Environmental and Resource Economics
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Lecture 26
Incentive Design Under Uncertainty and Effectiveness Part 2

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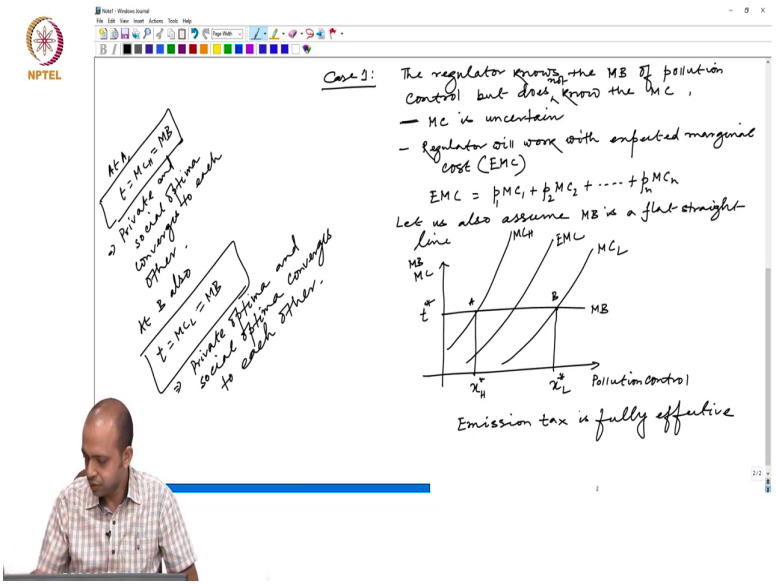

Now, instead of assuming a flat straight-line curve, let us now assume that MB curve is a downward sloping which is the standard case. MB curve is downward sloping.

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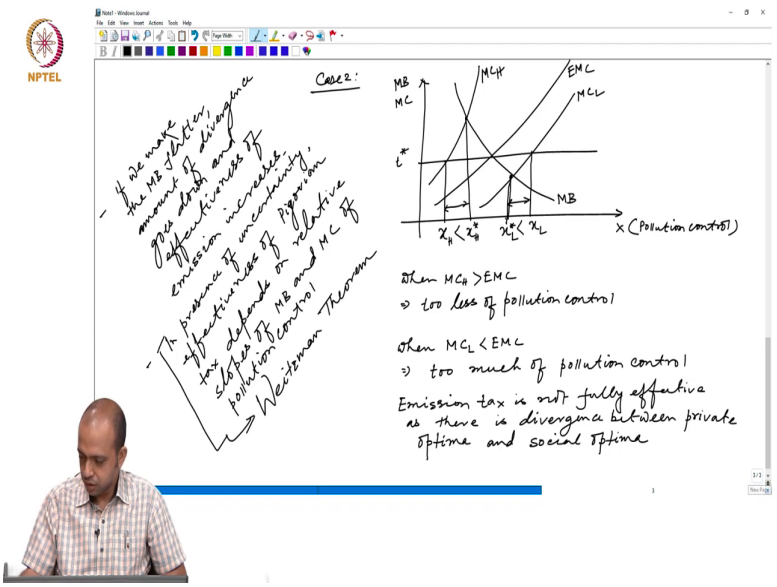

This is case two. So, this is MB this is MC this is x which is actually pollution control. So, let us say that this is now the MB curve, which is steep downward sloping curve and this is the MC, which is expected marginal cost and the intersection will give you the optimum tax rate. So, first step is to decide when we are analysing these alternative cases, that means, one thing you have to keep in mind that first to decide about MB and then expected MC, an intersection between EMC and MB will decide about the optimum tax rate that is the first step.

Then we will assume the actual marginal cost. Let us now, this is this is higher than the expected one, let us say that this is this is MCH. Where is the private optima? Private optima is decided by T equals to MC so, that means, this is private optima, let us say this is denoted by xH. Where is the social optima? This is the social optima, where MB equals to MC is achieved.

So, this is called x dot H. So, that means, we can see that x star H is actually greater than xH. So, while society demands x star H amount of pollution control by equating MCH with MB private polluting form is willing to supply only xH amount of pollution control by equating t equals to MC. So, that means, there is a divergence between what the society wants and or the private polluting form is supplying.

