Petroleum Economics and Management
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Module - 03
Public Policies
Lecture - 14
Government Intervention - I

Hi everyone, I am Dr. Anwesha Aditya your instructor for the course Petroleum Economics and Management, we are in module 3 of our course where we are discussing about Public Policies. So, in lecture 14 of module 3 we are discussing about Government Intervention to be more specific we will be discussing about tax.

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So, if you remember in the previous lecture, we have already discussed how to measure welfare. So, we already have measured welfare in terms of consumer and producer surplus. So, today we will start our class by defining what do we mean by an efficient market ok.

So, we will see that the efficient market is the one where there is no intervention by any third party like government or any other regulatory body or the market is also perfectly competitive and we will find out that in such a market the amount of surplus in terms of both consumer surplus and producer surplus is highest.

And after that we will be devoting our entire lecture today in discussing the tax policies because for our purpose taxation policies are very important. We have already discussed about the importance of petroleum products in revenue collection of the government, we have also discussed about the environmental gains that tax policies can lead to because taxation can lead to discouraging the use of fossil fuel which are responsible for greenhouse gas emissions and global warming.

So, we will be discussing about how tax rate is formulated how the taxation policies are implemented and how the surplus changes in the post tax situation. So, we will be comparing the market outcome in the pre and post tax situation and finally, we will be seeing how the tax bargain is distributed between the consumers and the producers.

Because there are cases examples where we see that in mostly in reality where tax burden falls mostly on the goods with inelastic products. So, one such example is petroleum product. So, we will be studying the distribution of the tax burden how it varies with elasticities of demand and supply ok.

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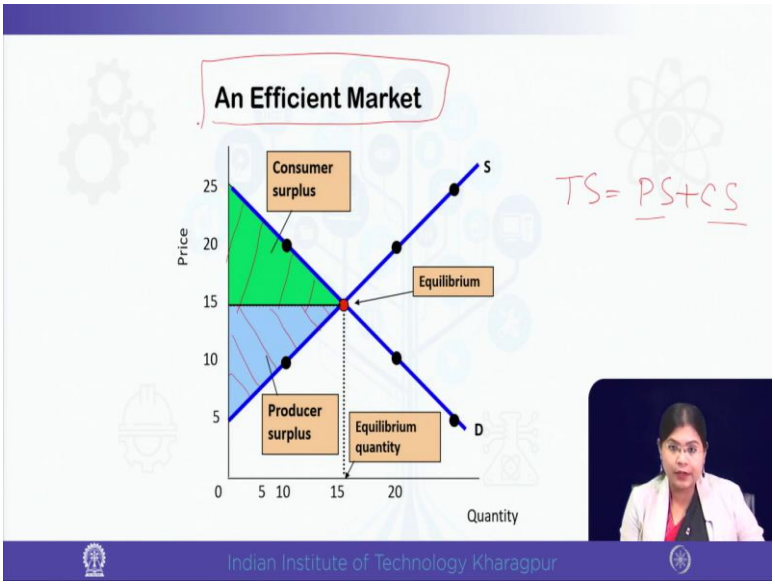

So, with this we will start by defining an efficient market. So, by efficient market we mean we refer to such a market where the surplus is maximum. So, we already know that total surplus is sum of consumer and producer surplus. So, in a market without any intervention, so in a free market and market which is perfectly competitive the total surplus in terms of producer surplus and consumer surplus is maximum. Like we can see

from this figure that we have plotted over here, the consumer surplus we already know it is the area below the demand curve above the equilibrium price.

So, we can see that this green shaded triangle is the consumer surplus and the producer surplus is the area below the equilibrium price and above the supply curve. So, this blue shaded triangle is the producer surplus. So, we can see that the total surplus is the sum of this green shaded triangle and the blue shaded triangle and this is highest.

Now, if we deviate from any type of imperfectly competitive market. So, if we bring any type of imperfect competition be it monopoly or oligopoly or duopoly or if a monopolistic competition we will see that the surplus will be falling. Now, that is not the purpose of our course, so we are not going into that direction, but we can see for our purpose we are mostly interested to see the impact of any type of government intervention.

To be more specific we will be discussing about the tax policies and later we will also be discussing about other type of government interventions like subsidy, quantity restriction or price control. So, we will see how these policies can influence the surplus both in terms of consumer and producer surplus, but one thing we should be careful in the post intervention scenario will be having three parties in the market, we know that in a market we have two parties the consumers and the producers.

However, when we discuss any type of policies, so we now have a third party. Say for example, the government or it can be the WTO, so then we will be considering the third party also. However, so this one we have plotted over here it corresponds to a perfectly competitive market without any intervention which is the highest possible surplus in terms of efficient market.

