosen allocation A is inefficient. By reallocating capital and labour one can produce both more x than x₂ and more y than y₂.

The efficient allocations in Fig. 16.2 are those such as P₁, P₂, P₃, and P₄, where the isoquants are tangent to one another. At any other points in the box diagram, the two goods’ isoquants will intersect, and we can show inefficiency as we did for point A. At the points of tangency, however, this kind of unambiguous improvement cannot be made. In going from P₂ to P₃, for example, more x is being produced, but at the cost of less y being produced, so P₃ is not “more efficient” than P₂ — both of the points are efficient. Tangency of the isoquants for good x and good y implies that their slopes are equal. That is, the Rate of Technical Substitution (RTS) of capital for labour is equal in x and y production. The curve joining Ox and Oy that includes all of these points of tangency therefore shows all of the efficient allocations of capital and labour. Points off this curve are inefficient in that unambiguous increases in output can be obtained by re-shuffling inputs between the two goods. Points on the curve OxOy are all efficient allocations, however, because more x can be produced only by cutting back on production of y and vice versa.

16.2.4 Efficiency in Output Mix

Technical efficiency will not necessarily ensure overall Pareto optimality unless the individuals’ preferences are tied up with the production possibilities. The necessary condition to ensure the Pareto optimum product mix is that goods produced with technical efficient allocation of resources are those which are most demanded by the consumers. Technically, this condition could be achieved when the marginal rate of substitution (MRS) for any two goods by consumers is equal to the rate of product transformation (RPT) of these two goods. The requirement for efficiency in product mix is illustrated graphically in Fig. 16.3 in one person economy, which could also be applied to an economy of many individuals with identical preferences.

It assumes that one person in this economy produces only two goods (x and y). Those combinations of x and y that can be produced are given by the production possibility frontier PP. Any point on PP represents a point of technical efficiency. By superimposing the individual’s indifference map on the figure, we see that only one point on PP provides maximum utility. This point of maximum utility is at E, where the curve PP is tangent to the individual’s highest indifference curve, U₂. At this point of tangency, the individual’s MRS (of x for y) is equal to the technical RPT (of x for y); hence, this is the required condition for overall efficiency.

In a single-person economy, the curve PP represents those combinations of x and y that can be produced. Every point on PP is efficient in a production sense. However, only the output combination at point E is a true utility maximum for the individual. At E the individual’s MRS is equal to the rate at which x can technically be traded for y (RPT).
Check Your Progress 1

1) What is an economically efficient allocation? How does an economically efficient allocation differ from an inefficient allocation?

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2) What is the production possibilities frontier? What is the marginal rate of transformation? How does the marginal rate of transformation relate to the production possibilities frontier?

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3) What do you mean by the term ‘technical efficiency’?

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As mentioned in the previous sub-section that there are two versions of efficiency: productive efficiency and allocative efficiency. By now, it would be clear that productive efficiency means ‘doing things right’, while allocative efficiency means ‘doing the right things’.

A firm is productively efficient when total use of resources (factor inputs) results in the lowest possible cost per unit of output. This would be the point where average total cost is minimised. Any other level of average costs would be sub-optimal. In regards to individual firms, the definition of allocative efficiency is that the individual firm is producing the correct quantity of the right goods – “doing the right things”. In stating that the correct quantity is produced, in fact, implies that the last unit produced costs (i.e. marginal costs) exactly what the consumer is willing to pay (i.e. the price of unit), resources have been optimally allocated. Resources have been optimally allocated when there is no waste, i.e. when the price equals marginal cost of the last unit produced. This occurs when the output level is where $P (AR) = MC$ for the firm. When all firms fulfil this criterion then supply equals demand on the market.

The firm operating within a perfectly competitive market will be both productively and allocatively efficient in the long run. It was proved in Unit 9 that the firm cannot have abnormal profit in the long run due to the entry of new firms, whereby the subsequent increase in supply and lower market price, will dissolve any such profits. Nor can the firm survive endless losses.

Fig. 16.4: Productive and Allocative Efficiency and LR Equilibrium for a PCM firm

Fig. 16.4 shows the LR equilibrium for a PC firm; output is at $P = AC_{\text{min}} = MC = AR = MR$. 

