Environmental and Resource Economics
Professor Sabuj Kumar Mandal
Department of Humanities and Social Sciences
Indian Institute of Technology, Madras
Lecture 27
Incentive Design Under Uncertainty and Effectiveness Part – 3

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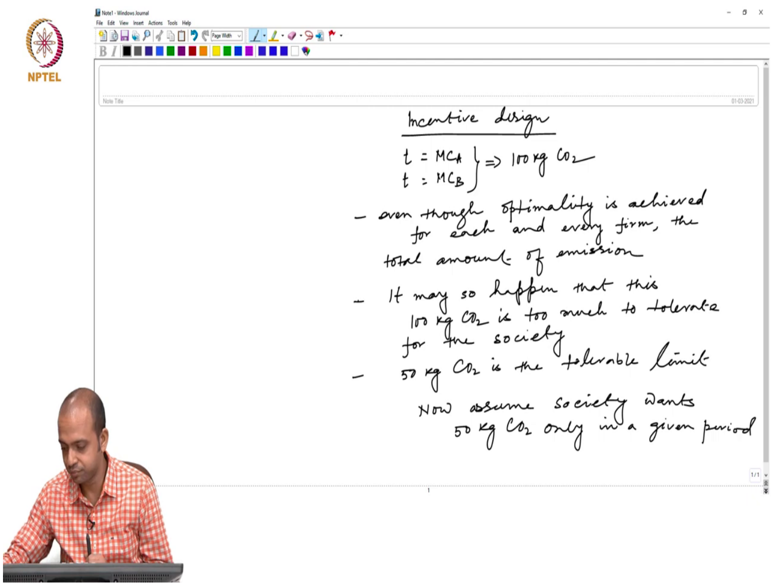

So, welcome once again to our discussion on incentive designing for pollution control. And in our last class, we were talking about effectiveness of emission charges. And then we assumed three alternative cases, we said that when the regulator is uncertain about marginal cost of pollution control, but the marginal benefits is known, then and if it is a flat straight line then its fully effective.

However, when the MB curve is steep downward sloping, then there is a divergence between the private objective and the social objective and as a result of which the effectiveness of pollution charges goes down. Now, in this emission charge mechanism, what happens each firm, so, once again we are talking about incentive design only, we are still in this module incentive design. So, each firm is trying to equate her marginal cost of abatement with the tax rate. This is let us say marginal cost of abatement.

So, firm A will equate her marginal cost of treatment with the tax rate, firm B will also equate with this. So, that means, by doing all these each firm will equate their marginal cost of abatement with the imposed tax rate, and then they will decide how much to abate and how much pollution to throw it to the environment.

So, in this process, even though what happens in a emission charge, so, even though optimality is achieved, for each and every firm, what is unknown or what is uncertain to the policymaker, the total amount of emission. Each firm is trying to equate its own marginal cost of abatement with the tax rate, imposed tax rate to decide about its own pollution, and pollution control.

So, in this process, when all these firms in the industry, or let us all the firms in an economy, they exercise this type of activity equating marginal cost of abatement with the tax rate. Ultimately, how much pollution would be generated, that is actually unknown to the policymaker, because policymaker is not aware fully aware of the marginal cost of abatement.

It may so happen, let us say a particular tax rate generates 100 kg of CO_2 which was unknown to the policymaker at the beginning. When the policymaker designed the tax rate, it was unknown. Now, it may so happen that this 100 kg of CO_2 is too much to tolerate for the society. Is this fine?

How much total pollution would be generated due to a specific tax rate in an industry that is unknown to the policymaker at the beginning, when the policymaker is deciding about the tax rate. So, it may so happen that at the end, it will result in 100 kgs of CO_2 while the society can tolerate let us say, with only 50 kg CO_2 is the tolerable limit. So, that is a problem with this emission tax, end result is unknown.

So, let us now suppose that the society wants in a given period of time, society wants only 50 kgs of CO_2. So, that means, the tolerable limit is fixed. Then this emission tax is actually ineffective in that case, because how much total pollution that will result in for a specific tax it is uncertain. So, what to do in this case?

Now, assume society wants 50 kg of CO_2 only in a given period. So, when the tolerable limit or the total amount of pollution is fixed to start with, pollution charges or emission tax is not effective in that context. So, environmental economists, they have designed another mechanism to achieve this objective. what is that that is what we are going to discuss today.