So, that is how we define efficiency. Since I am not going into very detail because those who are interested, they can look into the concepts of pareto efficiency and there is a theorem called the first fundamental theorem which tells that a perfectly competitive market is pareto efficient.

So, we are not going into that detail because as I already mentioned many times our purpose of studying the basic economics part was just to understand the concepts which are required for the course petroleum economics and management, but those who are

more interested in economics they can go for advanced courses or even during the interactive sessions also I can take queries on that.

So, the first fundamental theorem basically talks about it a perfect competitive market will be the pareto efficient solution. So, just in a nutshell pareto efficiency means no one can be made better off without making someone else worse off.

So, this is in very simple word this is the best possible outcome in terms of welfare there are other views also regarding the degree of market power I am not going into that debates just from the point of view of welfare economics a perfect competitive market without intervention will lead to the highest possible level of surplus ok.

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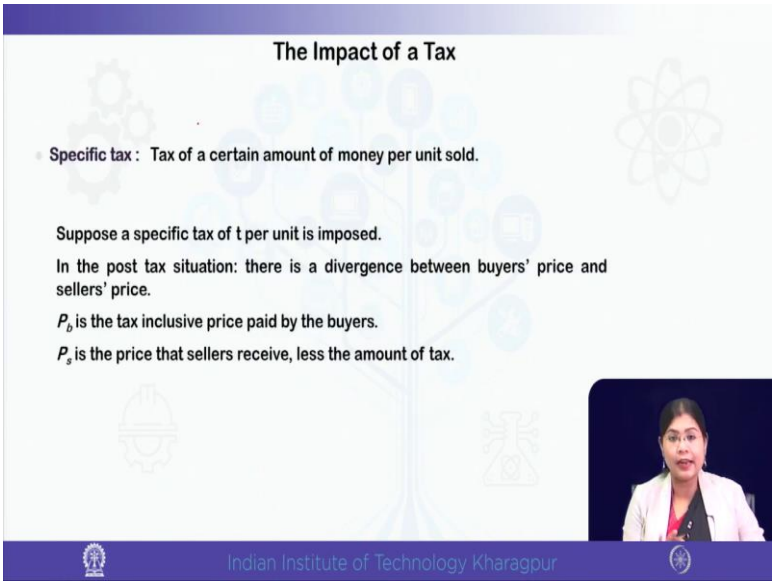

Now, we will be discussing about any intervention, so to start with we will be discussing about tax policy. Now, taxation can be of different types because you may be knowing about income taxes or we also know about the GST, the goods and services tax or the value added tax (VAT).

But I am not also going into that detail, so you can study more about taxes in other courses we have direct tax and indirect tax we will be considering a very simple example of what we call a specific tax or per unit tax ok. So, it is a tax of a certain amount of money per unit of the amount transacted ok.

So, if we buy suppose 1 unit, so the consumer has to pay a particular amount of tax, say for example this is t per unit, so this is called a specific tax or even it is also referred to as a per unit tax. So, we are presenting the things in the simplest possible way, so that we are able to understand the post tax equilibrium situation and we compare with the pre and post tax situation and we judge that how the welfare is changing and which party is benefited which party is adversely affected in the domestic economy.

So, the purpose is just as simple as that so we are just following a very simple framework even within a direct tax we have different types of taxes like value added tax which is a tax on value of the transaction, but we are just restricting ourselves to the simplest possible case of a per unit tax. So, we consider the example that a specific tax of P per unit is imposed ok.

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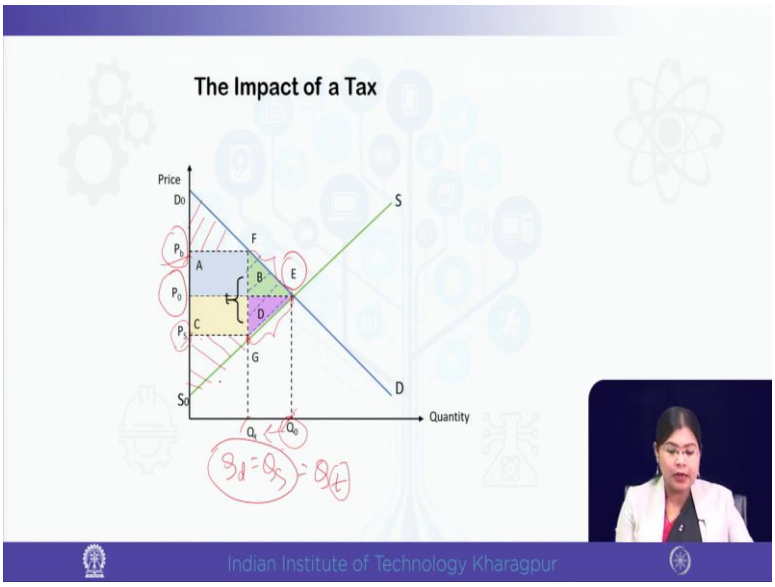

