Block 4
Market Failure

ignou
THE PEOPLE'S
UNIVERSITY

UNIT 7 EXTERNALITIES AND PUBLIC GOODS

Structure

7.0 OBJECTIVES

After going through this unit, you will be able to:

- define the concept of Externality;
- illustrate the condition of market failure in the presence of externalities and public goods;
- describe different mechanisms employed to correct for the market failures resulting from externalities;
- explain the concept of a Public good;
- discuss solutions/mechanisms ensuring optimal provision of Public goods;

7.1 INTRODUCTION

Consumption (or production) decisions of an agent affect people not directly involved in the transactions. Such indirect effects often remain unaccounted for by the agent creating them. In the previous units, we considered the cases of markets where negotiations between agents (the buyers and the sellers) led to optimal (in case of perfect competition) or suboptimal (in case of imperfect competition like monopoly, monopolistic competition, oligopoly) allocation of resources. In all these cases we assumed that there were no unaccounted indirect effects involved. Now we will study the cases when efficient private allocation may become infeasible. In other words, we will consider the case when markets fail to clear. The reasons for the market failure could be— *presence of externalities, public goods and asymmetry of information.*

In this unit we will come across the concept of externalities and public goods. Externality refers to the uncompensated impact of one agent's actions on another agent. When the impact is adverse, it is called a negative externality, and when the impact is beneficial, we have a case of positive externality.The presence of externality leads to market failure. By market failure we mean, when market is unable to reach an equilibrium outcome in price or quantity. As a result, firm may produce too much or too little so that market outcome is inefficient.

We start with defining what is meant by externality? How does it result in market inefficiencies and how to rectify them? We proceed by discussing the concept of a public good. By definition, public goods are defined by the properties of being non-excludable and non-rival. They are those goods that benefit all the consumers but which the market either undersupplies or does not supply at all. The best example of a pure public good is a street light. The consumption of light from street light is open for all, nobody can be excluded from its consumption and nobody's consumption benefit is reduced by the consumption of other people. In this unit we define the concept of a public good, and discuss how they are different from private goods? and what are the problems policy-makers face when trying to decide how much of public good to provide?

7.2 EXTERNALITIES

Externalities can arise between producers, between consumers, or between consumer and producers. An externality occurs if a person's activity, such as consumption or production, affects the well-being of some other person or group of persons, for which she(he) or the group has not been compensated. The term externality comes from the fact that someone external to the action or transaction is affected by the production or consumption of the good.

There are two types of externalities: A negative externality occurs if an activity creates costs (harm or discomfort) for uninvolved people. Examples of negative externalities: Cars and factories generate air pollution that affect people's health. Cars entering congested freeways impose time costs on other drivers, as all cars slow down as a result. Another example of negative externality is when a steel plant dumps its waste into a river that fishermen use for their daily catch. More the waste the steel plant dumps into the river lesser the amount of clean water available for fish breeding and consequently lower will be the output of the fishermen. It can be seen from this example that independent action of the steel plant increased the cost to the fishermen and adversely affected their output for which they are not compensated. Hence the presence of negative externality leads to the occurrence of additional costs, which the agent causing it fails to realise. As a result, in the presence of negative externality there is over-generation of the activity causing negative externality.

A positive externality occurs if an activity creates benefits for uninvolved people. Examples of positive externalities include, people who get vaccinations against a communicable disease reduce other people's chances of getting the disease. People who maintain their property well may create benefits for their neighbours by creating a more pleasing neighbourhood and increasing property values. In the presence of positive externality, agents creating it fail to recognise the additional benefits generated by the activity and hence under-generate it.

Thus, we can say that, production of goods or activities which involve generation of externalities are not produced at the optimum levels as far as transaction in a private market is concerned. Private market transactions will lead to overproduction of goods/activities with negative externalities and underproduction of goods/activities with positive externalities.

7.2.1 Negative Externalities and Inefficiency

Since the presence of externalities is not reflected in the market price, they can be a source of market inefficiency. When firms do not take into account the harms associated with negative externalities, the result is excess production and unnecessary social costs. To see how negative externalities affect market outcomes consider the case of a Steel firm and Fishermen. We assume the Steel firm to be a competitive firm. The production decision of the steel plant is shown in the Fig. 7.1.

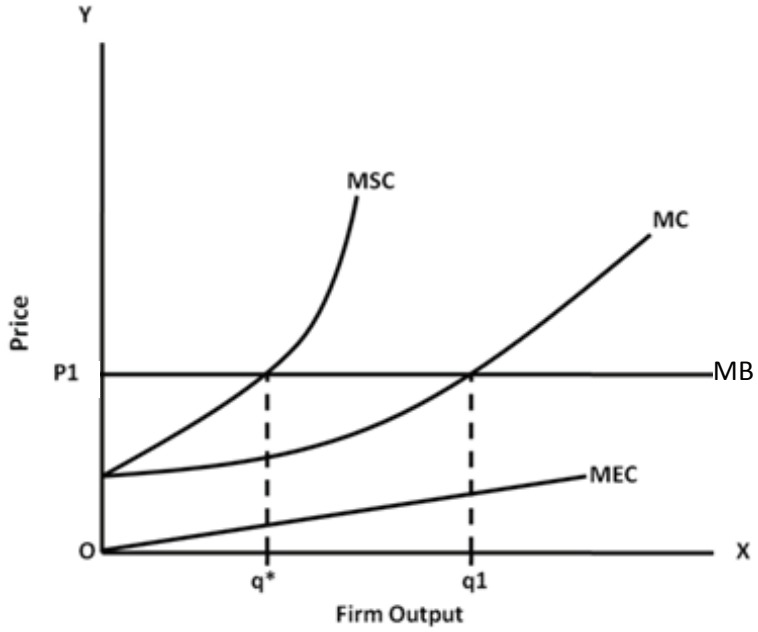

Fig. 7.1: Equilibrium along with Negative Externality

By competitive market we mean that the steel firm takes price as given. Here the competitive price taken by the steel firm is P1 which is also the marginal benefit (MB) curve of the firm in competitive market. Now supply curve of the firm is reflected by the firms' marginal cost curve, MC. The optimising firm will produce that quantity of steel where its MB intersects its MC. In the above figure, this happens at quantity q1. Hence a competitive steel firm will maximise its profits by producing quantity q1 at the given price P1. Now let us assume the steel plant dumps waste generated in the process of steel production in the river that pollutes the river used by the fishermen to catch the fish. Enhanced pollution level of the river water negatively impacts fish population in the river and hence the amount of fish a fisherman is able to catch. Thus, it can be said that production of steel involves a negative externality which is the additional cost to the society in the form of loss to the fishermen. This cost is reflected in the above figure as the marginal external cost (MEC).

The MEC curve is upward sloping indicating a positive relation with the firm's output. As production of steel increases, harm to the society increases. MSC represents the marginal social cost. It is the total cost to the society given by the sum of MC and MEC. It includes the cost to the steel firm and to the fishermen for the production of steel. Firms for profit maximisation equate MC to MB and ignore the costs it incurs to the society in the presence of negative externality. The social optimal is attained where MSC is set equal to MB, that is, at q*. Here we can see socially optimal steel output q* is lower than private optimal at q1.

In Fig. 7.2, it is shown how the presence of negative externality distorts the optimal outcome of the steel industry and leads to social loss. Considering that each firm faces similar externality, the steel industry will be facing the similar externality. MC1 is the marginal cost in the steel industry and DD is

the demand curve in the steel industry, showing the marginal benefit (MB). The industry will maximise the profits by producing the quantity of steel where MC1 equates MB.

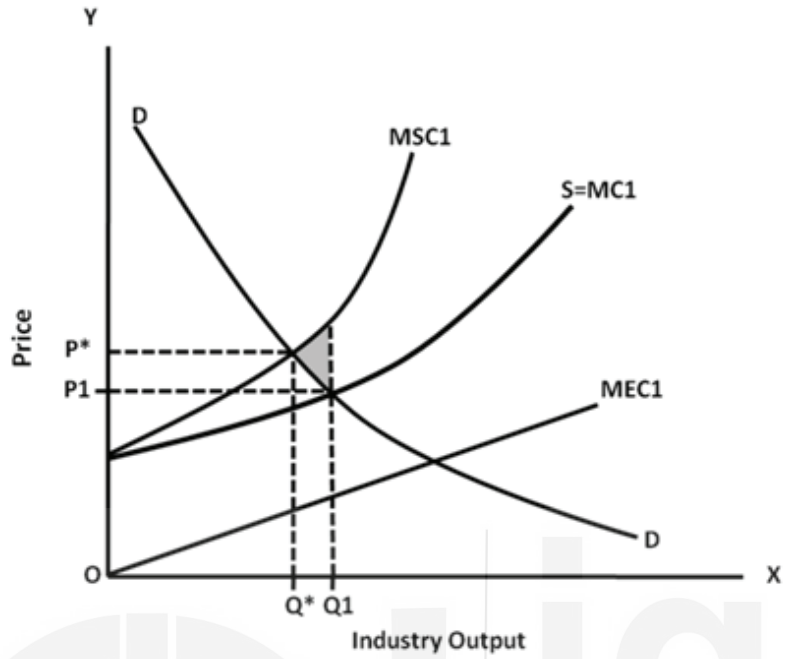

Fig. 7.2: Social Loss due to Negative Externality

The industry's private optimal is at quantity Q1 and optimal price P1. Now again industry fails to internalise the cost of its production activity on fishing industry. MEC1 depicts marginal external cost of production of steel industry, which is positively related to increasing output of the steel industry. MSC1 is the marginal social cost in the steel industry which is the sum total of MC1 and MEC1 (i.e., MSC1 = MC1 + MEC1). The social optimal is where MSC1 intersects MB, that is at quantity Q* and price P*. The socially optimal output of the steel industry should be Q* at price P* compared to private optimal output of the industry Q1 at the price P1. At the socially optimal output Q* external costs on the fishermen are internalised in the production cost.The loss to the society resulting from the excess production by the industry in the presence of negative externality is shown in the figure as the shaded triangular region.

The concept of market failure in the presence of externality is due to the fact that prices undervalue social costs. The private equilibrium of the industry is at P1, whereas the social optimal for the industry is at P*, where we can see:

$$P1 < P^*$$

Hence, we see that in the presence of negative externality the equilibrium price P1 is too low to include all the cost incurred in the production of steel. P1 in the above figure reflects the private marginal costs to the firms. It does not include the costs to the society. In the presence of externality the market price is not efficiently build to clear the market. Therefore, market

fails in the presence of negative externality. In the next section we will show how market fails in the presence of positive externality.