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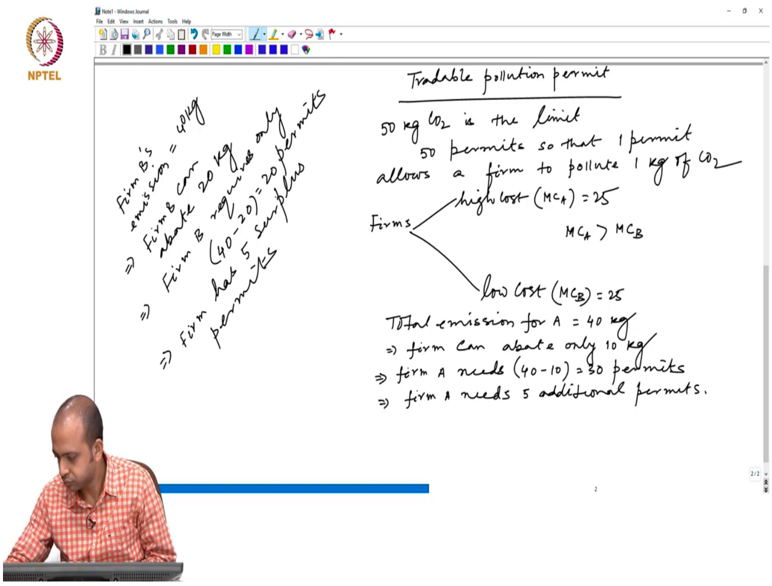

The other mechanism, the environmental economics or the design is tradable pollution permit. Now, from the name itself, it can suggest, that this is some kind of permit is given for the firms. This permit is given to the firms, for pollution, and then they are allowed to trade also these permits among themselves. What is the idea? Let us say that in a given period of time as we have assumed 50 kg of CO2 is the limit.

Alright, then the policymaker will assign, let us say 50 permits. So that, one permit allows a firm to pollute one kg of CO2. So, one permit is equivalent to emission of one kg of CO2. This is 50 permits in a given period of time a policymaker they have assigned. And then they will distribute among the firms. So, depending on their capacity, let us say that, there are two types of firm.

Firms are two types. One is high-cost and another one is low cost. I am talking about only cost of abatement, let us say that this is marginal cost A this is marginal cost B. So, we assume that MCA is actually greater than MCB. Let us say that there are only two firms A and B. And each of these two firms they are given 25 and 25 permits.

Now, since the abatement cost is higher for firm A, firm A would be able to abate only less amount. Let us say that total emission for firm A is actually 40 kg and firm A can abate only let us say 10 kg. So, that means firm A requires firm A needs 40 minus 10 equals to 30 permits, but firm A is assigned only 25. So that implies firm A needs five additional permits, from where these five additional permits will come?

Now, let us say that total emission for firm B is 25 kg and B can abate 20 kg. sorry, let us say that B can abate 5 kg sorry, 5 kg.

So, that means firm B requires only 25 minus 5 equals to 20 permits, or if you assume that let us say that firm B is also you might be thinking, let us say that both are equal size and they say that firm B is emission is actually to a same 25 kg sorry 40 kg but firm B since it is a low-cost firm B can abate, let us say instead of 10 let us say that 20 kg.

So, firm B required only 40 minus 20 equals to 20 permits but Firm B is having 25, So, that means, firm B has 5 surplus permits. Now, firm A and firm B they can trade they can interact with each other and then firm B says, look, I have five additional permits, if you want, I can sell it to you. So, they can sell it in the firm B can sell five permits to firm A, since the firm A is actually a high-cost firm.

So, that means, what the firms are doing policymakers job is only to assign total number of permits and allow these firms to trade with each other and result in efficient level of pollution that is the mechanism. Now, there are two ways by which the policymakers they can actually distribute the permits.

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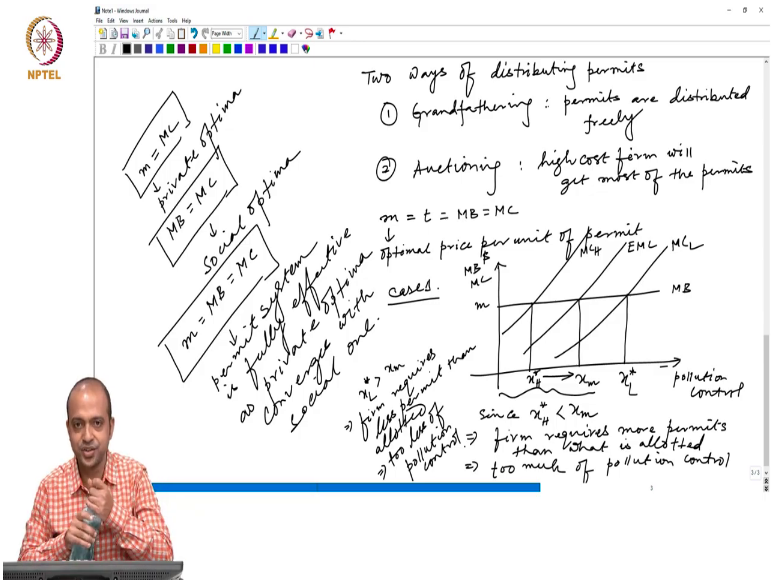

There are two ways of distributing permit. One is called grandfathering. What does it mean? It means policymakers acts like a grandfather of each and every firm. So obviously, when you are getting a permit firm your grandfather, you do not have to pay for it. So, permits are distributed freely. So, in this case, permits are distributed freely. And second one is called Auctioning and Bidding.