So, that means, what we can say when MCH is actually greater than the expected marginal cost then What is happening? Private polluting firm is supplying less pollution control than what the society want. So, that means, too less of pollution control. But if this is lower than this let us say this is MC low then what is the private optima decided by T equals to MC?

This is called let us say xL. But how much does the society wants? Society wants this much by equating MB equals to MC, this is let us say x star L. So, that means, private firm is supplying more pollution control then, what is socially desirable. So, that means that we can see when MCL is actually lowered than lower than EMC, too much pollution control.

Now, if you recall yesterday. We discussed neither too much of pollution control nor to less of pollution control is socially desirable because too much pollution control means, we are actually diverting some part of our productive resources for pollution control which otherwise would have been used for production purpose or some other purposes which the society wants. So, one thing is clear that in this case, there is a divergence between private optima

and social optima in both the cases when MC is higher than MC, when MC is lower than the MC.

So, that means, when MCH is higher than the EMC, what the society is doing actually, what does private firm is supplying less pollution control than what the society wants. When this is lower than what we expected then the private firm is supplying more pollution control than what the society wants. So, emission tax is not fully effective as there is divergence between private optima and social optima, there is divergence.

So, ineffectiveness is measured by this distance this is the measure of divergence and this is the measure of ineffectiveness. Now, if I make the MB a little flatter then what will happen? If we make the MB flatter then what will happen? The divergence will go up or come down? From the simple geometry itself you can understand if you make this curve little flatter then those degrees of divergence will go down actually.

If we make the MB flatter amount of divergence goes down effectiveness of emission tax increases and if you keep on rotating this MB curve clockwise, then what will happen? At the extreme case it will again become flatter I mean the flat straight line and emission tax rate again will become fully effective.

So, that means from here one thing is clear in presence of uncertainty effectiveness of Pigouvian tax depends on the relative slopes of MB and MC of pollution control and this is known as Weitzman theorem because Martin Weitzman, he was the first person to suggest this proposition, this is called Weitzman theorem, W e i t z man theorem.

When there is uncertainty effectiveness of emission tax or Pigouvian tax depends on the relative slope of MB and MC curve. When the MB is flat straight line, then it is fully effective when it is steep downward sloping curve then it is not fully effective there is divergence and if we make the MB curve flattered, if we rotate the MB curve clockwise then again, the divergence goes down effectiveness increases and again at the extreme when it again becomes the flat straight line the emission tax become fully effective. So, it all depends on relative slopes of the MB and MC of pollution control. Now, in case three we assume that the regulator knows MB curve with certainty sorry MC curve with certainty, but MB is unknown what will happen?

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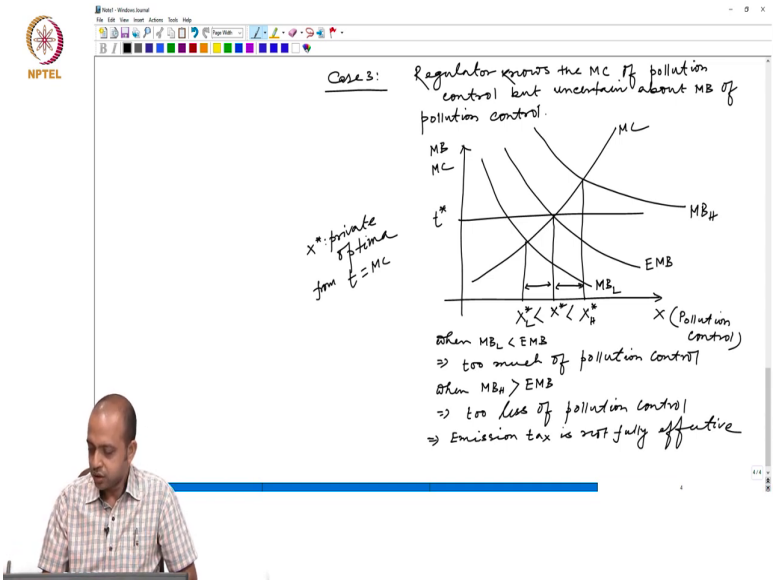

This is case three, regulator knows MC of pollution control but uncertain about MB of pollution control. So, what would be the diagram in this case? So, this is MB in the y axis we are measuring MB and MC this is x which is pollution control. So, regulator know MC with certainty let us say that this is our MC but uncertain about the MB.