So, if we first start with the pre tax situation; so pre tax situation is simple the way we have already defined. So, the equilibrium is arrived at the intersection of demand and supply curve, so we have the equilibrium at point E, where the demand curve DoD and the supply curve SoS intersect each other. So, the corresponding price is P0 and the quantity transacted is Q0 ok.

So, this is what we already have studied. Now, suppose we bring a third party say the government which is imposing a specific tax of t per unit of transaction. So, how the equilibrium changes in the post tax situation? Now, you see in the before tax situation to

buy the amount Q0 the demand maximum willingness to pay a price, but the consumer is P0 ok and to buy the amount Q0 the minimum price charged by the seller is also P0.

So, or we can also interpret that at the price at the equilibrium price P0 the quantity demanded is Q0 which is also equal to the quantity supplied at the price P0 therefore, we have already defined equilibrium to be a situation where the plans of all economic agents get realized no one has an incentive to deviate.

Therefore, if the price is P0 the consumers want to buy output Q0 which is exactly equal to the amount that the producers would like to sell. So, the purchase plan of the buyer is equated with the selling plan of the seller at the ongoing market price P0, but now with a tax we will be seeing the first point of departure is that now there will be a divergence between the demand price and the supply price, why?

Because what happens with a tax we already know that when a tax is imposed we have to pay a high price the consumers the price that the consumers are now paying increases ok, but who is collecting the tax the consumer is paying the high price not directly to the government like this happens for other taxes like say for example, income tax, but in this case the consumer is paying the tax to the producer who is again paying the tax to the government right.

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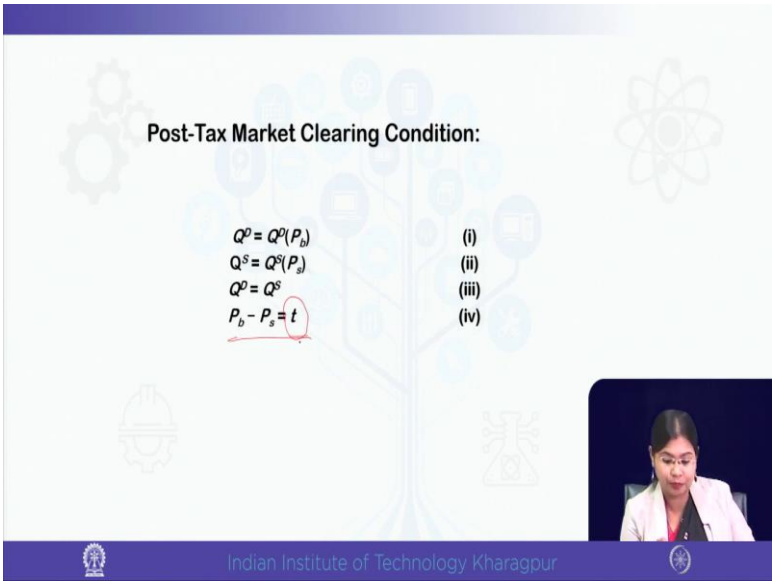

So, this high price of the tax is paid by the consumer, but a burden of the tax also falls on the producer right. So, now, there is a divergence between the demand price and the supply price because the government is collecting this specific tax from the producers. So, the net price or the tax inclusive price that the producer receives is also less than the equilibrium price P0.

So, now we see that there is a divergence between the demand price which is now Pb, the demand price exceeds the free market price that is P0. So, Pb is greater than P0 and the supply price now becomes in the post tax situation it is Ps which is less than P0. So, we see that the demand price and the supply price they differ. They differ by which magnitude? You see now the equilibrium conditions I have written over here the post tax market clearing condition; the demand price exceeds the supply price by exactly the amount of tax rate ok.

So, Pb minus Ps is exactly equal to the tax rate. So, what are the equilibrium conditions now? The equilibrium condition is that QD is now found out at the price Pb and Qs the quantity is supplied is found out at the price Ps and at the corresponding tax rate t is formulated in such a way that the gap between the demand price and the supply price is exactly equal to the tax rate and what about the quantity?

