**Microeconomics: Theory & Applications**
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**Lecture – 52**
**Externality & Market Failure (Part-1)**

Hello, welcome back to the lecture series on Microeconomics. Now, we are going to study one form of market failure, which is known as externality. What is the market failure? So, let us start with the discussion on first welfare theorem. What does it state? It states that perfectly competitive free market provides a Pareto optimal or welfare maximizing solution to the society's resource allocation problem, but there is a prerequisite to that.

This result depends upon lots of assumptions and one condition. And the condition is that there is no externality. What is externality? Sometimes, production and consumption of commodities generate benefits and impose costs on others, which are not captured by the market price. If this happens, then this situation is known as externality. Now, why we are saying that some benefits and costs are not taken care of by the market price, and what does it has to do with externality.

So, for that we have to go back to the basic diagram of perfect competition. So, where do we get the perfect competitive equilibrium, at the intersection of the market demand, and the market supply functions right. Now, what does a point on market demand function represents? If we talk about one representative consumer, so for a representative consumer any point along the demand function, actually gives the marginal utility that the consumer or the person derives from that very unit of the product or commodity.

So, how do we interpret one point along the supply curve, a supply curve for a representative competitive firm is derived from the marginal cost function and we know that any point on the marginal cost function represents the marginal the additional cost of production to produce that additional unit of commodity right. So, basically at the competitive equilibrium, where the demand and supply functions intersect; at that very point price equals marginal utility and marginal cost. So, basically the market price takes cares of all the benefits and costs, which are associated with production and consumption of a commodity for which we have the market. But, in the case of externality, if there is

some benefit or cost which is accrued, which is related to overall society not this individuals any more, then in that case that leads to the externality problem.

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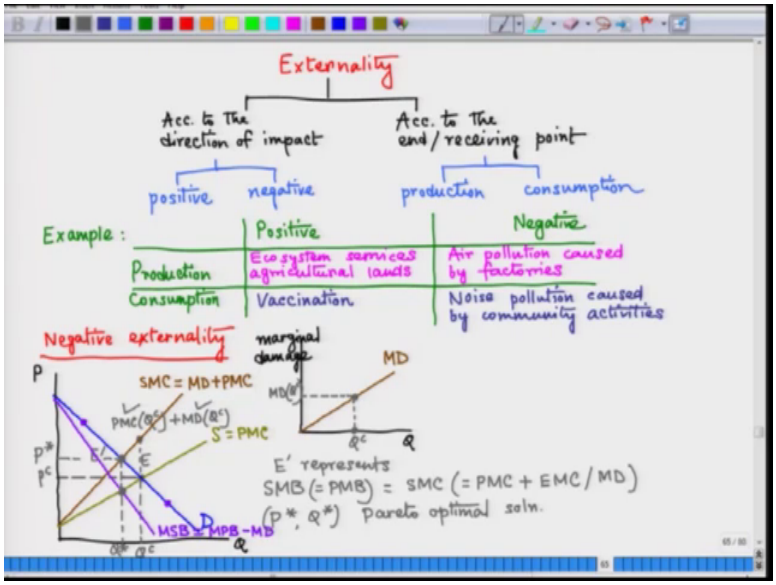


Now, we are going to talk about four types of externalities, and we will give examples. I hope that with this taxonomy of externality and this examples, this concept of externality, we will become even clear to you.

So, externality can be first broken down into two different ways. And they are according to the direction of the impact, and the other one is to divide according to the end point or receiving point ok. And now I can break this down into positive externality and negative externality right. And the second would be subdivided further in production and consumption externality right.

So, now let us discuss these four types of externalities one by one. So, when the externality is in form of cost imposed on the others without paying for it that is known as a negative externality. Now, what about the positive externality, when the externality is in form of some benefits for others, who do not pay directly for those benefits that is known as the positive externality.

When consumer welfare is impacted by any other economic agent's production or consumption activities; that is known as, consumption externality. And if firm's production possibilities or producer welfare is being impacted by some activities

production or consumption activities of other economic agents; then that is known as production externality.

Now, let us think about some examples ok. So, let us give an example of positive production externality to start with. So, one can think about ecosystem services generated by agricultural land. So, basically you are talking about some ecological benefits or environmental benefits of crop production in agricultural land right.

So, now let us talk about negative production externality. So, one can think about air pollution caused by factories ok. Now, let us move to positive consumption externality. And positive consumption externality example could be some associated benefits of vaccination right. And the negative consumption externality could be noise pollution caused by community activities right ok.

So, now we are going to look at simple analysis of externality through simple model and graph. First, we are going to show that if externality exists, then the perfectly competitive market provides a sub optimal solution to resource allocation problem. It implies that that there will be deadweight loss, so that the social welfare is not maximized under the presence of externality.

So, first we are going to discuss the case of a negative externality, and then we will move to the case of positive externality. So, we start with a perfectly competitive market and let us first draw the demand function, and then we have to superimpose the supply function. So, I start with a conventional supply curve, which has positive intercept along the price axis, supply function. So, now this is my equilibrium point right ok.