So, that means regulator will work with expected MB. So, let us say that this is our expected MB, EMB. So, again the intersection will give the tax rate. So, to analyse this case, so, what you need to do? First step is to decide always about the tax rate, optimum tax rate. Let us now suppose that the actual marginal benefit is lower than what we expected. So, this is the marginal benefit.

This is MB let us say lower. So, where is the private optima? Private optima is decided here t equals to MC so, this is actually this is let us say x star where is the private optima? t equals to MC where is the social optima? MB equals to MC so, that means it is here. This is let us say x star with L. So, what the society wants is actually lowered than what the private player is supplying.

So, when MBL What do you can say when MBL is actually lower than EMB then too much of pollution control. Because society wants x L star, but private player is supplying here t equals MC. So, too much population control. Similarly, if the marginal benefit is higher than this is let us see MBH. So, society wants this much pollution control but private player is supplying here.

So, that means when MBH marginal benefit is actually higher than the expected marginal benefit then, too less of pollution control. So, here x star indicates actually x star indicates the private optima. So, here x star is private optima. How it is decided? From t equals to MC. So, that means, this is just the opposite of what we did earlier when MC is downward sloping you can compare these cases.

So, these cases are very simple and logically you can analyse all these cases step by step first you draw your MB and MC depending on which is known which is unknown. Then next you decide about optimum tax rate then you draw your actual MC or MB depending on the assumption and then you try to derive the private optima by the by equating t equals to MC.

Social optima by equating MB equals MC and then you see whether the socially desirable level of pollution derived from the MB equals to MC condition is higher or lower than the private optimal level of pollution control, which is decided by t equals to MC, and depending on whether social optima is higher than the private optima, we will get either too less of pollution control or too much of pollution control, but both are equally undesirable for the society as we have decided earlier, that is the case.

So, these are the alternative three cases by which you can very well understand that importance of Weitzman theorem. So, when there is uncertainty either with MB or with MC effectiveness of emission control depends on the relative slopes of marginal benefit and marginal cost of pollution control. So, this is basically here also you can say that emission tax is not fully effective, when there is uncertainty here also it is not fully effective because there is divergence. This is the divergence amount. And again, if you make MB curve flatter, so that divergence will change and you can decide what will happen actually. Now, the next question what we are going to ask.

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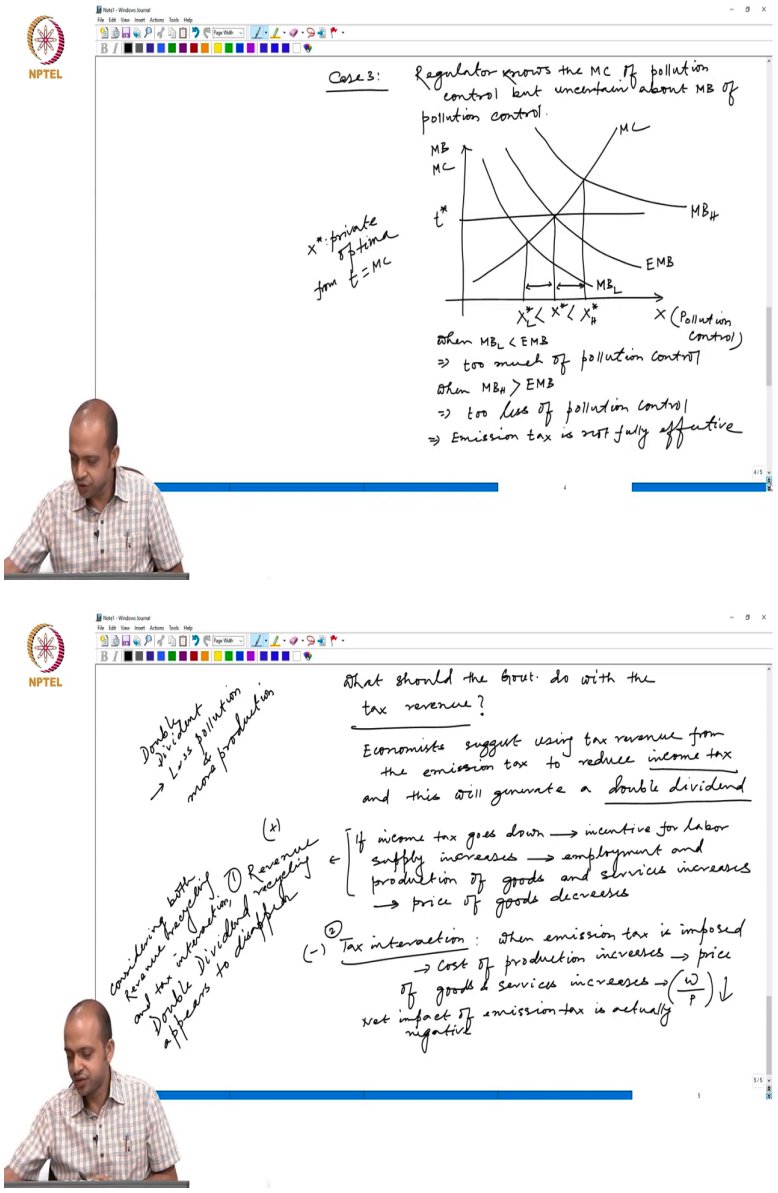