The quantity is also such that in the post tax situation we can find out from this graph you see the demand price is Pb in the post tax situation now look at the demand curve at price Pb what is the quantity demanded? We can see that the quantity demanded at price Pb is a Qd and also you see what about the quantity supply because the post tax supply price is Ps. So, we can see that the quantity supply at the post tax supply prices from the supply curve SoS we can find out it is Qs.

Now, it aren't these the same quantities? So, at the demand price we find out from the demand curve that at price Pb the buyers want to buy the amount Qd and at supply price Ps the sellers want to sell Qs such that Qd is equal to Qs is equal to Qt. What is Qt? Qt is the post-tax quantity transacted. So, you see I have written the post tax situation using this subscript t ok.

So, if we go back to this conditions; that means, the policy maker or the government has to find out the tax rate in such a way that the quantity demanded in the post tax situation should be exactly equal to the quantity supplied in the post tax situation because in the

post tax situation no longer the demand price and the supply prices are same. There is a gap between the demand price and supply price because the consumers are now paying a higher price and the sellers are receiving a low price.

So, the policy maker is calculating the tax rate in such a way that again the plans of the economic agents are realized, but for two different prices. So, again you see this is also an equilibrium. So, you can think that you may think that this how can this be an equilibrium because we do not have any one price right, because in the P pre tax situation we have the equilibrium at point E quantity transacted was Q0 and price was P0.

Now, what happens in the post tax situation? The quantity transacted is Qt, but what about the prices? The prices are different Pb and Ps. So, how can this be the equilibrium? Yeah, this is the equilibrium why? Because again at this quantity Qt the demand price exceeds the supply price, but you see the plans of the economic agents are realized because at the higher demand price we know by law of demand what happens if price increases quantity demand at falls by law of supply if price falls quantity supply falls.

So, by the laws of demand and supply we can conclude that if the buyer has to pay high price the buyer is now willing to buy less. So, quantity demanded by the buyer falls from Q0 to Qt and for the seller side also if the sellers are receiving a lower price they are now willing to sell less. So, at the supply price Ps quantity supply also falls to Qt.

Therefore, the policy maker is finding out the tax rate these two conditions the last two conditions are very important the policy maker is finding out the tax rate in such a way that in the post tax situation the quantity demanded should be equal to quantity transact supplied therefore, this is also an equilibrium. We can now say that the post tax situation equilibrium is output Qt and with two prices Pb and Ps such that Pb minus Ps is equal to t.

So, this is very important, the gap between the demand price and supply price should be exactly equal to the tax rate otherwise the plans will not be realized. So, the policymaker has to keep on changing the tax rate until and unless the quantity demanded by the buyer is equal to the quantity supplied by the seller in the post tax situation. So, this is the post tax equilibrium again that is an equilibrium ok.

Because you can see that no one has an incentive to deviate right because at the higher demand price quantity demanded is less which is again equal to the less quantity supplied at the lower supply price. So, neither the buyer nor the seller has any incentive to deviate from this situation. Now, let us analyze what is happening to the surplus or the welfare.

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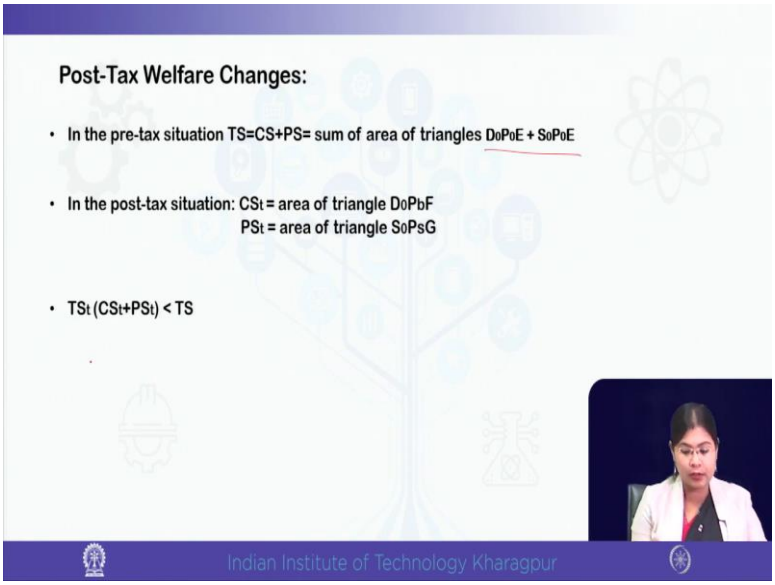

So, pre tax it is pretty simple we can find out the pre tax welfare situation which is the sum of consumer and producer surplus. So, you can see that the consumer surplus is DoPoE and the producer surplus is SoPoE. The post tax situation what happens? The post tax we have denoted the consumer surplus and producer surplus and the total surplus using the subscript t; t stands for tax.