7.2.2 Positive Externality and Inefficiencies

Positive externality occurs when an agent's independent action benefits the other agent's consumption or production for which the later has not paid. Here unlike negative externality, the presence of positive externality results in underproduction of the good or activity. In the case of positive externality there is existence of external benefit, which an agent fails to recognise and thus undersupply the good or the activity generating positive externality. This is referred to as an inefficient allocation. For example, immunisation prevents an individual from getting a disease along with the positive effect that the immunised individual getting immunised is not spreading the disease to others. To understand how market is inefficient in the presence of positive externality consider Fig. 7.3.

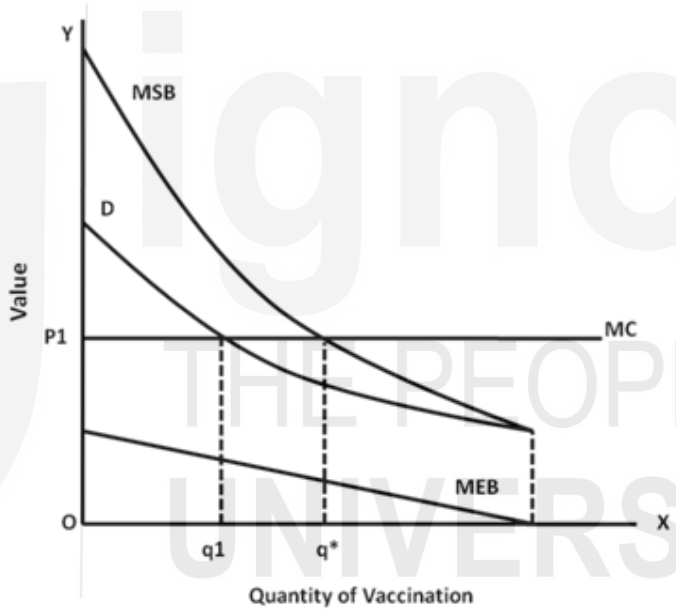

Fig. 7.3: Equilibrium along with Positive Externality

In Fig. 7.3, consider the case of vaccines against a communicable disease. Let the marginal cost of vaccine be constant and equal to MC. The demand for vaccine is shown as downward sloping D curve. This demand curve depicts the marginal benefit to single individual. An individual will optimise his/her consumption where private marginal benefit equals private marginal cost(MB=MC). Taking MC to be constant at P1, the private optimal is attained at quantity q1. Now this private allocation ignored the presence of an external benefit that vaccines will have on the society in terms of lower spread of the disease captured by the marginal external benefit (MEB). Marginal social benefit (MSB) is the sum of private MB and MEB. The social optimal is given by the quantity q* where MSB equals private MC. Notice in the Fig. that q* > q1.

So we see that in the presence of positive externality, the market allocation is under-produced than the social optimal and hence market allocation is called as inefficient and hence we see that in the presence of externality market fails.

Check Your Progress 1

1) Define externality. How does it leads to market failure?

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2) Is it true that in the presence of negative externality private allocation is over-provided and in the presence of positive externality it is under-provided? Explain.

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7.3 WAYS OF CORRECTING MARKET FAILURE

In the previous sections we discussed how market fails in the presence of externalities. In this section we will be discussing how to correct the market failure in the presence of externality. Some of the measures are:

7.3.1 Pigouvian Tax

In the presence of negative externality the market allocation is above the social optimal. To curb the effect of negative externality, one way to correct market allocation is by introducing output tax. If the firm that generates externality with production produces more than the socially efficient output level, then a socially optimal level can be ensured when such a firm is made to internalise the cost of externality so as to discourage the excess production beyond the socially optimal level. This can be done my imposing output tax on the production. Such tax is called Pigouvian tax. Under the Pigouvian tax, people would face the true cost of generating pollution. This in turn encourage the creator of the negative externality to reduce the emissions from production by investing in pollution control equipments, changing their transport modes, etc. in order to escape Pigouvian tax. One

typical problem with imposition of Pigouvian tax is that to charge optimal tax, optimal level of pollution from the steel industry needs to be calculated.

Consider Fig. 7.4. Private optimal in the presence of negative externality is q1. When per unit tax 't' is charged on the good produced, the tax increases the cost of production. Efficient output tax is the one which increases the cost to equate it to the MSC. Now, the optimal will be given by MC plus tax equal to MB.The resulting output level of q*(< q1) will be at the social optimal. Hence market allocation can be made efficient by adding an output tax on the production in case of negative externality. In the similar lines, a subsidy is advised in case of a positive externality.

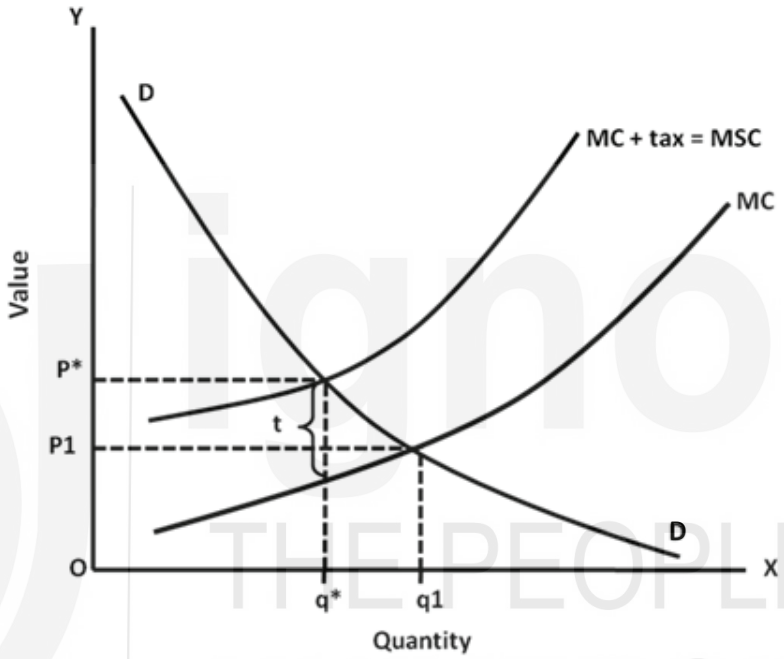

Fig. 7.4: Pigovian Tax

7.3.2 Merger and Internalisation

Another way in which the impact of externality on the market outcome can be curbed is when the parties involved merge to become a single unit and internalise the externality. In the case of steel firm and fisherman, this would mean both of them merging and acting as a single identity.

The waste produced in the production of the steel is dumped in the river and this adversely affects the fish industry. The steel manufacturers do not internalise this cost to the society in their private cost of production of steel. This results in a market outcome that is inefficient and greater than the social optimal. To persuade the steel producer towards internalisation of cost to the society because of its action, the two industries (Steel and Fish) can merge and in this way the externality in the cost of production can be internalised. There is a definite incentive for the two industries to merge. If the actions of one affect the other, then they can make higher profits together by coordinating their activities than by each going alone. The

objective of profit maximisation itself should encourage the internalisation of production externalities. So when the parties involved merge, the total marginal cost now will also include the external cost of steel production to the fish industry. Now the merged industries will optimise considering the social cost instead of private cost. Hence, with the merged industries the market allocation will be efficient.

7.3.3 Emission Standards and Emission Fee

An emission standard is a legal limit on how much pollutants a firm can emit. If the firm exceeds the limit, it can face monetary and even criminal penalties. Consider Fig.7.5 below.

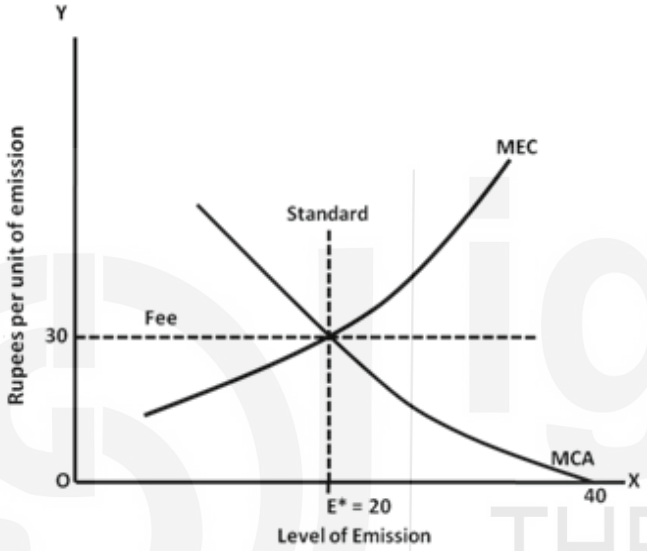

Fig. 7.5: Emission Standard

Suppose the regulatory body set the efficient emission standard at E* (say equal to 20 units). The firm will be heavily penalised for emission greater than this level. Now suppose the firm produces emissions greater than this level. To make sure that the firm follows the emission standard the regulatory body determines the emission fee. Emission fee is the amount required by the emitting firm to pay per unit of emission released by its production activity. Standard emission fee is determined at the intersection of MEC and MCA curves in the above figure. MEC stands for marginal external cost, which is the cost the emission causes to the society. MCA is the marginal cost of abating the emission borne by the firm. It measures the additional cost to the firm for installing pollution control equipment. MCA slopes downwards showing that when the emission abatement is high, or the level of emission is low, higher costs are borne by the firms to abate the emission. So with low level of emission, required abatement is high and vice versa. With no abatement cost to the firm, profit maximising firm will produce emissions equal to 40 units, where marginal cost of abatement is zero. E* equal to 20 is the optimal emission level, when there is abatement cost involved and marginal fee of emission is Rs. 30. If the firm lowers the emissions to somewhere below 20, cost of abatement will be greater than

cost to the society and vice versa. Hence we see E* is the optimal emission level.

However, there are problems associated with this instrument. Firstly, the government or regulatory authorities often does not possess enough information regarding the level of the legal emission standards to be set or the optimal amount of the emission fee to be charged to ensure optimal generation of emissions. Secondly, cost of enforcing the limits is ignored. For instance, if the industry emits smoke and the firms have to cut down on smoke emission by putting filters on the chimneys then this cost should be taken into account.

7.3.4 Missing Markets

The problem with externalities is that there is no property right and no market for certain goods. If we take pollution, it may be considered to be an output of the production process, since both chemical dyes and pollution are the results of production. However there is no market for pollution (a bad) and no price for it. This is the problem of missing market. The firms are the suppliers of pollution. The consumers are the potential buyers and since pollution is a bad, we can anticipate that consumers will buy this goods only if they are paid to buy it (the price of a bad will be negative).

Suppose there are two firms 1 and 2. Firm 1 operates in a perfectly competitive market and produces an output x which imposes a cost e(x) on firm 2. Assuming per unit price of output sold by firm 1 to be p and cost function faced by this firm to be c(x), the profits of firm 1 and firm 2 will be given by:

$$\text{Firm 1: } \pi_1 = px - c(x) \text{ and Firm 2: } \pi_2 = -e(x)$$

We assume $\frac{dc}{dx} > 0, \frac{de}{dx} > 0$. Profit maximisation condition led by private motive would lead firm 1 to produce x such that $\frac{d\pi}{dx} = 0 \Rightarrow p = c'(x)$. For maximising social welfare, socially optimal level of output may be obtained by optimising profits that takes into account not only the private cost but also the external cost: $\pi_S = px - c(x) - e(x)$, where π_S represents the profits which takes into account both the private and the social costs. First-order condition gives: $\frac{d\pi_S}{dx} = 0 \Rightarrow p = c'(x) + e'(x)$; where the expression on the right-hand side is the marginal social costs.