Welfare: Allocative Efficiency under Perfect Competition
In sum, we may conclude that the PC firm in the long run produces at an output level where \( P = AC_{\text{min}} = MC = AR = MR \). This identity fulfils the criteria for both productive and allocative efficiency in the long run, i.e.

- **Productive efficiency**: The LR equilibrium for the perfectly competitive market shows that \( AR = AC_{\text{min}} \). The firm is productively efficient.

- **Allocative efficiency**: The horizontal demand curve will set output along the upward sloping MC curve, inevitably forcing the firm to produce where the marginal revenue equals the marginal cost. In LR equilibrium, \( P = AR = MC \). The firm is allocatively efficient.

### 16.4 EFFICIENCY IN A PERFECTLY COMPETITIVE MARKET ECONOMY

Consider a simplified competitive economy where all individuals are identical and engaged in growing food. Further assume: (a) as per law of diminishing returns, each extra minute of work on fixed land brings less and less extra food, (b) each extra unit of food consumed brings diminished marginal utility (MU).

Fig. 16.5 shows supply and demand for our simplified competitive economy. When we sum horizontally the identical supply curves of our identical farmers, we get the upward-stepping MC curve. As we have seen in Unit 9, the MC curve is also the industry’s supply curve, so the figure shows MC = SS. Also, the demand curve is the horizontal summation of the identical individuals’ marginal utility (or demand-for-food) curves; it is represented by the downward-slopping MU = DD curve for food in Fig. 16.5. The intersection of the SS and DD curves shows the competitive equilibrium for food. At point E, farmers supply exactly what consumers want to purchase at the equilibrium market price. Each person will be working up to the critical point where the declining marginal-utility-of-consuming-food curve intersects the rising marginal-cost-of-growing-food curve.
ECONOMIC SURPLUS AND EFFICIENCY

Fig. 16.5 also shows a new concept, economic surplus, which is the area between the supply and demand curves at the equilibrium. The economic surplus is the sum of the consumer surplus, which is the area between the demand curve and the price line, and the producer surplus, which is the area between the price line and the SS curve. The producer surplus includes the rent and profits to firms and owners of specialised inputs in the industry and indicates the excess of revenues over cost of production. The economic surplus is the welfare or net utility gain from production and consumption of a good; it is equal to the consumer surplus plus the producer surplus.

Analysis of the competitive equilibrium will show that it maximises the economic surplus available in that industry. For this reason, it is economically efficient. At the competitive equilibrium at point E, the representative consumer will have higher utility or economic surplus than would be possible with any other feasible allocation of resources. At this point, it is observed as follows:

a) \( P = MU \), i.e. consumers choose food purchases up to the amount where \( P = MU \), implying that every person is gaining \( P \) utils of satisfaction from the last unit of food consumed (unit is a unit for measuring the utility or satisfaction).

b) \( P = MC \), i.e. as producers, each person is supplying food up to the point where the price of food exactly equals the MC of the last unit of food supplied (the MC here being the cost in terms of the forgone leisure needed to produce the last unit of food). The price then is the utils of leisure-time satisfaction lost because of working to grow that last unit of food.

c) Putting these two equations together, we see that \( MU = MC \). This means that the utils gained from the last unit of food consumed exactly equal the leisure utils lost from the time needed to produce that last unit of food. It is exactly this condition — that the marginal gain to society from the last unit consumed equals the marginal cost to society of that last unit produced — which guarantees that a competitive equilibrium is efficient.

The result will remain unchanged even if the model is extended to any number of commodities. In such a generalised case too, the rule remains the same, i.e. utility-maximising consumers spread their \( \text{₹} \) income among different goods until the marginal utility of the last rupee is equalised for each good consumed. Since this marginal utility of money is equal to the price ratios which in turn will be equal to ratio of marginal costs of the corresponding commodities in the perfectly market economy. Thus, under certain conditions, perfect competition guarantees efficiency, in which no consumer’s utility can be raised without lowering another consumer’s utility.

Check Your Progress 2

1) Define the fundamental role of the marginal cost in achieving efficiency in a perfectly competitive market?