So, we can calculate very easily now that the consumer's surplus falls ok. The new consumer surplus is DoPbF and the new producer surplus is SoPsG. Now why are they falling?

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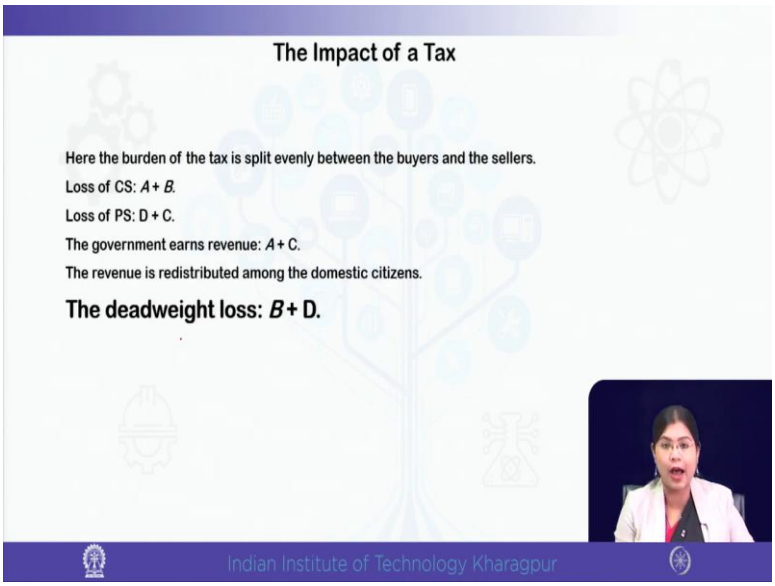

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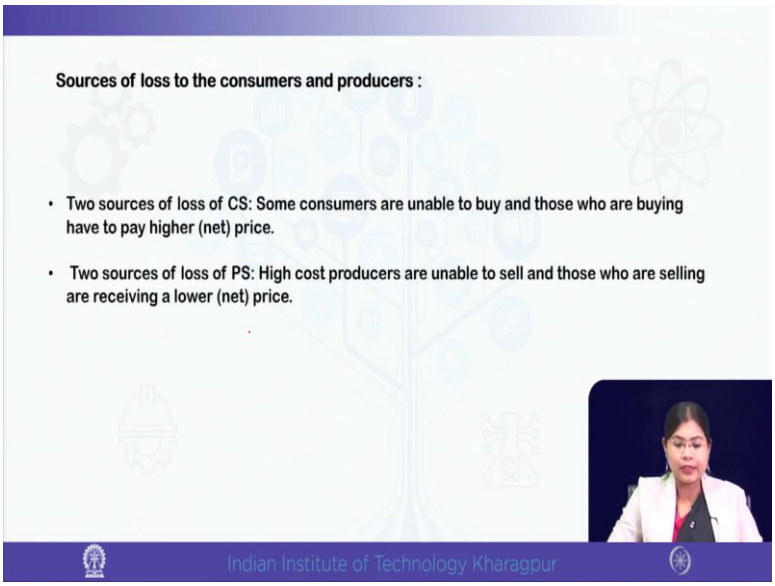

So, in the consumer side we can see that there are two sources of loss of consumer surplus why? If we go back to this figure, we see that in the pre tax situation the consumers were buying up to quantity Q0 and for each unit they were paying the price P 0. Now, in the post tax situation we can see that quantity transacted is falling right.

So; that means, if we look at the demand curve DoD we can see that the consumers in the range Ef of this demand curve they are not able to buy the good anymore because their maximum willingness to pay prices are less than the demand price Pb.

So, now, these consumers beyond the output Qt are not able to consume the good. So, some consumers are now outside the market they are not able to consume the good and those who are buying what is happening to them? Earlier they were paying the price P0, but now those who are buying they have to pay the higher price Pb therefore, we can say that there are two sources of loss of consumers are plus because now some consumers are outside the market.

So, if it is a necessary good the consumers are not able to buy that good and those who are buying they are paying a higher price therefore, the gap between the maximum willingness to pay price and the equilibrium price for the consumer now it is less. So, this is the reason for loss of consumer surplus.

Now, what about the producers? For the producers also we can see that earlier the producers up to output Q0 were selling in the market now what is happening? Now, we can see that the relative high cost producers who are in the range of Ge of this supply curve S0S they are not able to sell the good in the market because their minimum price to sell the good in the market exceeds the supply price Ps. So, these relatively high cost producers are now outside the market.