Suppose there is now a market for pollution. If we let the price of pollution per unit as τ. Let x_1 be the amount of pollution firm 1 wants to sell and x_2 be the amount of pollution firm 2 wants to buy. The profits of the two firms now are given by:

$$\text{Firm 1: } \pi_1 = px_1 + \tau x_1 - c(x_1) \text{ and Firm 2: } \pi_2 = \tau x_2 - e(x_2)$$

The first order condition are: $p + \tau - c'(x) = 0$ and $\tau - e'(x_2) = 0$

When the demand for pollution equals to supply for pollution: $x_1 = x_2 = x$; now we get back to the social optimality condition : $p = c'(x) + e'(x)$.

Since $e'(x) > 0; and\ \tau < 0,$ the price of pollution is negative. Moreover, for a market of pollution to exist, there must be property rights in pollution. Either the polluting firm should have the right to pollute or the polluted firm should have the right to clean air/water, that is should own clean air/water. Further the market for certain pollution can be quite thin where there may be few agents in the market.

7.3.5 Private Bargaining and Negotiation: Coase theorem

We have seen how government regulations (taxes, standards, etc.) can deal with the inefficiencies that arise from externalities. Such regulations change a firm's incentive, forcing it to take into account the external costs due to externality. Government regulations are not the only way to deal with the problem of externalities. By assigning well-defined property rights is another solution to the externality problem. Property right means the legal rules that state how an economic resource is used and owned. In the example of fishery and steel firm, if fishery had property rights on the river then it can legally penalise the steel firm for dumping waste into its property. On the other hand, had the property right of the river been with the Steel firm, it could have charged the fishery for polluting less. As per the Coase theorem, in the presence of well-defined property rights and zero transaction cost of negotiations between the two parties, the one who cause externality and the one who is affected by the externality, can result in a socially optimal outcome. Moreover, the solution works irrespective of whom the property rights are assigned. An example explaining how in the presence of well-defined property rights, private players can bargain and come down to mutual advantageous outcome, where the outcome is efficient irrespective of the fact how the property rights were initially defined, is discussed below.

Let us consider the example of negative externality involved in case of Steel industry and Fisheries. Along with the production of Steel, the Steel industry dumps waste generated in the process of production in the river that negatively impacts the Fish industry. Let X denote the level of Steel generated, MB(X) denote the resulting marginal benefit to the Steel industry from producing X units of Steel, MC1 is the marginal cost or the supply curve of the steel industry, MEC(X) denote the damage to the Fish industry from the waste dumped into the river by the Steel industry, and MSC represents the marginal social cost given by the sum of MC and MEC.

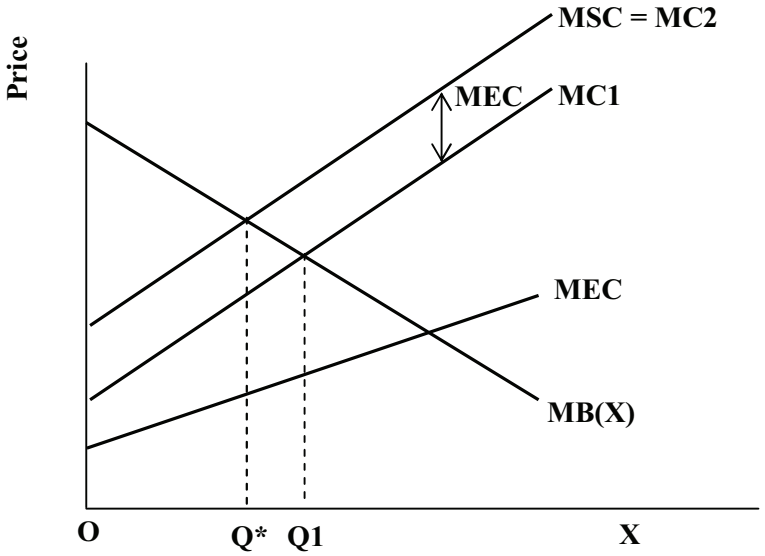

Fig. 7.6: Social Optimal Output

It includes the cost to the steel and Fish industry. Steel industry for profit maximisation would equate MC1 to MB and produce at Q1 ignoring the costs to the society. On the other hand, social optimal is attained where MSC is set equal to MB, that is, at Q* (< Q1).

Now we assume, river which was considered a free resource earlier, is owned by the Fish industry. Fish industry can now charge the Steel industry for polluting the river. To ensure an optimal production of Steel output, Fish industry will charge the Steel industry the marginal external cost per unit of output. This will increase the Steel industry's marginal cost from MC1 to MC2 to coincide with the marginal social cost. The Steel output falls from Q1 to Q*, at the socially optimal level of production.

On the other hand, if the Steel industry owned the river, it can charge (marginal external cost per unit of output) the Fish industry for dumping less. The socially optimal output of the Steel industry will be same in both the cases. This way, inefficiency associated with the negative externality can be taken care of without the need for government intervention when the externality affects relatively few parties and when property rights are well specified. Parties can bargain with each other, without costs, and to their mutual advantage, and the resulting outcome is more efficient, regardless of how the property rights are assigned.

Private property provides such a mechanism. Indeed, we have seen that if everything that people care about is owned by someone who can controlits use and, in particular, can exclude others from overusing it, then there are by definition no externalities. The market solution leads to a Pareto efficient outcome. Inefficiencies can only result from situations where there is no way to exclude others from using something. Of course, private property is not the only social institution that can encourage efficient use of resources. For example, rules could be formulated about how much of waste can be

dumped into the river. If there is a legal system along with strict monitoring, to enforce those rules, this may be a cost-effective solution to provide an efficient use of the common resource. However, in situations where the law is ambiguous or non-existent, the suboptimal solution can easily arise. Overfishing in international waters and the extermination of several species of animals due to overhunting are sobering examples of this phenomenon.

Check Your Progress 2

1) What are the different ways of correcting the market failure resulting in the presence of negative externality?

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2) How can private bargaining lead to efficient allocation in the presence of externality?

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7.4 PUBLIC GOODS

Pure public goods, unlike private goods, are by definition non-excludable and non-rival. Such goods are not optimally provided in the private markets. These goods have certain characteristics which makes their optimal provision not profitable for the private players. These characteristics are—non-rivalry and non-excludability.

Non-excludability means**,** no agent can be excluded from the consumption of that public good once it is provided. As a consequence it is difficult or impossible to charge people for using that non-excludable good. These goods can be enjoyed without direct payment. Best example would be National Defence. Once a nation has provided for its national defence, all citizens enjoy its benefits. A lighthouse and public television are also examples of goods/service having the characteristic of non-excludability. This feature goes against that with the private goods that are excludable, implying, the seller can debar a buyer from consuming a private good. This is

done through the pricing of that good (those who do not pay the price, do not get the goods).

Non-rivalry means consumption of a public good by an agent does not reduces its availability to the other agents. Accordingly, at any given level of production, the marginal cost of providing it to the additional consumer is zero. For example, consider the use of highway (uncongested). Once the highway is functional and open for public use, if there are 100 cars running on it, there is no additional cost of providing the highway to 101st car. Hence an uncongested highway is a non-rivalrous good. Most goods are rival, especially private goods. This means that if in a market a seller brings 100 units to sell, if an individual buys 5 units, then for the other individual the available number of units to buy is 95. This is so because there is marginal cost of production associated with each unit of private good and hence they have limited production. A good, consumption of which is rivalrous must be allocated among individuals. A good which is non-rival in consumption can be made available to everyone without affecting any individual's opportunity for consuming them.

Different kinds of goods have different characteristics. Broadly there are 4 categories of the goods,

	Rival	**Non-rival**
Excludable	Pure Private goods	Club goods
Non-excludable	Common Resource goods	Pure Public goods

Goods that are non-excludable and non-rival are the pure public goods, like, national defence. Goods that are rival and excludable are the pure private goods. Goods that are rival but non-excludable are referred to as the common property resources , like common pasture lands, ground water, fishing grounds. They are non-excludable as there are no established property rights on such resources so as to exclude someone from using it. Rivalrous nature for instance results from the fact that excessive grazing by one herd of cattle will result in erosion of the land and hence limit its use for other cattle herders. Goods that are non-rival in consumption but excludable are called club goods. Club goods are like membership of club. Membership into a club is non-rivalrous, as the facility of club is open to everyone but the club can make the entry excludable by charging the membership fee (or allowing only its members to enjoy certain programmes/ performances etc).

Public goods are not necessary national: The list of public goods is much smaller than the list of goods that government provide. For example, Education is rival in consumption. This results from the fact that as class size increases, each student gets lower attention. Hence there is positive marginal cost of providing education to one more child. Likewise charging

tuition fee can exclude some children from enjoying education. Hence, education is provided by local government because it entails positive externalities, not because it is a public good.

7.5 PUBLIC GOODS AND MARKET FAILURE

To produce the optimal amount of each public good, the government must know something that it cannot possibly know— everyone's preferences. Because exclusion is impossible, nothing forces households to reveal their preferences. Furthermore, if we ask households directly about their willingness to pay, their true value might not be revealed. If your actual payment depends on your answer, you have an incentive to hide your true feelings. Knowing that you cannot be excluded from enjoying the benefits of the good and that your payment is not likely to have an appreciable influence on the level of output finally produced, what incentive do you have to tell the truth or to contribute?

How does society decide which public goods to provide? We assume that members of society want certain public goods. Private producers in the market cannot make a profit by producing these goods, and the government cannot obtain enough information to measure society's demands accurately.

7.5.1 The Free-rider Problem

Provision of public good is often faced with the *free-rider problem*. Free-rider problem occurs in non-excludable goods case. Since the provision of public goods is where sum of marginal benefits equals to the marginal cost of providing the good, the individuals tend to free ride, that is, they tend to make use of the public good without making payment for that good. Moreover, since individuals are made to pay according to their marginal benefits, they tend to undervalue their marginal benefits so that they have to pay less. Since it is a collective good, it is often believed by an individual that someone else will pay for it. Market for provision of public good fails, if everyone tends to free ride, undervaluing their marginal benefits to the level that the sum of marginal benefits is lower than the marginal cost of providing the good and hence no public good is provided. Free riding is one of the biggest challenges in the provision of public good, as it is very difficult to judge the true valuation of the public good to the individuals.