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2) What role does consumer utility maximisation and firm cost minimisation play in a general equilibrium analysis?

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3) Briefly explain the cost structure of a PCM firm and its relevance in determining the price and output of such a firm?

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16.5 COMPETITIVE PRICES AND EFFICIENCY: THE FIRST FUNDAMENTAL THEOREM OF WELFARE ECONOMICS

The essence of the relationship between perfect competition and the efficient allocation of resources can now be easily summarised as below:

- Attaining a Pareto efficient allocation of resources requires that (except when corner solutions occur) the rate of trade-off between any two goods, say x and y, should be the same for all economic agents. In other words, Marginal Rate of Technical Substitution for all producers and Marginal Rate of Substitution for all consumers should be equal.

- In a perfectly competitive economy, the ratio of the price of x to the price of y, i.e. \( p_x/p_y \) provides this common rate of trade-off to which all agents will adjust. Because prices are treated as fixed parameters both in individuals’ utility-maximising decisions and in firms’ profit-maximising decisions, all trade-off rates between x and y will be equalised to the rate at which x and y can be traded in the market (\( p_x/p_y \)), i.e.

  \[
  \text{MRTS}_{x,y} = \text{MRS}_{x,y} = \frac{p_x}{p_y}
  \]

- As all agents face the same prices in perfectly competitive market, all trade-off rates will be equalised and an efficient allocation will be achieved. This is the First Theorem of Welfare Economics.

The Fig. 16.6 illustrates the efficiency properties of the theorem.
Although all the output combinations on PP are technically efficient, only the combination $x^*, y^*$ is Pareto optimal. A competitive equilibrium price ratio of $P_x^* = P_y^*$ will lead this economy to this Pareto efficient solution.

![Fig. 16.6: Competitive Equilibrium and Efficiency in Output Mix](image)

In Fig. 16.6, given the production possibility frontier PP and preferences represented by the indifference curves, it is clear that combination $x^*, y^*$ represents the efficient output mix. Possibly $x^*, y^*$ could be decided upon in a centrally planned economy by the planning board or alternatively, in a competitive market, the self-interest of firms and individuals will also lead to this allocation. Only with a price ratio of $p_x^*/p_y^*$ will supply and demand be in equilibrium in this model, and that equilibrium will occur at the efficient product mix, $E$, where $MRS_{x,y}$ (the slope of indifference curve) and $MRTS_{x,y}$ (slope of the isoquant) and $p_x/p_y$ (slope of the budget line are all equal. The price mechanism ensures not only that production is technically efficient (that output combinations lie on the production possibility frontier) but also that the forces of supply and demand lead to the Pareto efficient output combination. This is the First Fundamental Theorem of Welfare Economics.

The correspondence between competitive equilibrium and Pareto efficiency provides “scientific” support for the laissez-faire position (which is based upon the free market mechanism without intervention of the Government. For example, Adam Smith in his book ‘Wealth of Nations’ asserted in support for such a policy with an example, “it is not the “public spirit” of the baker that provides bread for individuals’ consumption. Rather, bakers (and other producers) operate in their own self-interest when responding to market signals. Individuals also respond to these signals when deciding how to allocate their incomes”. Government intervention in this smoothly functioning process may only result in a loss of Pareto efficiency.

However, it is difficult to draw policy recommendations from such a theoretical analysis that pays so little attention to the institutional details of the real world. The efficiency properties of the competitive system however do provide a benchmark — a place to start examining reasons why competitive markets may fail.
16.6 DEPARTING FROM THE COMPETITIVE ASSUMPTIONS

You will learn in Unit 17 that various factors distort the ability of competitive markets to achieve efficiency. These include (1) imperfect competition, (2) externalities, (3) public goods, and (4) imperfect information. A brief summary of these categories is given below:

16.6.1 Imperfect Competition

“Imperfect competition” includes all those situations in which economic agents exert some power over the market in determining price. A firm that faces a downward-sloping demand curve for its product, for example, will recognize that the marginal revenue from selling one more unit is less than the market price of that unit. Because it is the marginal return to its decisions that motivates the profit-maximising firm, marginal revenue rather than market price becomes the important magnitude. Market prices no longer carry the informational content required to achieve Pareto efficiency.

