Environmental and Resource Economics
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Effectiveness of Incentive design and Economic valuation of Environmental goods
and service Part – 5

Welcome once again to our discussion on environmental pollution and related policies. So far we were discussing about different types of externalities and related solutions, so that means basically we were discussing about how different market based instruments can actually solve the externality problem.

And then in our last class, we were discussing about how to measure environmental efficiency empirically, why we are discussing this? Because, in the context of porter hypothesis, wherein porter says that regulation, any type of regulation is not always bad as it was believed traditionally, rather if the regulation is properly implemented and well designed, then it can actually lead to innovation and thereby less amount of pollution with higher amount of output.

And then, we discussed how empirically we can test this porter hypothesis and even if such opportunity exist, whether we knew win-win opportunity which is a proposition of porter hypothesis will always result in pollution abatement or not. So, that means, when discussing about externality problems so far, what we assume that pollution is confined in a country where it is generated, and we have a national government who can actually impose some kind of emission tax or any other market based instruments in that sense to internalize the externality problem.

But, today we are going to discuss about transboundary pollution and global public goods, because many a times pollution generated in one country does not get confined in that country rather it travels to so many other countries without seeking any permission from them. And if the pollution is transboundary in nature, then whatever remedial measures the market this instruments we have discussed so far, they are not actually applicable.

So, that is why trans-boundary pollution requires a special attention, particularly in a context when we you all are concerned about global warming and climate change. Global warming

related climate change is nothing but a transboundary pollution problem. So, let us talk about them transboundary pollution and global public good in today's discussion.

So, this is transboundary pollution and global public good that we are going to discuss today. So, there is a saying that pollution does not respect political boundary. What does it mean actually? Like all of us, we political boundary, we the human being, that is why when we travel from one country to another we need to have permission in the form of having visa as we all know.

But that is not true for the pollution, pollution does not respect political boundary that is why pollution generated in India can easily travel to Bangladesh, Nepal, Bhutan, China, Pakistan, even in UK and Japan, they know they do not need any visa or anything. So, that is why when political boundary is not respected by pollution, then we call this pollution as transboundary in nature.

So, that is why when pollution does not respect political boundary, then that type of pollution becomes transboundary pollution. So, this is called transboundary pollution. And the transboundary pollution can be better characterized by international externality, so this can be characterized by international externality. So, the market is instruments what we were discussing so far, which were applicable in the context of national externality they are not applicable to international externality. Why?

Because when the pollution is confined into one country's territory, then that country's government can always impose a tax t which is equal to the marginal abatement cost of a firm

located in that particular country who is actually responsible for that pollution. So, this t equals to MC can actually lead to socially optimal level of pollution.

But in the context of international pollution or transboundary pollution, international externality there is no supranational government who can actually impose this type of tax, even though India is generating a pollution and if that pollution travels to China and Nepal, Bangladesh or Japan, none of these countries have actually the power to impose such emission tax on India's firms.

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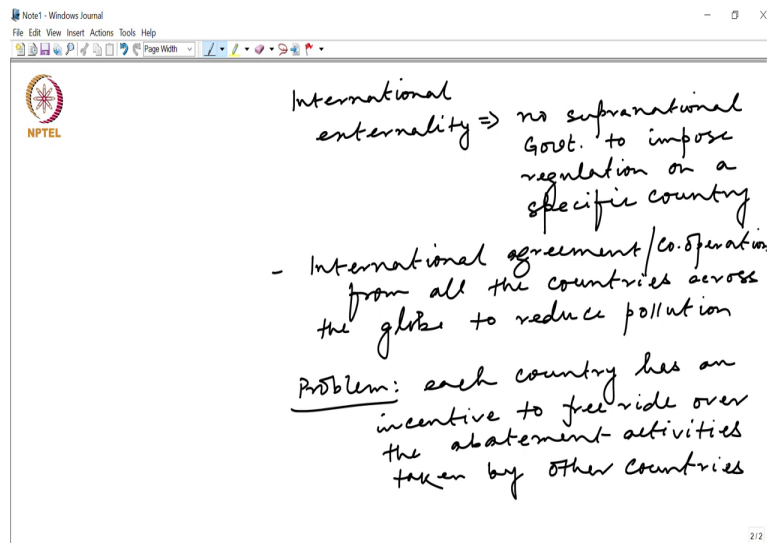
So, that means in the context of international externality what happens no supranational government to impose regulation on a specific country. So, we need to have different type of arrangement, so different type of arrangement to solve this international externality. In the context of national externality the market with instruments or what you were discussing so far they can easily internalize the externality, but in the context of international externality or transboundary pollution, since there is no supranational government who can actually impose regulation on the country who is responsible for the pollution separation, what do we need basically, a different type of arrangement.