Free riding situation bears its resemblance to the Prisoners' Dilemma game, though the two are not exactly same. Suppose there are two tenants in a house who are trying to decide whether to construct a collapsible gate at the entrance or not. If the gate is constructed, both will enjoy better security in equal measure. So we may treat it like a public good. Suppose both the individual earns Rs. 5000 and each value the gate at Rs. 1000 and the cost of the gate is Rs. 1500, so the joint valuation of the gate exceeds the cost. Once

the gate is constructed it will benefit both the tenants. Now the question is whether to get a gate constructed or not.

		Tenant 2	
		Buy	Don't Buy
Tenant 1	Buy	(−500, −500)	(−500, 1000)
	Don't Buy	(1000, −500)	**(0, 0)**

Here the strategy 'Don't Buy' is the dominant strategy for both the tenants. So the dominant strategy equilibrium or the Nash equilibrium is mutual free riding (Don't Buy, Don't Buy) leading to suboptimal provision of public goods. If the tenant 1 decide to buy the gate then the tenant 2 is having the incentive to free ride and enjoy the better security and vice versa. So there is a credible threat for both the tenant that the other one will free ride against his decision to opt for 'Buy', which leads to the equilibrium of mutual free-riding. However here the social optimal situation is one person take the responsibility to buy the gate and both to enjoy the better security.

7.6 OPTIMAL PROVISION OF PUBLIC GOODS

Now we discuss two solutions to the provision of public goods:

a) When Marginal benefits of the consumers are known as given by the Samuelson- Musgrave theory, and

b) When Marginal benefits of the consumers are unknown as given under the Tiebout model

7.6.1 The Samuelson–Musgrave Theory

In the early 1950s, economist Paul Samuelson, building on the work of Richard Musgrave, demonstrated that there exists an optimal, or a most efficient level of output for every public good. The discussion of the Samuelson and Musgrave solution that follows leads us straight to the thorny problem of how societies, as opposed to individuals, make choices.

As per the theory, an efficient economy produces what people want. Private producers, whether perfect competitors or monopolists, are constrained by the market demand for their products. If they cannot sell their products for more than it costs to produce them, they will be out of business. Because private goods permit exclusion, firms can withhold their products until consumers pay in order to consume them. Buying a product at a posted price reveals that it is "worth" at least that amount to you and to everyone who buys it.

Market demand for a private good is the sum of the quantities that each household decides to buy (as measured on the horizontal axis) at each price.

The diagrams in Fig. 7.7, illustrate the derivation of a market demand curve. Assume that society consists of two people, A and B. At a price of Re 1, A demands 9 units and B demands 13 units of the private good. Market demand at a price of Re 1 is 22 (= 9 + 13) units. If price were to rise to Rs. 3, A's quantity demanded would drop to 2 units and B's would drop to 9 units; market demand at a price of Rs. 3 is 2 + 9 = 11 units. The point is that the price mechanism forces people to reveal what they want, and it forces firms to produce only what people are willing to pay for, but it works this way only because exclusion is possible.

People's preferences and demands for public goods are conceptually no different from their preferences and demands for private goods. You may want fire protection and be willing to pay for it in the same way you want to listen to a CD. To demonstrate that an efficient level of production exists, Samuelson assumes that we know people's preferences.

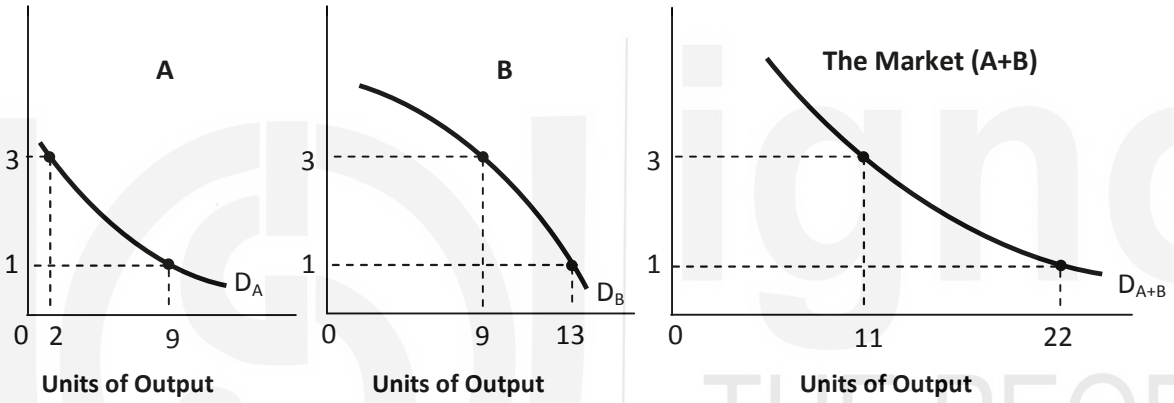

Fig. 7.7: Optimal Provision of Private Good

Fig. 7.8 shows demand curves for buyers A and B. If the public good were available in the private market at a price of Rs. 6, A would buy X1 units. Put another way, A is willing to pay Rs. 6 per unit to obtain X1 units of the public good. B is willing to pay only Rs. 3 per unit to obtain X1 units of the public good. Remember, public goods are non-rival and non-excludable. Hence, one and only one quantity can be produced, and that is the amount that everyone gets. When X1 units are produced, A gets X1 and B gets X1. When X2 units are produced, A gets X2 and B gets X2.

To arrive at market demand for public goods, we do not sum quantities. Instead, we add the amounts that individual households are willing to pay for each potential level of output. In Fig. 7.8, A is willing to pay Rs. 6 per unit for X1 units and B is willing to pay Rs. 3 per unit for X1 units. Thus, if society consists only of A and B, society is willing to pay Rs. 9 per unit for X1 units of public good X. Likewise, for X2 units of output, society is willing to pay a total of Rs. 4 per unit.

For private goods, market demand is the horizontal sum of individual demand curves— we add the different quantities that households consume (as measured on the horizontal axis). For public goods, market demand is

the vertical sum of individual demand curves— we add the different amounts that households are willing to pay to obtain each level of output (as measured on the vertical axis).

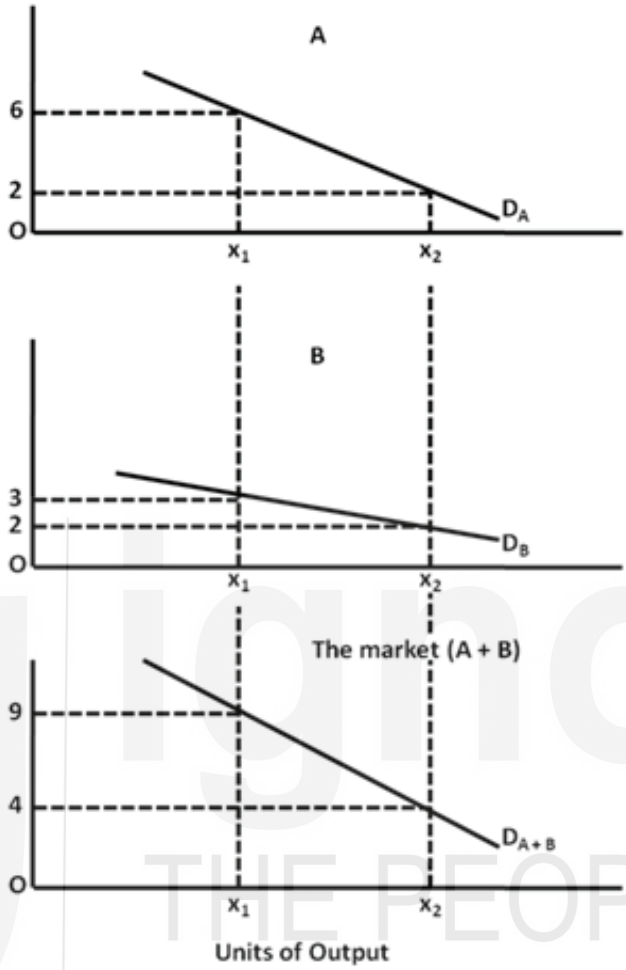

Fig. 7.8: Optimal Provision of Public Good

Samuelson argued that once we know how much society is willing to pay for a public good, we need to only compare that amount to the cost of its production. Fig. 7.9 reproduces A's and B's demand curves and the total demand curve for the public good. As long as society (in this case, A and B) is willing to pay more than the marginal cost of production, the good should be produced.

Given the MC curve as drawn in Fig. 7.9, the efficient level of output is X1 units. If at that level A is charged a fee of Rs. 6 per unit of X produced and B is charged a fee of Rs. 3 per unit of X, everyone should be happy. Resources are being drawn from the production of other goods and services only to the extent that people want the public good and are willing to pay for it. We have arrived at the optimal level of provision for public goods. At the optimal level, society's total willingness to pay per unit is equal to the marginal cost of producing the good.

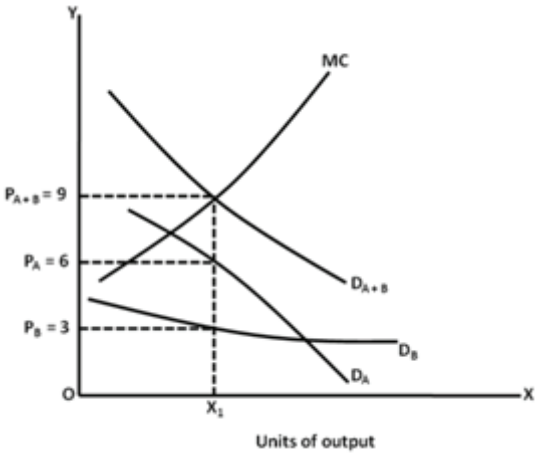

Fig. 7.9: Optimal Provision of Public Good

Optimal Provision of Public Goods: The Model

Here we discuss the optimal level of public good that should be produced and/or provided. Consider an economy with only two goods one public and one private. Suppose there are two individuals 1 and 2 and their initial wealth levels are given by $w_1 \; and \; w_2$. The respective provision for the public good by individual 1 and 2 be given by $g_1 \; and \; g_2$; and let $x_1 \; and \; x_2$ denote the consumption of private goods by each individual. Let G be the total amount of public good produced and c(G) be the cost of producing and/or providing that public good. The agents face the constraint that their initial wealth cannot exceed their total expenditure on the private goods and the public goods:

$$x_1 + x_2 + c(G) = w_1 + w_2$$

We consider a Pareto efficient provision of the public goods. The provision is Pareto efficient if agent 1's utility is maximised given the utility level of agent 2. Note that both agents consume same amount of the public goods. The problem can then be written as:

$$\text{Max } U_1(x_1, G) \;\; \text{w. r. t. } x_1, x_2, G \;\; \text{subject to } U_2(x_2, G) = U_2^* \text{ and}$$
$$x_1 + x_2 + c(G) = w_1 + w_2$$

The Lagrangean function is given by:

$$\mathcal{L} = U_1(x_1, G) + \lambda_1\{(U_2^* - U_2(x_2, G)\} + \lambda_2\{w_1 + w_2 - x_1 - x_2 - c(G)\}$$

First-order conditions for optimisation are:

$$\frac{\partial \mathcal{L}}{\partial x_1} = \frac{\partial U_1}{\partial x_1} - \lambda_2 = 0 \qquad \text{(i)}$$

$$\frac{\partial \mathcal{L}}{\partial x_2} = -\lambda_1 \frac{\partial U_2}{\partial x_2} - \lambda_2 = 0 \qquad \text{(ii)}$$

$$\frac{\partial \mathcal{L}}{\partial G} = \frac{\partial U_1}{\partial G} - \lambda_1 \frac{\partial U_2}{\partial G} - \lambda_2 c'(G) = 0 \qquad \text{(iii)}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda_1} = U_2^* - U_2(x_2, G) = 0 \qquad \text{(iv)}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda_2} = w_1 + w_2 - x_1 - x_2 - c(G) = 0 \qquad \text{(v)}$$

From (i) we get $\lambda_2 = \frac{\partial U_1}{\partial x_1}$. Then from (i) and (ii) by eliminating λ_2 we get $\lambda_1 = \frac{\frac{\partial U_1}{\partial x_1}}{\frac{\partial U_2}{\partial x_2}}$.