So, let us start with a perfectly competitive market, where we have the usual download sloping demand function, and upward sloping supply function. And at the point E, the market equilibrium is struck. And the market clearing prices and quantities are obtained. And let me denote this market clearing quantity as Q c, c denotes the case of perfectly competitive market, and price P c ok.

So, now let us talk about negative production externality. So, suppose we are talking about industrial production, and from the factory chimneys the smoke comes out. And the smoke has some social cost in terms of damages, it creates. So, there could be health

problems and other problems associated with the air pollution that is generated by these industrial production units.

So, suppose I assume it is simple assumption that my marginal damage caused by these industrial pollution air pollution is a linear function of the quantity that is being produced by the industry of the firm. So, basically I am talking about straight line, which passes through the origin. And this is basically known as my marginal damage curve abbreviated by MD. Now, what is marginal damage? So, by marginal damage, we mean the additional damage cost to society by production of one unit of this commodity in the industry ok.

So, if there is this negative externality, how to accommodate this in our market diagram? So, this could be done in two different ways. So, first we are going to show the way through the supply side. So, basically if there is air pollution caused by the firm, then basically that is an additional cost of production, which is not captured by the original supply function.

So, basically one can say that the supply function that we deal with in the perfectly competitive market is the private marginal cost, because this is the cost which is borne by the producer, which and this cost basically takes cares of all the issues, which actually takes place in the factory shed under the factory shed. But, what is happening in the outer society like hill damages and all that the producer is not bothered about.

So, there is this external damage cost, and that is basically captured by the marginal damage function that I have drawn separately, so that should be added to this private marginal cost. So, if I now join this marginal damage to the private marginal cost, then I get another curve. And given the nature of the marginal damage curve basically, I get another straight line. And this straight line basically represents what marginal damage plus the private marginal cost right.

So, basically I am talking about the summation of the marginal damage numbers to the private marginal cost figures for each and every unit of the quantity being produced right. So, basically if we do so, then the curve that we get as a result is known as the social marginal cost, because any point on the social marginal cost, basically takes cares of both the private marginal cost and marginal damage cost right.

So, let us take an example here. So, basically if we talk about the Q c quantity, which is the market clearing output level, then basically for that quantity of production, suppose I want to plot this level of production here Q c right. So, basically to produce that unit of those units of the output the firm is also causing some kind of air pollution, and that is basically creating some damage to the society. And the marginal damage is given by is MD Q c amount, which is to be read from the marginal damage function right.

So, basically it is not only the PMC at that point, which is given by the supply curve, we need to add the MD Q c amount as well. So, basically this point here on the supply function gives me the total cost, which is borne by the society, and that is basically PMC the private marginal cost that is incurred by the producer and the marginal damage cost, which is incurred by the larger society right. So, basically any point on the social marginal cost basically talks about the total cost of production. So, this total cost of production has two components. One is this private marginal cost, and the other one is basically the external marginal cost, which is to be borne by the society right.

So, in this situation what would be the Pareto optimal solution for the society? So, for Pareto optimality, we know that the true marginal cost of production should be equal to the true marginal benefit of the commodity. So, basically we have strike that P equal to MU equal to MC condition, which we have explored before now those MC and MU figures should be the total figures of the society right. So, there should not be any hidden benefit, there should not be any hidden cost. So, if that is the case, then how to find the equilibrium or how to find the Pareto optimal solution let us again revisit the graph.

So, the intersection point of these demand function and the social marginal cost function, which is basically given by this point say E prime is a point where the social marginal cost is equal to the social marginal benefit ok. So, the intersection point E prime represents a situation, where the social marginal benefit, which is exactly equal to the private marginal benefit in this case, because there is no externality impact on the demand side shall be equal to the social marginal cost, which is in this case is a sum total of the private marginal cost plus the external marginal cost or this is also known as the marginal damage right ok.

So, basically at that intersection point, we get some price and quantity combination right. So, the price that we see let us denote that by P start, now captures all the benefits and all

the costs, which are seen in the society for the production and consumption of this particular commodity. So, the externality is now captured by the market price, and the corresponding output level is Q star, which clears the market. So, demand is equal to supply.

So, basically in this case the P star Q star combination is basically my Pareto optimal solution in the presence of externality ok. Note that as we have we have incorporated the externality component in our model; we see that the equilibrium output level has fallen and the equilibrium price has gone up. So, what we can say, we can say that in the presence of externality, negative externality the mark competitive market outcome provides an output level, which is basically higher than the Pareto optimal level of the output level. So, basically the commodity is being over produced, because there is no market for the bad, which is pollution being produced as a byproduct of this commodity. So, basically this pollution is not priced, and that creates the market failure problem ok.

So, now let us also look at the other way to handle this externality issue through the same diagram. And this time we are going to study, how to incorporate the negative externality through the demand function. So, note that last time we have added the marginal damage caused by the production, and we have treated that as a hidden cost of production. But, we can also say that if pollution is created that we will basically lead to some health impacts and all and basically, these negative utility, which is being generated from the production and consumption of these commodity is not captured in the market price. So, to say that the consumers also do not pay a price which is basically capturing the society's total benefit or net benefit from this commodity.