We understood that when there is uncertainty that means, when there is uncertainty about this, the effectiveness depends on relative slope, but the next question is what the government should do with the revenue generated from this emission tax? This is a relevant question. So, far we have discussed about the effectiveness of emission tax next question that naturally comes to our mind, government imposes some emission tax on polluting firms and thereby government will generate some tax revenue.

Now, what should the government do with this tax revenue? What should the government do with the tax revenue? Now economists, they suggest that this tax revenue should be used in other areas, such a way that society's reliance on tax revenue from some other sources goes

down. So, economists they suggest using tax revenue from the emission tax to reduce let us say income tax.

Because anyway government require revenue from taxation because taxation is the biggest source of revenue. So, when government is getting some amount of revenue from this emission tax, why not reducing the income tax rate, income tax rate. Now, why income tax rate and this will generate a double dividend.

Now, how does this double dividend work? This double dividend works here the mechanism is this, if income tax goes down that gives the labourer to work more. When my income tax is less, I have an incentive to work more. Apart from my regular work. Suppose I am working here in IIT Madras. I have now an incentive to teach in IIM Bangalore or IIT Tirupati or some other organizations.

If I see that income tax is less, I have an incentive to supply more labour. So, when income tax goes down, incentive for labour supply increases. Labour supply increases. And when labour supply increases, then employment increases. And production of goods and services increases and as a result of which price of product decreases. So, this is called revenue recycling.

I am getting revenue from this emission tax, I am using the revenue for some other purposes, but to reduce the tax rate for income tax rate that gives more incentive for the labourer to work more, labour supply increases employment will increase and production of goods and services increases this is called revenue recycling effect. So, my pollution is going down employment and goods and services increasing that is why it is called double dividend; why it is called double dividend?

By imposing emission tax firms are reducing their pollution, pollution is coming down and there is more production of goods and services. So, double dividend implies less pollution and more production but another group of economists, they say that, this emission tax it has another effect also which is called tax interaction effect, what is this tax interaction?

When emission tax is imposed, what will happen? That will lead to increased production cost, which is very simple. If you impose tax cost of production will increase and when cost of production increases as I discussed yesterday, that the firms will try to bypass some amount

of this cost extra cost on the consumer which is called incidence of taxation, which we have already studied in our microeconomics or Principles of Economics.

That means when a tax is imposed on the producer, the entire tax burden is not borne by producers. What they will do, they will try to bypass some amount of this tax on the consumer as well. How much they will bypass? That means what would be the exact tax sharing that depends on the elasticity of demand and supply. If the consumers are highly elastic, then the producers would be able to bypass less amount of the tax.

If the consumers are less elastic consumer producer will bypass a large amount of that tax burden. Whatever might be the case, what I am saying here, some part of this extra cost of production due to emission tax, will go to the consumer as well that means price of goods and services increases and when price increases, what will happen to relative wage?