Substituting these values in (iii) we get:

$$\frac{\partial U_1}{\partial G} \Big/ \frac{\partial U_1}{\partial x_1} + \frac{\partial U_2}{\partial G} \Big/ \frac{\partial U_2}{\partial x_2} = c'(G)$$

In other words the condition for optimal provision of public goods can be written as: $MRS^1_{GX} + MRS^2_{GX} = MC_G$

i.e., The sum of the marginal rates of substitution between the private good and the public good for the two individuals must equal the marginal cost of providing the public goods. This condition is known as the 'Samuelson Rule'. If we interpret MRS as the marginal willingness to pay, then the Pareto efficiency condition can be interpreted as sum of the willingness to pay must be equal to the cost of providing an extra unit of public goods.

If the efficiency condition is violated, it can be shown that at least one individual can be made better off and nobody is made worse off. Suppose for example the sum of the MRS is less than the marginal cost. Let MC_G = 1 and $MRS^1_{GX} = \frac{1}{2}, MRS^2_{GX} = \frac{1}{3}$. Then agent 1 would be willing to accept Rs. $\frac{1}{2}$ worth of the private good for the loss of Re 1 of the public good and agent 2 would be willing to accept Rs. $\frac{1}{3}$ worth of the private good for the loss of Re 1 of the public good. Suppose we reduce the amount of the public good by Re 1. Then we can compensate the two agents by giving them Rs. 5/6 worth of the private good and still have Rs. 1/6 worth of private good left to be distributed to the two individuals and make them better off. Thus if the sum of the MRS between the private good and the public good for the two individuals is less than the MC, less of the public good and more of the private goods should be provided.

7.6.2 Local Provision of Public Goods: Tiebout Hypothesis

In 1956, economist Charles Tiebout made this point: To the extent that local governments are responsible for providing public goods, an efficient market-choice mechanism may exist. Consider a set of towns that are identical except for police protection. Towns that choose to spend a great deal of money on police are likely to have a lower crime rate. A lower crime rate will attract households who are risk-averse and who are willing to pay higher taxes for a lower risk of being a crime victim. Those who are willing to bear greater risk may choose to live in the low-tax/high-crime towns. Also, if some town is efficient at crime prevention, it will attract residents— given that each town has limited space, property values will be bid up in this town. The higher home price in this town is the "price" of the lower crime rate.

According to the Tiebout hypothesis, an efficient mix of public goods is produced when local prices (in the form of taxes or higher housing costs) come to reflect consumer preferences just as they do in the market for private goods. What is different in the Tiebout world is that people exercise consumer sovereignty not by "buying" different combinations of goods in a market, but by *"voting with their feet"*, that is by choosing among bundles of public goods provided and tax rates charged by different towns and participating in local government.

7.6.3 Social Choice Problem: Voting Mechanism

One view of government, or the public sector, holds that it exists to provide things that "society wants."A society is a collection of individuals, and each has a unique set of preferences. Defining what society wants, therefore, becomes a problem of *social choice*— of somehow adding up, or aggregating, individual preferences.

In social goods it is difficult to calculate the true valuation of the individual's marginal benefits. One such solution to the free-rider problem is given by the mechanism of *voting*. When individuals vote, they show their preference. Voting is commonly used to decide allocation questions. Although voting is assumed to be a genuine solution to the allocation issues, often it leads to inconsistent results. According to Arrow's impossibility theorem, no system of aggregating individual preferences into social decisions will always yield consistent, non-arbitrary results. Most important problem with voting outcomes is that when preferences for public goods differ among individuals, any system for adding up, or aggregating, those preferences can lead to inconsistencies. In addition, it illustrates just how much influence the person who sets the agenda has. Another problem with majority-rule voting is that it leads to *logrolling***.** Logrolling occurs when congressional representatives trade votes, agreeing to help each other to get certain pieces of legislation passed. Recent work in economics has focused not just on the government as an extension of individual preferences but also on government officials as people with their own agendas and objectives. That is, government officials are assumed to maximise their own utility, not the social good.

7.6.4 Role of Government in Provision of Public Goods

There is no question that government must be involved in both the provision of public goods and the control of externalities. No society has ever existed in which citizens did not get together to protect themselves from the abuses of an unrestrained market and to provide for themselves certain goods and services that the market did not provide. The question is not whether we need government involvement. The question is how much and what kind of government involvement we should have.

Critics of government involvement correctly say that the existence of an "optimal" level of public-goods production does not guarantee that governments will achieve it. It is easy to show that governments will generally fail to achieve the most efficient level. There is no reason to believe that governments are capable of achieving the "correct" amount of control over externalities. Markets may fail to produce an efficient allocation of resources, but governments may make it worse. Measurement of social damages and benefits is difficult and imprecise. For example, estimates of the costs of acid rain range from practically nothing to incalculably high amounts.

Just as critics of government involvement must concede that the market by itself fails to achieve full efficiency, defenders of government involvement must acknowledge government's failures. Many on both sides agree that we get closer to an efficient allocation of resources by trying to control externalities and by doing our best to produce the public goods that people want with the imperfect tools we have than we would by leaving everything to the market.

Check Your Progress 3

1) Define public goods. How they different from pure private goods?

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2) Why does market fail in presence of public good?

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3) Explain Samuleson-Musgrave solution to optimal allocation of a public good.

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7.7 LET US SUM UP

Often when we engage in transactions or make economic decisions, the impact of it falls on the second or third parties that we the decision makers have no incentive to take account of. These are called externalities. When external costs are not considered in economic decisions, we may engage in activities or produce products that are not "worth it". When external benefits are not considered, we may fail to do things that are indeed "worth it". The result is an inefficient allocation of resources. A number of alternative mechanisms are employed to control for externalities: (1) government-imposed taxes and subsidies, (2) private bargaining and negotiation, (3) legal remedies such as injunctions and liability rules, (4) sale or auctioning of rights to impose externalities, and (5) direct regulation.

In an unfettered market, certain goods and services that people want will not be produced in adequate amounts. These public goods have characteristics that make it difficult or impossible for the private sector to produce them profitably. Public goods are non-rival in consumption (meaning, their benefits fall collectively on members of society or on groups of members), and/or their benefits are non-excludable (that is, it is generally impossible to exclude people who have not paid from enjoying the benefits of public goods). An example of a public good is national defence. Theoretically, there exists an optimal level of provision for each public good. At this level, society's willingness to pay per unit equals the marginal cost of producing the good. To discover such a level, we would need to know the preferences of each individual citizen. According to the Tiebout hypothesis, an efficient mix of public goods is produced when local land/housing prices and taxes come to reflect consumer preferences just as they do in the market for private goods. Because we cannot know everyone's preferences for public goods, we are forced to rely on imperfect social choice mechanisms such as majority rule. The theory that unfettered markets do not achieve an efficient allocation of resources should not lead us to conclude that government involvement necessarily leads to efficiency. Governments also fail.

7.8 SOME USEFUL REFERENCES

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- Varian H.R, *Intermediate Microeconomics,* (2010), W.W. Norton and Company,
- Case K.E., Fair R.C and Oster S.M, *Principles of Economics* (2012) 10th edition. Pearson Education, USA
- Anindya Sen, *Microeconomics: Theory and Applications,* 2007, OUP.

7.9 ANSWERS OR HINTS TO CHECK YOUR PROGRESS EXERCISE

Check Your Progress 1

1) Refer Section 7.2 and answer.

2) Refer Sub-sections 7.2.1 and 7.2.2.

Check Your Progress 2

1) Refer Section 7.3 and answer.

2) Refer Sub-section 7.3.2 and answer.

Check Your Progress 3

1) Refer Section 7.4 and answer.

2) Refer Section 7.5 and answer.

3) Refer Sub-section 7.6.1 and answer.

UNIT 8 ASYMMETRIC INFORMATION

Structure

8.0 OBJECTIVES

After going through this unit, you will be able to:

- explain the concept of asymmetrical information;
- discuss how asymmetrical information leads to market failure;
- describe market solutions to the problem of asymmetric information;
- define the problem of moral hazard resulting in the presence of asymmetric information; and
- understand principal agent problems.

8.1 INTRODUCTION

In a perfect competitive market structure, one of the key assumptions defining the market is that of complete and symmetric information among the parties involved in the transaction. That is, we assumed no seller knows more about a product's characteristics than a buyer, and no buyer knows more about the product's costs than a seller. Such an assumption is unrealistic due to the fact that in real life, one party to a transaction often has more information than another about the characteristics of the good or

service to be traded. This condition is referred to as that of asymmetric information.

For instance, the seller of a product usually knows more about the quality of the good than the buyer; workers usually know more about their abilities than the potential employers; in the market for second-hand cars, sellers have more information regarding the true status of the car than the buyer; in the financial market, the creditor has relatively lesser information about the default risk of the debtor than the debtor himself; and in the health insurance market, the insurance company has lesser information about the health status of the individual than the individual himself. These are some of the common examples of the presence of asymmetrical information.

As per the first welfare theorem of Economics, perfect competition leads to a Pareto efficient allocation of resources. A key assumption for the theorem to hold is that all the information related to the trade in the market should be equally observed by all the agents involved. When such assumption fails to hold, that is, when information is asymmetric with one agent possessing more information related to the trade than other agent(s), prices are distorted and we do not get a Pareto efficient allocation of resources. This is referred to as the situation of market failure. The present unit will discuss the concept of asymmetric information; how does it lead to market failure and how equilibrium is attained in the presence of asymmetric information.