16.6.2 Externalities

The competitive price system can also fail to allocate resources efficiently when there are interactions among firms and individuals that are not adequately reflected in market prices. For example, a firm polluting the air with industrial smoke and other debris. Such a situation is termed an externality: an interaction between the firm’s level of production and individuals’ welfare that is not accounted for by the price system. With externalities, market prices no longer reflect all of a good’s costs of production. There is a divergence between private and social marginal cost, and these extra social costs (or possibly benefits) will not be reflected in market prices. Hence market prices will not carry the information about true costs necessary to establish an efficient allocation of resources.

16.6.3 Public Goods

A similar problem in pricing occurs in the case of “public” goods. These are goods, such as public education and public health institutions providing free services, which (usually) have two properties that make them unsuitable for production in markets. First, the goods are non-rival in that additional people can consume the benefits of them at zero cost. This property suggests that the “correct” price for such goods is zero, which obviously a problem for market mechanism to operate. A second feature of many public goods is non-exclusion: no individual can be precluded from consuming the good. Hence, in a market context, most consumers will adopt a “free rider” stance, waiting for someone else to pay. Both of these technical features of public goods pose substantial problems for market economies.

16.6.4 Imperfect Information

The efficiency of perfectly competitive pricing is based on the assumption of availability of full information with both producers and buyers in the market. It implicitly assumes that buyers and sellers have complete information about the goods and services they buy and sell. Firms are assumed to know about all the production functions operating in their industry. Consumers are presumed to know about the quality and prices of goods. If this assumption breaks down
and consumers are uncertain about prices and quality of a good and/or firms are unaware of the production processes in the industry, it will be difficult to achieve the efficiency through competitive pricing.

These four impediments to efficiency suggest that one should be very careful in applying efficiency properties of perfectly competitive markets for policy formulation in the arena of public welfare.

**Check Your Progress 3**

1) Explain how the conditions of utility maximisation, cost minimisation, and profit maximisation in competitive markets imply that the allocation arising in a general competitive equilibrium is economically efficient.

2) State the distortions leading to failure in achieving the efficiency in perfectly competitive market.

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### 16.7 LET US SUM UP

The efficient allocation of resources requires that the rate of trade-off between any two goods should be the same for all economic agents. In a perfectly competitive economy, the ratio of the prices of the goods produced provides this common rate of trade-off to which all agents will adjust and eventually be equated. The firm operating within a perfectly competitive market will be both productively and allocatively efficient in the long run, i.e. in the long run perfectly competitive market shows that \( AR = AC_{\text{min}} \) (the firm is productively efficient) and \( P(AR) = MC \) (the firm is allocatively efficient).

It is, however, very pertinent to note that even though the competitive equilibrium outcome is efficient, there is no guarantee that all consumers fare equally well under the equilibrium. The welfare of an individual consumer depends on his or her endowment of scarce economic resources, which in the societies are not equally distributed. An economy with great inequalities in distribution of endowments is not necessarily efficient. In such a society, the economy might be squeezing a large quantity of guns and butter from its resources. But the rich few may be eating the butter and feeding it to their cats, while the guns are mainly protecting the butter of the rich. A society, therefore, does not live on efficiency alone. A society may choose to alter market outcomes to improve the equity or fairness of the distribution of income and wealth. Nations may levy progressive taxes on those with high incomes and
wealth and use the proceeds to finance food, schools, and health care for the poor.

It was also noted that the term ‘Marginal’ (cost, price, revenue and utility) is a fundamental concept for efficiency.

16.8 REFERENCES


16.9 ANSWERS OR HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1
1) Read Section 16.2 and answer
2) Read Sub-section 16.2.1 and answer
3) Read Section 16.2 and answer

Check Your Progress 2
1) Read Section 16.3 and answer
2) Read Section 16.4 and answer
3) Read Section 16.4 and answer

Check Your Progress 3
1) Read Section 16.5 along with Section 16.3 and Section 16.4 and answer
2) Read Section 16.6 and Section 16.7 and answer