So, that means the policymaker will call all the firms to come for the auction and bidding and then highest bidder will get a permit. So obviously in that auctioning high-cost firm will outbid the low-cost firm, because if my cost of abatement is very high, obviously I will have more demand for this permit. If I am a low-cost firm, my cost of abatement is very low, I do not require that many permits. So, as a result of which I will only bid very less amount. So, in this case, high-cost firm will outperform will get most of the permits.

So, this is how this tradable pollution permit works. So, when the policymaker is uncertain about the total amount of emission and wants a fixed amount of emission to be tolerated in a given period of time, then instead of relying on a emission charge, policymaker will go for tradable pollution permit.

They will assign a number of permits depending on how much quantity of emission the society or the policymaker wants to get in and then allow the firms to trade their permits depending on their cost of abatement. So, high cost firm will require more permits, they will have excessive demand for permits, low cost firm will have surplus permits, they will trade the permit in the permit market and it will also result in the same type of situation what we have got in case of emission charges.

Now, the question is the way we discussed the three alternative scenarios about the effectiveness of emission charges, same way, we have to discuss about the effectiveness of tradable pollution permit when the policymaker is uncertain about the cost of pollution control, but certain about the benefit.

Now, if the information is perfect, policymaker is completely certain about marginal cost and marginal benefit. Then it can be proved that this m equals to t equals to MB equals to MC. What is m here , if t is the tax rate applying your analogy what should be m Can you think of? t is a tax rate then m should be the optimal price per unit of permit, that is m.

So, like the private optima m equals to MC is called private optima then MB equals to MC is social optima and then m equals to MB equals to MC if this is the condition then we will say that permit system is fully effective as private optima converges, with a social one, that is the case.

Now, let us say that this is our, in the y axis once again we are measuring dollar because you can measure marginal benefit and marginal cost of pollution control. And here we are measuring pollution control. So, the first case, in this case, policymaker is certain about the benefit, policymaker is certain about marginal benefit, which is again the flat straight line and uncertain about the marginal cost. So, as a result of which this is expected marginal cost.

And this is actually m the permit price and this gives you let us say number of permits. Now, in the x axis, we are measuring pollution control, how can I measure the number of permits also in the same axis, is it possible to measure number of permits as well as level of pollution control in the same axes? Yes, its possible.

So, that means let us say that this is the number of permits. So, if your level of pollution is more than Xm this level, then additional you have to abate or let us say that you can abate this much then additional is your requirement of permit whatever you may think , if you think that you have only this much of permit, so, any level of pollution which is higher than the Xm, you have to abate for that or if you feel you can abate only Xm level of pollution, then for additional pollution, you need more permit.

Now, that is the way we can measure pollution control as well as Xm in the same axis. Now, let us say that your actual marginal cost is actually higher than this, this is MCH, let us say that this is Xh star. So, here the firm will equate the permit price with the marginal cost and then will decide about the optimum level of pollution control and the level of pollution control the firm can abate only Xh star amount of pollution.

So, that means rest of the thing for rest of the pollution the firm require permits. So, from this since, Xh star is less than Xm, what is the intention then? firm require more permits than what is assigned. Firm require more permits because this is the area beyond Xh star the entire right-hand side is the amount of permit required but they are given only Xm. So, obviously this distance is higher than this distance.

So, firm require more permits than what is allotted, but at a given period of time once the permits assigned new permits cannot come in the market. So, what will happen then even though firm can abate only Xh star amount of pollution at optimal at equilibrium firm will be forced to move firm XH to XM.

Firm will be forced to abate more. So, that means, we are asking the firm for too much of pollution control. So, this will result in too much of pollution control. Now, if the actual marginal cost is lower, let us say this is MCl, then the firm can abate up to here, this is let us say Xl star and this rest of the amount only the firm require permits. So, firm requires less permit than what is required. So, since Xl star is actually greater than Xm, it implies firm requires less permit than allotted.

But once the permits allotted policymakers cannot take the additional permit back. So, what will happen even though the firm can abate up to Xl star, since the permits are already given firm will abate only up to XM, and for rest of the pollution, the firm will use the permits. So, that means, even though the firm has a capacity to abate up to Xl, they will abate only up to Xm. So, this implies too less of pollution control.

Now, if you compare this situation with the earlier emission charge, in case one when the marginal benefit was flat straight line, we said that emission charge was fully effective, irrespective of whether your marginal cost of abatement is higher or lower, for each and every cases t equals to MC and MV equals to MC was achieved.

But here since the permit system is not flexible like the emission charge system it that just the opposite is happening in this case. Permit once allotted, if there is a surplus, policymaker cannot take the additional permit back. Permits once it is allotted, if the firms require more additional permits cannot be given as a result of which when the MC is actually higher than EMC, then what is happening too much of pollution control.

I need more permit, but there is no supply, what I have to do? I have to have it move even though my optimality says I should stop only at Xh star. Similarly, when my marginal cost of abatement is lower than what I expect, I can abate up to Xl star and require very less amount of permit.

But amount of permit is fixed at Xm, already given so many permits, then why should I abate up to Xl? I will abate only Xm and therefore rest of the pollution I already have permits. So, two layers of pollution control in this case, so that means permit system is not effective when the marginal benefit is flat straight line.