8.2 ASYMMETRIC INFORMATION

The concept of asymmetric information was first analysed by George Akerlof in his 1970 paper titled *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*. He considered an example of automobile market. Asymmetric information exists, when amongst different parties in the trade, unequal information set persists. That is, if we assume there are buyers and sellers in the market, then under asymmetric information, one agent will have greater (or lesser) information than the other. For example, in the market for second-hand cars, also called the market for lemons, sellers of the second-hand cars have more information about the real value of the car than the buyer. This information asymmetry gives the seller an incentive to sell goods of less than the average market quality. The average quality of goods in the market will then reduce as will the market size. Moreover, buyer possessing lesser information, often is discouraged to go in trade, as he wants to reduce the risk of buying a damaged car, called a ‘lemon’. Thus the presence of asymmetric information, may result in no trade taking place at all. In another example, in the market for health insurance, buyer of insurance has more information about his/her status of health than the insurance company selling such policies. More such examples exist in the real world. The existence and persistence of asymmetrical information cannot be denied and due to it, many markets fail to trade. This simply means, that due to lack of symmetry in information between the parties,

they are unable to construct tradable price in the market and without tradable price, trade cannot take place. This way asymmetrical information leads to market failure.

To correct for the market failure resulting from asymmetrical information, one way out is when such asymmetries in information can be nullified, in other words when more equal distribution of information is possible. For instance, in markets for second-hand cars, some certification or quality accreditation with some years of guarantee from an organisation can help spread information about the true real value of the second-hand car amongst buyers and sellers. In the market for health insurance, a thorough medical check-up can reveal true status of the buyers' health. In the financial market for credit, borrowers borrowing-score can help reveal the actual default rate of the borrower.

8.3 ADVERSE SELECTION

Asymmetric information exacerbates inefficiencies. One reason behind why presence of asymmetric information leads to market failure is due to adverse selection. Adverse selection refers to a situation when parties gaining from the presence of asymmetric information are more likely to enter into a trade than the parties suffering from information asymmetries. In our examples mentioned in the previous section, if buyers of the second-hand cars cannot distinguish good cars from bad ones, sellers may be inclined to sell only lemons (bad-quality cars). If insurance companies have difficulty in evaluating applicants' health status, they may end up serving high-health risk policyholders and may not be able to harness the cross subsidies from the low health risk policyholders and thus may not be able to breakeven due to high insurance claims from the high risk clients. If the potential employers have trouble assessing the abilities of workers, they may end up employing poorly qualified workers. In each of these examples, the informed parties, viz. second-hand car sellers, insurance buyers, workers, are more willing to trade when trading is less advantageous to the uninformed parties, viz. second-hand car buyers, insurance companies, and potential employers, respectively. This phenomenon is known as adverse selection. When the affected uninformed parties realise that they face adverse selection, they may become reluctant to even come forward for trade, causing a market failure.

Let us discuss a few of these examples which lead to adverse selection and market failure in detail.

8.3.1 Market for 'lemons'

Let us consider a market where buyers and sellers have different information regarding the quality of the product offered for sale. Consider a market where there are 100 sellers and 100 buyers for used cars. Everyone knows that all the used cars are not of same quality and there is 50 per cent

chance of getting a car in good condition ('Plums') and 50 per cent chance of getting a car in bad condition ('lemons'). However, the owner of the cars know the actual quality of the car, but the buyers have no clue about which one is plum and which one is lemon. Moreover it is not easy to verify the quality of car from the market.

Let the owners of the lemon want to sell it at Rs. 1,00,000 and the owners of the plums want to sell at Rs. 2,00,000. Let the buyer of the car is ready to pay Rs. 2,40,000 if the car is a plum but Rs. 1,20,000 if the car is a lemon. If there is no problem in verifying the quality of car from the market, then the lemons will be sold at some price between Rs. 1,00,000 to Rs. 1,20,000 and the plums will be sold at some price in between Rs. 2,00,000 to Rs. 2,40,000. Since buyers cannot observe the quality of car to be purchased, they will have to guess about the quality of an average car. Given that there is only 50 per cent chance of getting a plum (i.e., a car is equally likely to be a plum or a lemon), the expected value of the car for a typical buyer is:

$$E(B) = \frac{1}{2} \times 240000 + \frac{1}{2} \times 120000 = \text{Rs. } 1{,}80{,}000.$$

However, at that price the owner of the lemons will be only willing to sell the car (because $E(B) = \text{Rs. } 180000 > E(S_{Lemon}) = \text{Rs. } 100000$) but not the owner of the plums (because $E(B) = \text{Rs. } 180000 < E(S_{Plum}) = \text{Rs. } 200000$). The price that the buyers are willing to pay for an average car is less than the price that the sellers of plum expect from the transaction. So at a price of Rs. 180000, only lemons would be offered for sale. Even though the price at which buyers are willing to buy plums exceeds the price at which sellers are willing to sell them, no such transaction for plums will take place. This is the problem of **market failure**. In an extreme case, if the buyer was certain that he would get a lemon, he would not be willing to pay Rs. 1,80,000 for it. The equilibrium price then would have settled somewhere between Rs. 1,00,000 to Rs. 1,20,000. For this price range market would have been segregated, for sellers of plums would not offer their cars for sale.

There is an externality problem between the sellers of plums and lemons, which result in the market failure. When an individual is trying to sell lemons he affects the buyers' perception on the quality of average car in the market. This lowers the price that the buyers are willing to pay for an average car in the market. This further discourages the sellers of plums. This is an externality problem. Thus in the presence of information asymmetry, if too many low quality items are offered for sale, it changes the buyers' perception (and dampens the willingness to pay) on the average product, and thus making difficult for the sellers of high quality items to offer their products in the market.

8.3.2 Market for Labour

Now consider market for labour in Fig. 8.1. Let us represent the number of workers on the horizontal axis and monthly wages on the vertical axis. The figure shows demand curves for high- and low-ability workers when workers' abilities are observable to the potential employers, labelled as DH and DL respectively. The figure also shows the supply curves for high- and low-ability workers labelled as SH and SL respectively. The higher the monthly wage, more the high-ability workers are willing to accept employment.

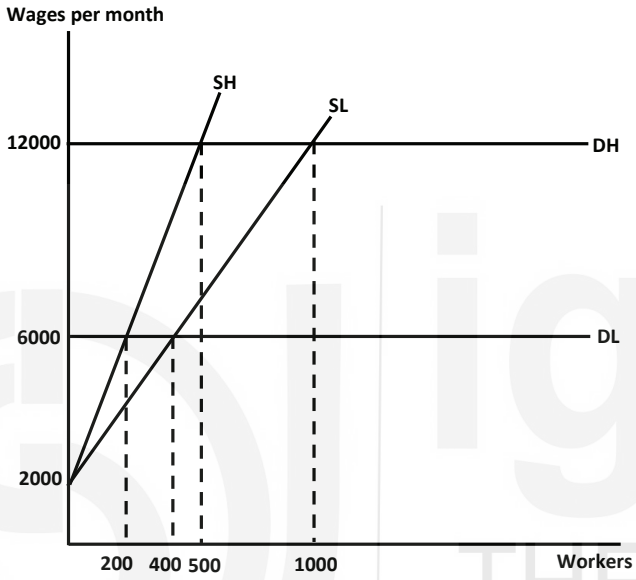

Fig. 8.1: Market for Labour

Using this figure, we show how asymmetries exist in the labour market. Usually workers have greater knowledge about their abilities than their potential employer. We assume here that workers are paid according to their abilities.

Initially we assume the ideal market situation where the potential employer can easily differentiate between a high-ability and a low-ability worker. Accordingly, a high-ability worker will be paid where curve DH intersects SH. The number of high-ability worker employed will be 500 and they will be paid a monthly wage of Rs. 12,000. The equilibrium for low-ability worker is where curve SL intersects DL, that is, at 400 low-ability workers paid a monthly wage of Rs. 6000 per month. Low-ability workers are paid lower than the high-ability workers when the labour market is in equilibrium. In this case, we do not face a situation of asymmetric information, as the abilities of the workers to be hired are common knowledge. Thus, the employer can easily differentiate between a high-ability and a low-ability worker.

Now consider the case when we have a situation of asymmetric information in the labour market. That is, the abilities of the workers to be hired are not the common knowledge anymore. For this refer Fig. 8.2.

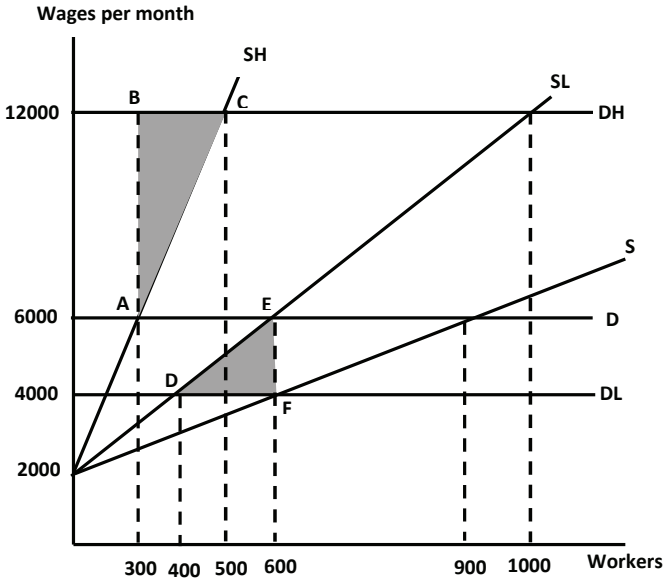

Fig. 8.2: Deadweight loss under Market for Labour

Given that there is information asymmetry, the potential employer is not able to distinguish between the high- and low-ability workers. So for the employer the demand for labour is depicted by the demand for an average worker. Thus following Fig. 8.2, D represents the demand for an average worker which is given by the average of low-ability and high-ability workers. DH represents demand for high-ability workers and DL is the demand for low-ability workers. Let curve S represents the total supply of high- and low-ability workers together. Curve SH and SL are the supply of high-ability and low-ability workers, respectively. Thus in the presence of information asymmetry, the labour market equilibrium is defined by the intersection of the S and D curve, depicting the total employment of labour in the equilibrium as 900 workers. Out of 900, the existing 400 low-ability workers should be paid a monthly wage of Rs. 4000, while the existing 500 high-ability workers should be paid a monthly wage of Rs. 12,000. This would be the feasible outcome when the quality of labour was observable. But since in this case ability of labour cannot be distinguished, 900 workers in the market are paid a uniform monthly wage of Rs. 6000. This is due to the presence of asymmetric information to the potential employer about the abilities of the workers. As a result of this, a high-ability worker is underpaid and a low-ability worker is overpaid. This will discourage a high-ability worker from participating in the labour market. At Rs. 6000 per month, only 300 high-ability workers will participate (as shown by the intersection of SH with D curve). As low-ability workers are overpaid, they will be encouraged to participate more in the market. So instead of 400, 600 low-ability workers participate in the labour market in the equilibrium at the monthly wage of Rs. 6000 (as shown by the intersection of SL with D curve).