So, some producers are not able to sell the good and what about those producers who are selling the good? Now, you see those producers who are selling the good they are receiving a lower price why? Because earlier they were receiving the price P0 now they are receiving a lower price Ps therefore, producer surplus being the gap between equilibrium price and the supply curve that also falls.

So, you can see that the total surplus in the post tax situation the total surplus in terms of the consumer and producer surplus in the post tax situation is less than the total surplus in the pre tax situation, but that is not the end of the story why? Because as I mentioned towards the beginning of today's class that we have a third party apart from the consumers and producers.

So, we have the government who is implementing the tax policy. So, for each unit of transaction we assume that the government is imposing a tax of t unit right, which is given by the gap between Pb and Ps. So, what is the total amount of tax collection? So, we can see from this figure that the total amount of tax collection will be per unit tax t

into the total quantity transacted Qt. So, in graphically we can see that this area of this rectangle ACFG will be the revenue collection ok

Now, generally we see what we see that the government collects the tax revenue and the government spends back the tax revenue in terms of different welfare projects or creating the infrastructure in the economy. So, we are assuming that the tax revenue collected by the government is again spent back on the domestic citizens and the domestic citizens include both the consumers and the producers.

Because when the government is creating infrastructure, the producers are also benefited the government can give a subsidized loan or the government can give fertilizer, pesticides or can disburse different advantages to the producers giving incentives to the producers and for the consumers of course, the government is providing education health, lot of the government spends on lot of social welfare schemes.

So, the revenue collected by the government is again coming back to the consumers and producers. So, we can see that this area of the tax revenue collection it is then getting cancelled out from the loss of consumer and producer surplus ok. So, now, we have the new consumer and producer surplus CST plus PST and this area ACGF is getting cancelled out because first it is as if suppose if you take the loss of consumer surplus, so it is as if first the consumer surplus is going to the government, but then again a part is coming back to the consumers.

Same thing is happening with the producers also the government is collecting the tax rate, but again is spending back to the citizens therefore, we see that a part of the loss of consumer and producer surplus is compensated in terms of the revenue collection. But finally, if we compare all the three elements; that means, the consumer surplus producer surplus and the revenue we will see that we will be left with some amount of net loss right because we can see that this area of this say rectangle A; A is redistributed from the consumers to the government again it is going back to the consumers.

Now, you see the area of the rectangle C same thing the area of the rectangle is going to the producers to the government and again it is coming back to the producers. So, these areas are getting cancelled out, but what about the two triangles B and D this is not compensated. So, the sum of the area of the triangle B and D are not compensated right

so; that means, even after we redistribute the tax revenue from the government to the domestic citizens we are left with some net loss.

So, this net welfare loss has a particular name in economics that is called the dead weight loss. So, the dead weight loss is the net loss of total surplus sum of consumer and producer surplus. So, the we can see that in the post tax situation the consumer and producer surplus falls even though the government earns a revenue, but the loss of consumer and producer surplus is greater than the amount of revenue collection. So, finally, we are left with a net loss which is given by the sum of the area of the triangle B and D.

So, area of the triangle B is due to the loss of consumer surplus for the reason we have already discussed and the area of the triangle D is due to the loss of producer surplus. Because now the consumers and producers are not able to buy and sell the previous quantity, the consumers are paying a high price the producers are receiving a lower price therefore, there is a net loss which is a welfare loss.

Now, you see in this figure the way we have drawn the demand and supply curves they are more or less unit mean similarly elastic. So, it is as if the total dead weight loss or net welfare loss is divided between the consumers and producers equally; however, it may not always be the case.

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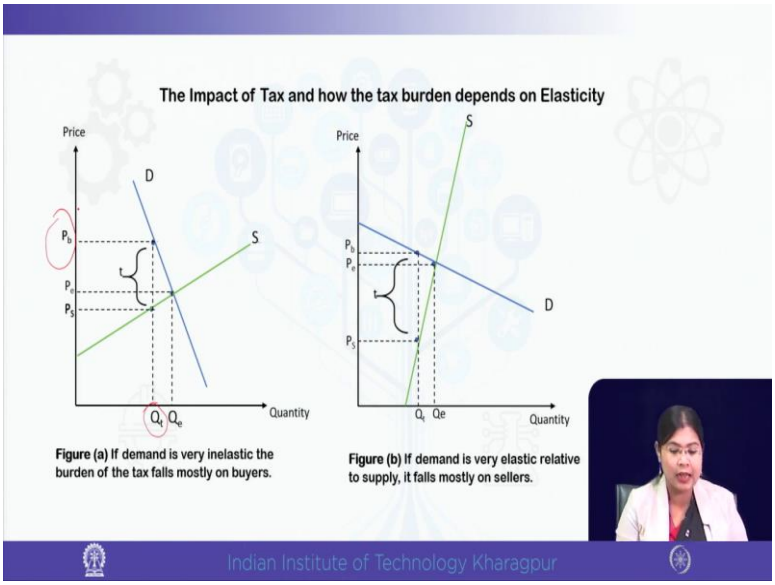