Basically, what we see here that each point on this demand function say a point here or a point there is basically not representing the societies through benefit from consumption of this commodity. Although there is a positive utility generated by consumption of this commodity, but there is a damage caused by the production of this commodity as well.

So, basically if we deduct the damage from the utility of consumption from this commodity, we will get the net utility of the commodity for the society. So, we can also deduct the damage figures that we obtain from the marginal damage diagram from the demand function. And if we do so for all units of the quantity, then we get a shift rotation

of the demand function, and the rotation will be inward given the nature of the marginal damage function we have.

And we get basically this violet colored demand function, which we can now write as marginal social benefit, which is basically equal to the marginal private benefit, which is basically given by the demand function minus the marginal damage caused by the production of the commodity. Now, note that interestingly I found an intersection of these MSB marginal social benefit curve with the original private marginal cost curve at a point, where the Q star is the quantity that is being produced and consumed by the society, so that is basically the Pareto optimal solution of the model.

So, basically what do we see from the graph, we see from the graph that it does not matter from which root we want to incorporate the externality effects, you know the final outcome is the same. So, it does not matter whether we shift the demand function or the supply function, we get the same quantity of Pareto optimal level of output. But, you know the lesson is that we should not shift both the curves simultaneously. Now, we are going to move to the discussion of dead weight loss associated with a negative production externality ok.

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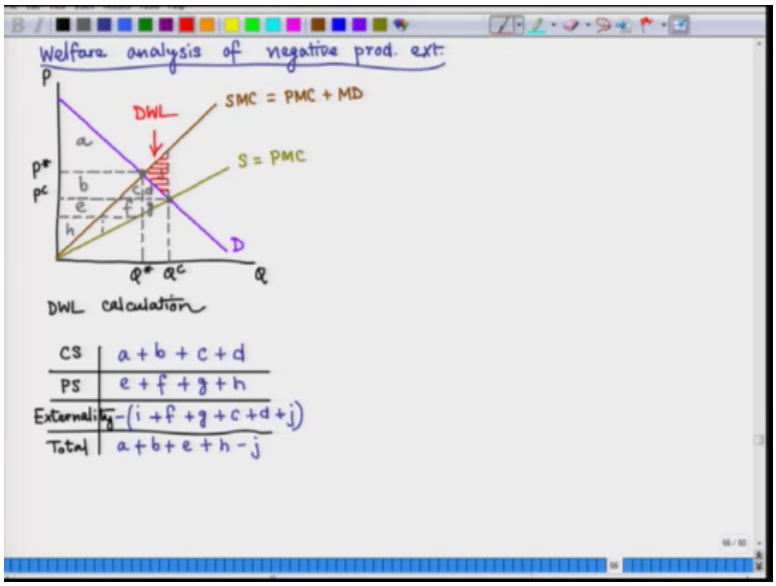


So, now let us consider a diagram, where we could do our deadweight loss analysis for the negative externality. So, as it is complicated diagram, we have drawn it before. Now, note that at the intersection of the supply and demand function. When you ignore the

presence of negative externality, I get my competitive market output level Q c, and the corresponding price PC right ok. And then at the intersection of the social marginal cost and the demand function, we get our Pareto optimal solution to the problem Q start, P star. And note that here; we have accommodated the presence of negative production externality through the supply side of the story ok.

Now, we go for the dead weight loss calculation from the diagram. We have already marked the areas with some alphabets. Let us use these alphabets in order to compute the dead weight loss ok. So, first we are going to list down our components of deadweight loss calculation or social welfare calculation. So, basically first we need to talk about the consumer surplus, then we need to talk about the producer surplus, there is this externality thing as the new component right. And finally, there is this society, which is basically total of sum total of these three components right ok.

So, now let us look at the numbers. So, here we see that for consumer surplus, we have a plus b plus c plus d, this is emerging from the perfectly competitive market outcome. Now, the producer surplus is basically the area e f g and h right ok. Now, the externality is basically given by the area, which is basically in between the private marginal cost curve and the social marginal cost curve and bounded by the straight line, which is drawn as vertical one from the Q c level of output right. So, it is basically i plus f plus g plus c plus d plus j.

Now, note that it is a negative externality. So, I have to use this negative sign in front of all the elements ok. So, if we sum these individual welfare components, then basically many alphabets, we will fall off after cancelling with each other. So, finally we are left with right ok. So, basically what we see here this triangle, which is now being marked in red is giving me the dead weight loss associated with the negative production externality. And this is due to the over production of the commodity by the market, when it does not capture the externality impacts ok.

We will continue with this discussion on externalities in the next lecture. Basically, in the next lecture we are going to see, how different economic policies could be taken to counter the dead weight loss associated with the perfectly competitive equilibrium, because we cannot forgo that perfectly competitive equilibrium. If there is a dead weight loss associated with that due to the presence of externality, we have to correct for that

using some economic policy instrument and that is going to be the subject matter for the next lecture.