In the market, ideally if no asymmetry in information is present, there were total 900 workers employed, out of which 400 were low-ability and 500 high-ability workers. In the presence of asymmetric information, there 300

high-ability and 600 low-ability workers.This shows that quality of the labour in the market dropped due to the presence of the asymmetric information. This is known as the situation of adverse selection. Potential employers would have hired 500 high-ability and 400 low-ability workers when there was no asymmetric information, but they ended up hiring 600 low-ability and 300 high-ability workers. Hence, the market has become adverse due to the presence of asymmetric information.

Deadweight loss due to asymmetric information:

In Fig. 8.2, area ABC represents the deadweight loss due to lower hiring of high-ability workers and area DEF represents the deadweight loss resulting from hiring too many of low-ability workers. In the above case we saw that in the labour market equilibrium, with the presence of asymmetric information, fraction of high-ability workers will be smaller than it would have been in the first best scenario (without any information asymmetry) where the potential employers would able to identify abilities of the workers before hiring. Because of asymmetric information, low-ability workers drive high-ability workers out of market. This phenomenon is an important source of market failure.

8.3.3 Market for Insurance

Huge asymmetric information exists in the market for insurance. For instance, in the case of health insurance, the maximum and true information about one's own health is known only to the person himself or herself. The insurance company often suffers from the lack of information about the person's real health status. People facing high health or disability risk (and old in age) would prefer buying a fat medical insurance, so that their medical bills can be taken care of. While healthier (and younger) people facing a lower health risk, generally do not need much insurance and hence they would prefer to buy insurance which are attractive to them in terms of premium and insurance cover. If the insurance company sells insurance to proportionately more sick or old people, then it may not be sustainable for them to run business because it won't be able to draw the benefit of cross subsidies from the healthy (and young) clients. The insurance company will incur huge costs of frequent claims and may find it difficult to breakeven. In such cases the profit maximising company may withdraw from the market.

In the presence of asymmetric information, it is difficult for the insurance company to segregate individuals facing high health risk from the ones facing a lower risk. This leads to the problem of adverse selection in the market for health insurance. If the pricing or the insurance contract (defined by the amount of yearly/monthly premiums and amount of insurance benefit in case of sickness) is uniform for both the healthy and sick individual, then it may induce a relatively stricter clause (over priced) for the healthy individual and relatively easier clause (under priced) for the sick individual. This situation is similar to 'market for lemons'. In such a scenario,

the healthy individuals may have disincentive to buy insurance while sick individuals may have high incentive to buy insurance. Adverse selection will prevail as individuals applying for insurance will now consists more of the sick people than healthy people, leading to insurance company losing out profits. This will lead to market failure in insurance market.

8.3.4 Market for Credit

Similar problem of asymmetric information exists in the market for credit. In market for credit, the borrower has more information about his true credit worthiness as compared to the lender. In other words, it is often difficult for the lender to judge the true credit worthiness of the client. Choosing a wrong client would mean greater risk of default and hence larger losses to the lender. As in the case for market for 'lemons', low quality or risky borrowers are more likely to enter the credit market for credit than high quality or safe borrowers. This forces the lending interest rates based on the average default risk to go up further, which in turn may induce the safe borrowers to withdraw from the market and may increase the client profile of lenders by more risky borrowers. This leads to the problem of adverse selection in the credit market.

8.4 SOLUTION TO ASYMMETRIC INFORMATION-SIGNALING AND SCREENING

8.4.1 Signalling

The existence of asymmetric information often leads to the problem of adverse selection and this leads to market failure. Now what to do when asymmetric information is prevalent? One way in which the buyer and seller can deal with this problem is through market signalling. The concept of market signalling is where the buyer or the seller signals the other uninformed party, to increase their information about the product in trade.

To see how market signalling works, let us consider the case of asymmetric information in the labour market. In the labour market where high- and low-ability workers are present and are not easy distinguishable, employing somebody can be very costly to the potential employer. If an employer hires a low-ability worker for a job requiring high-ability, he will be in severe loss. In such a case *market signalling* works great. The high-ability worker can signal the employer about his abilities, which stand out amongst all the other low-ability candidates. Signals could be in the form of better resume, being highly qualified, education level, showing good etiquettes, speaking in decent language, etc. These mechanisms are often used by the high-ability worker to signal the potential employer about his (her) potential and makes sure the employer credit him (her) with a high quality tag.

8.4.2 Screening

Presence of asymmetric information provides incentives to the parties concerned to communicate with each other. In the previous sub-section we came across how informed parties (workers) provide information to the uninformed parties (the potential employer) to make up for the asymmetries in the information. There, the informed parties initiate communication by signalling about their hidden type to the uninformed parties. There is another way to take care of the information asymmetries, which is when uninformed parties initiate communication by conducting a test either for the informed parties or the goods those parties seek to trade. For instance, in the market for second-hand cars, the potential buyer of a second-hand car can learn about its quality by getting it checked from a mechanic or learn about the accident record of the car. Similarly, a life insurance company can gain information regarding the health of an insurance policy applicant by obtaining the applicant's medical records, contacting his current physician, or subjecting him to a physical examination. Another common way of implementing screening is by designing and offering different contracts for the different types of agents with hidden information, instead of offering one homogenous contract. In this way each agent's type gets revealed.

There is one significant difference between signalling and screening. In signalling it is the more informed party that initiate the communication, whereas in screening the communication intended to make up for the information asymmetries is initiated by the less informed.

Check Your Progress 1

1) Define asymmetrical information? How does asymmetrical information lead to market failure?

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2) How does *market for lemons* turn into adverse selection?

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3) What is solution to the problem of adverse selection?

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8.5 MORAL HAZARD

Moral hazard is also a result of asymmetric information where asymmetry arises due to hidden action by agents such that the action of one party is not observed by the other party in trade, which in turn affects the benefits of the latter. For example, in the case of the insurance market, an insured individual's risk of death or disability may increase in the post insured stage because of his unhealthy lifestyle including smoking, excessive drinking, or a lack of exercise. However, the insurance company is likely to have difficulty in monitoring his behaviour and adjusting its premiums accordingly.

Moral hazard often arises in the labour market since employers cannot monitor the behaviour and efforts of their employees completely. This causes inefficiency with employees exerting less effort than the employer would consider required. Moral hazard is also prevalent in big corporations, where individual managers may take actions that further their own interests at the expense of the company, which we discuss in the next section. In general, moral hazard occurs when a party to a transaction takes hidden actions that remain unobserved by its trading partner and that affect the benefits or payoff of the latter.

A simple illustration explaining moral hazard associated with asymmetric information problem and how it leads to increase in the costs is as follows. Consider a case of night security guard in a company. Since the duty is for the night, nobody observes the actions of the security guard. This in turn is incentive enough for the guard to shirk, that is, not guarding properly. Suppose he frequently sleeps during his duty hours as he knows his actions are not observed. As a result of this, one night the company suffers a break-in, leading to huge costs to the company. This is due to the presence of moral hazard in the guard's hidden behaviour which the firm is unable to observe. Thus the presence of asymmetric information leads to market failure.

8.5.1 Principal-agent Problem

We often study a simplified model with only one agent on either side of the market to understand asymmetric information problems. The agent who proposes the contract is called the principal and the agent who either

accepts or rejects the contract is called the agent. The existence of moral hazard too occurs because of the principal and agent. Agents are the individuals employed by the principal to achieve principal's objective. In the presence of information asymmetries, often preferences of the principal and agents are not aligned and agents tend to pursue their own goals rather than the goals of the principals. For instance, the employee (or the agent) on duty has incentive to shirk effort, which his employer (or the principal) fails to observe.

Common examples of a principal-agent relationship include corporate management (agent) and shareholders (principal), politicians (agent) and voters (principal), or brokers (agent) and markets— buyers and sellers (principals). Consider a legal client (the principal) wondering whether their lawyer (the agent) is recommending protracted legal proceedings because it is truly necessary for the client's well-being, or because it will generate income for the lawyer. Similarly a surgeon advising a patient for an expensive knee replacement surgery may be because of genuine requirement of the patient or because it is profitable for the surgeon. In fact the problem can arise in almost any context where one party is being paid by another to do something with the agent having a small or non-existent share in the outcome.

Moral hazard problem arises where parties have different interests and there exists information asymmetries with agent having more information than the principal. In such a case, principal cannot directly ensure that agent is acting in their (the principal's) best interest, particularly when activities that are useful to the principal are costly to the agent, and where elements of what the agent does are costly for the principal to observe. Often, the principal may be sufficiently concerned at the possibility of being exploited by the agent that they choose not to enter into the transaction at all, when it would have been mutually beneficial: a suboptimal outcome that can lower welfare overall. The deviation from the principal's interest by the agent is called agency costs. Principal-agent problem can be found both in private enterprises and public enterprises. One way to correct for the principal-agent problem is by making an effective incentive mechanism, wherein the agent can be tied with some share in the profits so that the agents and the principal's objectives are aligned together. For example, giving managers (agents) some share in the company's equity so that they do not shirk on their full potential in their duty.

Check Your Progress 2

1) Define Moral hazard. What does it lead to?

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2) What is meant by the principal-agent problem? What leads to principal-agent problem? How can that be corrected?

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8.6 LET US SUM UP

The present Unit discussed the market condition when one of the key assumptions of perfect competition given by full and symmetric information among the agents involved in trade does not hold. Asymmetric information exists when in a two-party trade one party has greater information than the other party.It leads to market failure with one reaching an inefficient allocation of resources. Such an inefficient solution results due to adverse selection that arises when there exist asymmetric information. In adverse selection the high quality goods or worker leave the market and market essentially consists of low quality goods or workers. Examples of markets suffering from asymmetric information are— market for used cars, health insurance market, market for credit, market for labour, etc. There is deadweight loss to the society in the presence of asymmetric information, as efficient allocation of resources is not happening. One solution to achieve equilibrium in the presence of asymmetrical information is through market signalling or screening. The Unit proceeded with describing the problem of moral hazard that exists when one agent tries to shirk as the other agent is not able to observe former's actions. In such a case the agent pursue his/her own goals rather than the goals of the principal.

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8.8 ANSWERS OR HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Refer Sections 8.2 and 8.3 and answer
2) Refer Sub-section 8.3.1 and answer
3) Refer Section 8.4 and answer

Check Your Progress 2

1) Refer Section 8.5 and answer
2) Refer Sub-section 8.5.1 and answer

GLOSSARY

Constant Returns : Constant Returns prevails when the proportionate increase (decrease) in input(s) leads to the increase (decrease) in output in the same proportion.

Contract Curve : It is the locus of the tangency points of the isoquants representing the two goods in the Edgeworth box.