It may not so ideal a scenario because now if we draw different types of demand and supply curves. Let us say suppose if we consider the left hand side figure we have drawn the demand curve is quite inelastic compared to the supply curve and inelastic demand means now we can see that in the post tax scenario if the government is imposing tax rate of t per unit we see that the demand price exceeds the supply price by the amount of tax.

But now if we compare the demand price with the equilibrium price we see that Pb minus Pe is much greater than the extent to which the Pe exceeds Ps so; that means, what; that means, when demand is highly inelastic the extent to which the demand price exceeds the equilibrium price is much greater than the extent to which the supply price falls below the equilibrium price.

So, what is the implication? Implication is that you see again it is a post tax situation quantity transacted is less Qt, but now what about the distribution of the burden of tax between consumers and producers now we see that a greater burden of the tax falls on the consumers why?

Because the demand price exceeds by a much higher extent as compared to the fall in the supply price why is so? Because demand being inelastic the producers are able to sell pass on the burden of the tax to the consumers because the producers know that since demand is inelastic the consumers will have to pay for the good.

They will reduce the quantity price increases, but it will be more less than proportionate reduction because demand is inelastic. So, we can think of examples of necessary good like medicine or say goods of addiction like alcohol or cigarette and more importantly for our course petroleum products.

So, we have already discussed about the indispensable nature of petroleum. So, petroleum being inelastic we have already shown with empirical evidences that in retail price of petrol the importance of tax is very high. In many of the countries we have seen including the advanced countries in retail price even the crude oil price is less than the tax rate. So, tax rate is a greater part of the high retail price of petroleum products.

So, we can see this the rationale from this figure ok. So, that is why it is so important for our purpose the tax policy. So, you can see that the distribution of the tax burden depends on the elasticity of demand and supply. So, if demand is inelastic a greater burden of the tax falls on the consumers like in the case of necessary good.

In the right hand side figure we, so we represent a case where the supply is relatively inelastic and here we can very easily see that the greater burden of the tax falls on to the producers because the supply price falls by a greater extent from the equilibrium price than the extent to which the demand price exceeds.

But to be very specific or if we look at examples from reality we have less type of these type of taxes because often we see that the producers are lobbied or in imperfect competition the producers have significant market power, but consumers are mostly perfectly competitive.

So, in reality we do see the taxes mainly which are having inelastic demand. So, higher tax rates generally fall on the products with inelastic demand this is one rationale, so the government can earn stable revenue from the products with inelastic demand.

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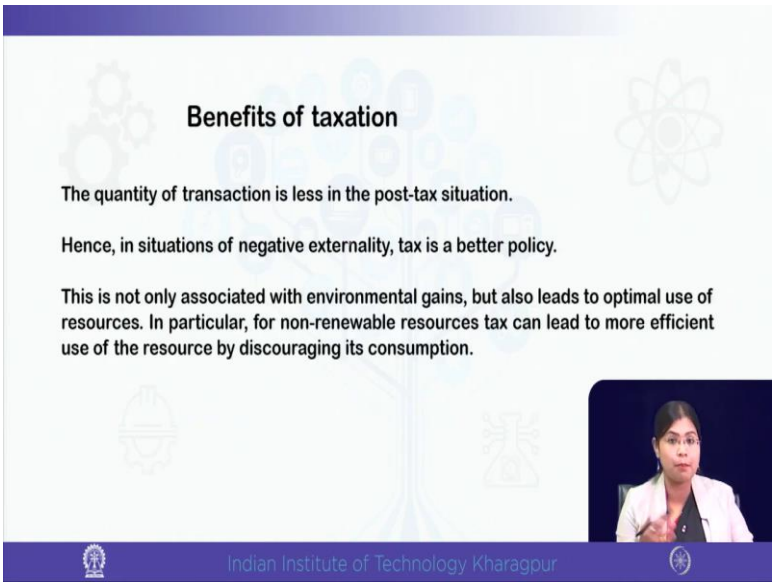

So, example include petroleum products as well, but the other benefit of taxation is as we discussed in the last lecture also that tax can reduce the quantity of transaction as you can see. That in the post tax situation because the demand price is greater the consumers' willingness to buy the good falls at a lower supply price the producers are willing to sell less.