What is that arrangement? All the countries should come forward, they should cooperate, they should take a joint responsibility to reduce the pollution. So, that means it requires an international agreement or cooperation from all the countries across the globe to reduce

pollution. But there is a problem, there is a problem in this kind of cooperation or agreement from all the countries across the globe, even though nations across the globe they have a common interest to protect their environment at the private level no country has an incentive to control pollution, why?

Because the pollution control activities, we can think of a global public, so that means that environment, the global environment is like a global public good, where we cannot restrict any country to enjoy benefit from the global public. Like, for example, if other countries are agreed to go for abatement, to go for pollution abatement, and they reduce their pollution, no country can be prevented from enjoying the benefit of such abatement activities.

For example, let us say that India, Bangladesh, China, Nepal and Bhutan, these countries are cooperating, they are coming forward to an agreement, they all are reducing their pollution at their private level, but Japan is not cooperating with all these countries, even then, Japan can also get benefited out of these abatement activities, irrespective of whether Japan joins or does not join in this cooperative activities, that is why each country has an incentive to free ride over the pollution abatement activities taken by others.

So, what is the problem of this type of international agreement? Each country has an incentive to free ride over the abatement activities taken by other countries, and economist the proof that higher is the net benefit from such cooperation larger would be the incentive for a particular country to free ride. What they say?

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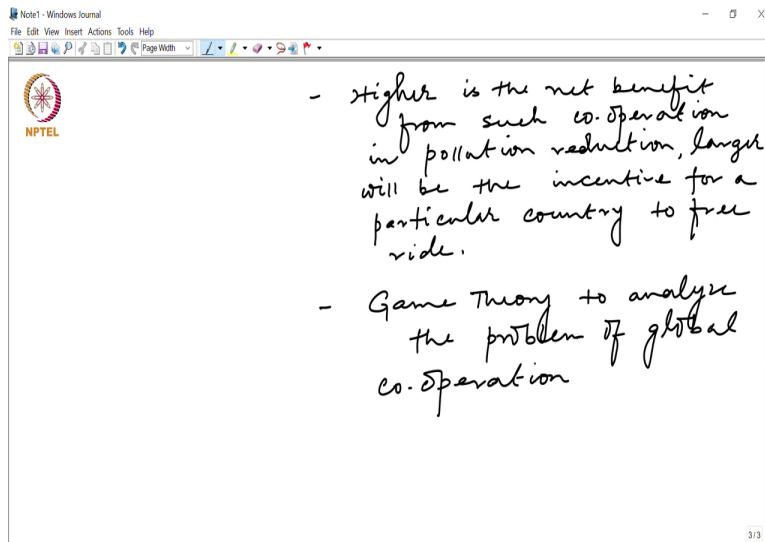
That higher is the net benefit from such cooperation in pollution reduction larger will be the incentive for a particular country to free ride. So, that means this is the problem by this setup actually we can understand why it is so problematic to bring the climate change under control, because it requires cooperation from all the countries, all nations they have a common interest to protect their environment, but at the private level, each country has an incentive to free ride.

Because no country cannot be prevented from enjoying the benefit of global cooperation, because global atmosphere, global climate, it is a global public good irrespective of whether a particular country cooperates or not, it will definitely enjoy the benefit out of it, if other countries cooperate, then a specific country can also enjoy the benefit without taking any cooperation from their part.

So, this free riding this incentive to free ride actually makes this global cooperation so difficult, and that is why we see the controlling global climate change is so difficult. Now, what we will do? We will try to analyze the situation in a game theoretic model simple game theoretic model wherein we say that we apply a game theory to analyze the problem of global cooperation, we will use this using a simple mathematical model.