That will go down. So, initially when the tax was imposed, and that tax revenue was used to reduce the income tax rate, we say that that is very good for the labourer, because I am earning more by supplying more labour, but in real sense, what is happening after the imposition of tax, the price of goods and services also increased. So, when the laborers are actually calculating the real wage, which is W by p that is going down.

And economists they say that if you calculate the net effect, so, that means this is the revenue recycling is the positive effect. And here it is a negative effect on the wellbeing of the laborers that means, wellbeing general social welfare and economists they say that net impact of emission tax is actually negative. So, when you consider both revenue recycling and tax interaction effect considering both revenue recycling and tax interaction and double dividend actually.

So, what I am saying that when you consider the revenue recycling and tax interaction effect, then, this is double dividend is actually appears to disappear, this double dividend or what the economist said earlier, what the economists they suggested the double dividend actually appears to disappear when we consider this revenue recycling and tax interaction effect. And this again points out to the famous story of second best.

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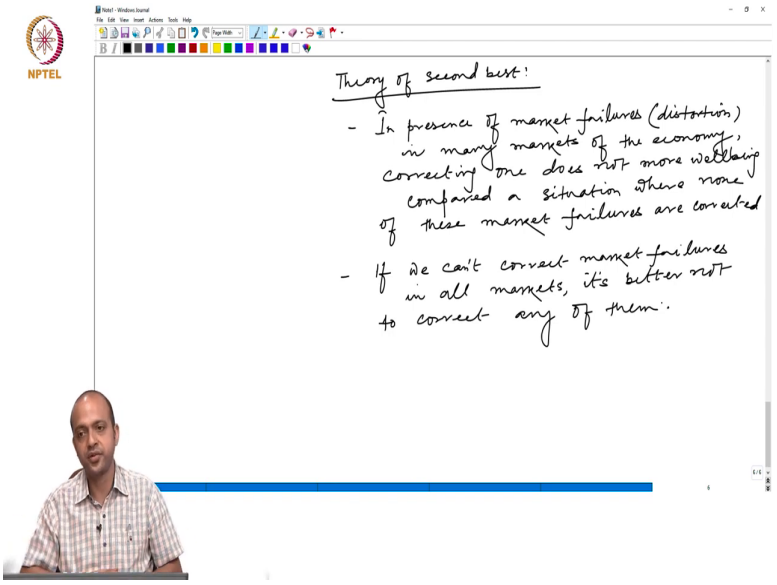

What is that? Theory of second best. What it suggests when there are many distortions in the economy that means, when the labour market is distorted, goods market is distorted it does not generate more wellbeing when we correct only one type of market failures so, basically what it says?

In presence of market failures or I will say distortion in many markets of the economy correcting one does not generate more wellbeing compared to a situation where none of these market failures are actually corrected. That is called theory of second best, what, why it is called second best because first best is correcting all type of market failure if there are n number of markets in the economy, first best solution is correcting market failure in all n such markets in all n markets.

If that is not possible, sometimes we may feel let us correct market failure in one on two that is what we are trying to do here there is market failure in capital market, there is market failure in labour market, there is market failure in goods market. So, we are trying to correct market failure let us say here in one goods market by imposing emission tax, thinking that will generate more wellbeing.

But economists they proved actually by taking this revenue recycling and tax interaction the net effect is negative. So, if you cannot correct all let us not correct any of them so, that they will counterbalance each other. So, they will counterbalance each other that is why we say that if we cannot correct market failure in all markets it is better not to correct any of them.

This is called theories of second best in presence of market failure in all so many markets. It is better not to correct any of them if you cannot correct them all. That is called theories of second best so that means from this entire discussion one thing is very clear, public policymaking is not very straightforward. Because in the economy, all the markets all the sectors are interconnected.

Doing something in one sector by a partial equilibrium framework may not result in general wellbeing more general wellbeing, we need to discuss everything in a general equilibrium framework thinking all the markets are interconnected. Imposing any policy in one market will have impacts on all other and then we need to decide about the net impact before we actually implement a policy in a particular sector. That is how the emission tax rate even though we thought of generating double dividend, it is actually not the case when you consider both revenue recycling as well as tax interaction. Thank you.