Therefore, what happens? The quantity transacted settles below the free market level and this is good for the economy also if the good the product under consideration leads to say environmental pollution like greenhouse gas emissions in the case of fossil fuel. So, since the tax discourages consumption therefore, the quantity of transaction can be limited, it is also very important from the point of view of sustainability suppose when you consider non renewable resources.

So, if we are using the resource at a faster rate we will be running out of the resource. So, if we want to limit the consumption of resource we can discourage that by putting higher tax rate on such exhaustable or non-renewable resource. So, we can see that taxation policies are beneficial not only for the government as a reliable sources of revenue.

But also in cases of negative externality when the industry or the product generates a lot of pollution on greenhouse gas emission and from the point of view of sustainable use of resource. If we think that we should stretch the use of the resource we should not run out

of the resource tax will be a much better policy to discourage the consumption and limit the use of the resource for future consumption ok.

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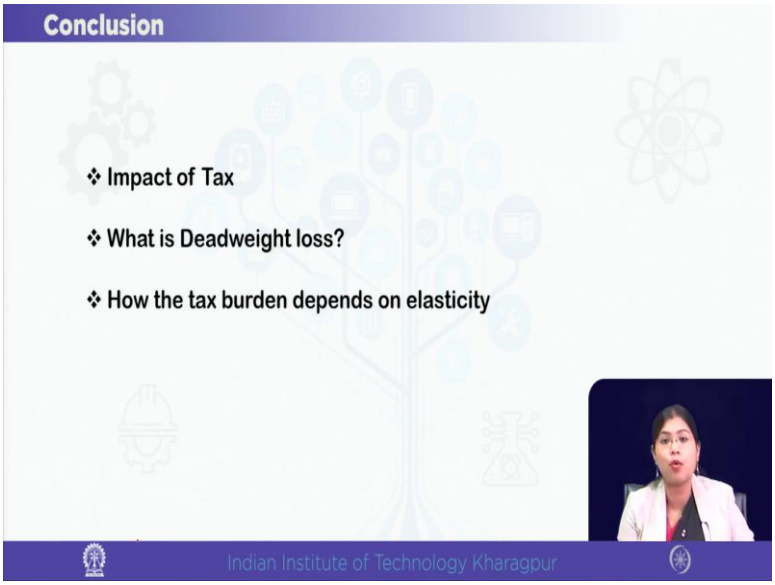

So, you see that tax policies are very important for our purpose. So, in today's class we have discussed about what happens to the market outcome after imposition of tax. So, we have discussed about the net welfare loss and then we discussed about the distribution of the tax burden between the consumer and the producer and we see that how the tax burden varies inversely with elasticity of demand and supply.

And we do see in reality more of such taxes where demand is inelastic. So, that is not only a good source of revenue collection, but it actually reduces or discourages the greater consumption of the good which may be beneficial for environmental perspective and from the perspective of sustainable use of resources.

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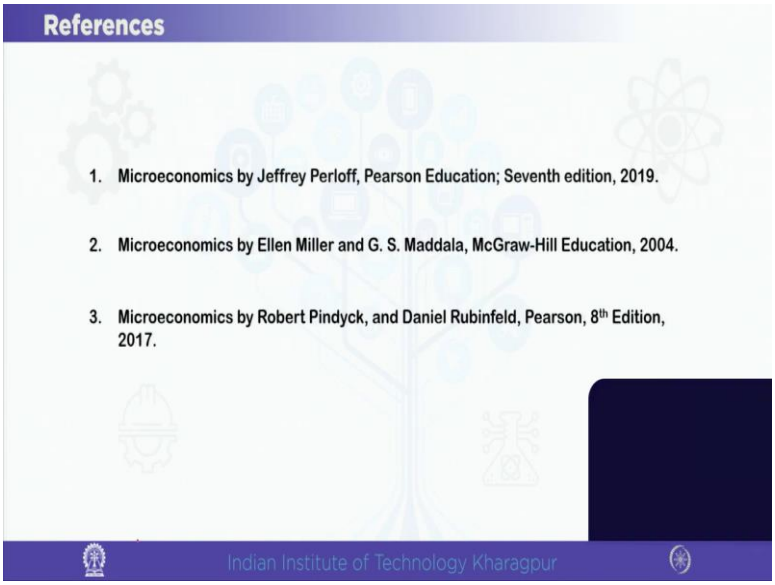

So, with this I finish today's lecture.

Thank you very much see you in the next class.