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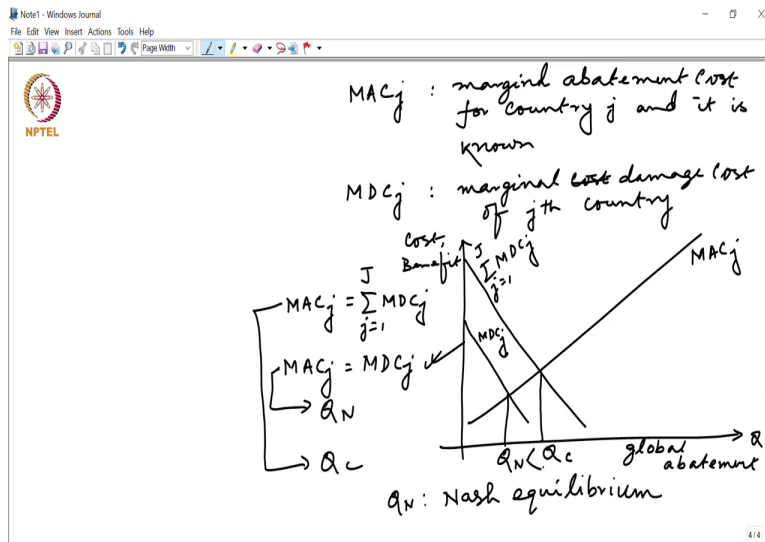
Let us, assume that marginal abatement cost for a particular country j is denoted by MACj and it is known, this is marginal abatement cost for country j and it is known. Similarly, the marginal damage cost, MDC it is marginal damage cost or marginal damage cost of jth country. So, in a simple diagram let us say in the x axis, we are measuring global abatement denoted by Q, and then the y axis we are measuring cost and benefit.

So, let us say this is MDCj for the jth country, and this is MDC for all the countries taken together j running from 1 to capital J and this is marginal abatement cost of the jth country. So, if each country has to decide about the socially optimal level of pollution control, then the country j should equate its marginal abatement costs with the sum of MDC j, why this is so? MDC, marginal damage cost is here we can think of as the benefit of any type of pollution control activity, if the country abuts its pollution, then the country can avoid the damage.

That is why MDC is basically the benefit of pollution abatement, and MAC is basically the cost of abatement, so optimality is arrived at a point where MAC and MDC they are equal. So, socially optimal level of pollution is basically MACj should be equal to summation MDCj, where j running from 1 to capital J.

And this solution will determine the level of pollution which is let us say Qc, c stands for cooperation. So, that means when all the countries are cooperating, when all the countries are

coming forward for an agreement to reduce pollution globally, then each countries should think the benefit of its pollution control activity not only in terms of its own benefit, that means not only in terms of its own damage, but also to think about the global benefit.

If India reduces its pollution, then the damage for Nepal, Bangladesh, Bhutan, China, Pakistan, so on and so forth, all the countries damages can be avoided, that is why MACj should be equals to some of MDCj and that will tell us the globally optimal level of pollution abatement which is Qc. But as we discussed earlier, even though all the nations they have a common interest to protect their environment, while deciding about optimal level of pollution, jth country thinks only about its own benefit, each country has a tendency to free ride.

India is thinking if other countries are cooperating let me free ride, because in any case I will also be able to enjoy the benefit of such pollution control activities, that is the reason what the country j can do is actually equating MACj equating one MDC of that particular country. And that will lead to abatement level which is called QN, non-cooperating solution.

So, that means even though cooperation at the global level is beneficial for all the countries all the nations, they have a common interest to protect their environment, that is why if they cooperate, if each country thinks about the global benefit then abatement level is Qc, less pollution globally, which is beneficial for all the nations.

However, each country has a tendency to deviate from such cooperation, each country can become a free rider over the abatement activities of others, they can only equate their marginal cost of abatement with their own benefit only, and that leads to a solution this will lead to QN, and these leads to Qc. Now, in the language of game theory, this is called this QN that means non-cooperation, the solution derived from non-cooperation is termed as Nash equilibrium.

Why? Because no country can unilaterally benefit itself by deviating from such situation. Rather this Qc is not an equilibrium, because at this level each country has a specific interest to deviate from cooperation because by deviating by free riding country j can increase its own profit, because country j is enjoying the benefit without incurring any cost in terms of pollution Qc, that

is why they always have a tendency of non-cooperation, they always have a tendency to deviate from such cooperation.

And as a result of which they will come to a situation, where countries are not cooperating, equating their marginal cost of abatement with their own marginal damage cost. And that leads to QN level of pollution abatement which is much lower than Q. So, this is much greater.