Diminishing Returns : Diminishing Returns prevail when the proportionate increase (decrease) in all the input(s) results in the less than proportionate increase (decrease) in output.

Efficiency : The economic state in which all the resources are optimally employed and all economic gains are fully exhausted such that any change to assist someone will harm another.

Full Employment : Is a condition when all the productive resources of the economy are fully employed.

Equity : The state of distribution where all agents get the equitable share of the pie.

First Welfare Theorem : The first welfare theorem ensures that a perfect competitive equilibrium is Pareto efficient.

General Equilibrium : General equilibrium theory explains the functioning of economic markets as a whole. It is concerned with the equilibrium in all the markets simultaneously.

Increasing Returns : Increasing Returns prevails when the proportionate increase (decrease) in all the input(s) results in the more than proportionate increase (decrease) in output.

Isoquant : An isoquant shows different combinations of two inputs that can produce a constant level of output.

Marginal Rate of Technical Substitution : Slope of an isoquant. It gives the amount at which one input is reduced for an additional unit of another input while producing the same level of output.

Pareto Efficiency/Optimality : It is the state of allocation of resources such that no one can be made better off without making someone else worse off.

Pareto Inefficient : State of resource allocation such that there is a possibility to make someone better off without making anyone else worse off.

Partial Equilibrium : Partial equilibrium explains the concept of economic equilibrium of a single market, holding all other factors and markets constant.

Perfect competition : It is a market form with large numbers of informed buyers and sellers all of whom are price takers.

Production Possibility/ Transformation curve : Given the resources and the state of technology, it depicts different combinations of two goods that can be produced by fully and efficiently employing all the resources of the economy.

Second Welfare Theorem : Second welfare theorem states that any Pareto efficient allocation can be rationalised as competitive market equilibrium.

Aggregation of Preferences : It is the way of depicting individual preferences into social preferences.

Benthamite Social Welfare Function : It is a social welfare function which is derived from aggregation of individual utility functions. It is represented as $W(u_1, \ldots\ldots, u_n) = \sum_{i=1}^{n} u_i$

Bergson-Samulseon Social Welfare Function : Also known as individualistic welfare function, it is given by $W = W(u_1 \ldots\ldots, u_n)$, where u_i (with i = 1…n) represent individual utility functions which are ordinal and are a function of whatever it may be that provides individuals with utility or satisfaction.

Efficiency in Product Mix : It refers to Pareto efficiency in production and exchange.

Isowelfare Curve : The curve depicts combination of utility of two individuals which gives same level of welfare.

Overall Efficiency : It means efficiency in product mix. A Pareto efficient allocation in production and exchange.

Rawlsian Social Welfare Function : It is also known as Minimax social welfare function:
$W(u_1, \ldots\ldots, u_n) = \min\{u_1, \ldots\ldots, u_n\}$.It takes into consideration welfare of the worse off agent.

Social Welfare Functions : Social welfare function is the aggregation of individual utility functions. It depicts social welfare as a function of individual preferences.

Utility Possibility Set : Utility possibility set depicts the utility set of two individuals.

Utility Possibility Frontier : The curve or the boundary of utility possibility set is known as utility possibility frontier. It consists of all Pareto efficient allocations.

Value Judgements : It refers to the concept of beliefs of individuals about what is good and what is bad.

Welfare Economics : It is a branch of economics which is concerned with the overall social welfare of the economy. It aims at developing economic policies and target different welfare problems and issues. Value judgement plays an important role in welfare economics.

Consumer Surplus : Difference between the total amount consumers are willing and able to pay for a good and the total amount that they actually pay.

Deadweight Loss : A loss of economic efficiency that is generated by an economically inefficient allocation of resources within the market.

Economies of Scale : Cost advantage in terms of fall in the long-run average cost experienced by a firm when it increases its scale of production.

Inverse Demand Function : Inverse of demand function expressed in the form of price as a function of quantity demanded P(Q).

Lerner's Index : A measure of monopoly power, it measures the price-cost margin, as is given by $\frac{P(Q)-MC}{P(Q)}$

Natural Monopoly : Occurs when one firm (because of possession of unique raw material, technology, or other factors) can supply market's entire demand for a good or service more efficiently than two or more firms can.

Price Discrimination : A pricing strategy which involves charging different consumers different prices for the identical good or service.

Price Elasticity of Demand : A measure of responsiveness of demand for a product to its own price.

Producer Surplus : Difference between the amount the producer is willing to supply goods for and the actual amount received by him.

Allocative Efficiency : Efficiency resulting when resources are allocated in such a manner that society is as well off as possible. This results when output is produced to the point where the marginal benefit to society from a unit just equals the marginal cost of producing that unit. Perfect competition ensures allocative efficiency by producing where price equals marginal cost, whereas under both monopoly and

monopolistic competition, price is marked-up over marginal cost due to which allocative efficiency is not ensured.

Deadweight Loss : The loss of social welfare measured in terms of the sum of producer and consumer surplus when the equilibrium outcome is not achievable or not achieved. Both monopoly and monopolistic competition create deadweight loss by producing lower output and charging a higher price than what a competitive market would produce and charge.

Economic Profit : Difference between a firm's total revenue and the sum of its explicit and implicit costs, also called the supernormal profit.

Excess Capacity : A distinctive feature of monopolistic competition, it is given by the increase in the current level of output that is required to reduce unit costs of production to a minimum.

Imperfect Competition : Competition is said to be imperfect when one or more characteristic features of a perfect competition (viz. homogeneous products, many sellers and buyers, perfect information, no barriers to entry and exit, no government intervention) does not hold.

Incumbent Firm : A firm which is already operating in a market.

Minimum Efficient Scale : The output level at which the internal economies of scale have been fully exploited so that the long-run average cost is minimised. It is also known as the output range over which a producer achieves productive efficiency.

Non-price Competition : Sellers competing on factors other than price, which include, aggressive advertising, product innovation, better distribution, after-sale services, etc.

Normal Profits : Also called zero economic profit, it equals the difference between the firm's total revenue and total cost.

Productive Efficiency : Efficiency achieved when production is undertaken without waste, that is, at the minimum cost. Perfect competition ensures

productive efficiency, while both monopoly and monopolistic competition do not.

Selling Cost : Expenses incurred for promotion of a differentiated product and increasing the demand for it.

Cartel : A direct formal agreement among competing Oligopolist with the aim of maximising joint profit and reducing uncertainty.

Collusion : An agreement whether explicit or tacit among the rival firms to coordinate on various accounts such as price, market share, etc.

Dominant Firm : A firm which accounts for a significant share of a given market than its next largest rival.

Fringe Firms : Group of firms where each firm possess an insignificant market share and are therefore price takers.

Nash Equilibrium : Mutually best response strategy, where each player is doing the best it can given the strategies of all the other players, so that nobody has a unilateral incentive to deviate from their own strategy.

Oligopoly : A market structure characterised by a small number of firms that operate with a lot of interdependence.

Reaction Curve : Also called best-response function, is the locus of optimal (profit-maximising) actions that a firm may undertake for any given action chosen by a rival firm.

Tacit Collusion : Collusion where rival firms agree upon a certain strategy without putting it in as a formal agreement or spelling out the strategy explicitly.

Backward Induction : A method to solve for a subgame perfect Nash equilibrium. Under this method, we start with solving for the optimal strategy at the "end" of the game tree, and work "back" up the tree.

Dominant Strategy : A strategy for a player that yields the best payoff no matter what strategies the other players choose.

Dominant Strategy Equilibrium : Dominant strategy equilibrium results when every player has a unique best strategy, independent of the strategies played by others.

Dominated Strategy : A strategy for a player that is outperformed by another strategy which is at least as good no matter what other players choose.

Game Tree : A directed graph whose nodes indicate players making a choice. Branches originating from the node indicate a particular choice made by a player. At the end of the tree we have the associated payoffs.

Mixed Strategies : A probability distribution that assigns to each available action a probability of being selected.

Nash Equilibrium : Mutually best response strategy. It is the set of strategies, such that no player has incentive to deviate from his or her strategy given what the other players are doing.

Sequential Move Game : A game in which players act at well-defined turns, and have some information on what the other player(s) did at previous turns.

Simultaneous Move Game : A game in which all players act at the same time, and thus have no information on the actions of the others in the same turn.

Subgame : A subset of a game that includes an initial node (independent from any information set) and all its successor nodes.

Subgame Perfect Nash Equilibrium : A strategy profile which is a Nash equilibrium of every subgame of the original game.

Arrow's Impossibility Theorem : As per Geanakoplos, according to the Arrow's impossibility theorem, "Any constitution that respects transitivity, independence of irrelevant alternatives and unanimity is a dictatorship."

Coase Theorem : Developed by Ronald Coase, as per this theorem, in the presence of externalities, existence of proper property rights with the parties involved lead to an efficient outcome regardless of which party owns the property rights, as long as the transaction costs associated with bargaining are negligible.

Externality : A cost or benefit of an economic activity experienced by an unrelated third party.

Free-rider Problem : A type of market failure that arise when an individual may be able to obtain the benefits of a good without contributing to the cost of it provision.

Logrolling : Agreeing to trade votes and support each other's favoured initiatives.

Marginal Private Cost (MPC) : Change in the producer's total cost resulting from the production of an additional unit of a good or service.

Marginal Social Cost (MSC) : Sum of marginal private cost faced by producers of the good and the marginal external cost faced by the party not involved, such as environmental or social costs, arising from a good's production.

Market Failure : An economic situation defined by an inefficient allocation of goods and services in the free market.

Non-excludable Good : A good for which it is not possible to prevent consumers who have not paid for it from having access to it.

Non-rival in Consumption Good : A good whose consumption by one consumer does not prevent simultaneous consumption by other consumers.

Public Goods : Goods that are both non-excludable and non-rivalrous in that individuals cannot be excluded from using it, and where use by one individual does not reduce availability to others.

Social Choice Theory : The study of collective decision processes and procedures.

Adverse Selection : Originally defined in the insurance theory, to describe a situation where the information asymmetry between policy-holders and insurers leads to a situation with policy-holders claiming losses that are higher than the average rate of loss considered to set premiums.

Asymmetric Information : Occurs when one party to an economic transaction possesses greater material knowledge than the other party.

Market for Lemons : In America, 'lemon' is used as a slang denoting a bad quality car. In the presence of asymmetric information, bad cars tend to drive out good cars from the market, leaving behind a Market for lemons (bad cars).

Moral Hazard : A situation arising as a result of asymmetric information in which one party gets involved or consider entering in a risky event after it has struck a deal involving covering of the risky situation by the other party.

Principal-agent Problem : Arises when one party (principal) delegates an action to another party (the agent), and there exists information asymmetries between them.

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MPDD/IGNOU/P.O.4K/July, 2021

BECC-108 Intermediate Microeconomics-II

ISBN: 978-93-91229-68-9