Introduction to Environmental Economics

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Lecture – 31

Household Production Function: Averting Expenditure /Defensive Expenditure Method

Hello everyone. So, today we will be discussing Household Production method and as you understand that we are discussing this revealed preference method. And under this revealed preference method we are to discuss another three methods; we have already discuss the hedonic price method and today we will be discussing the household production method.

And in household production method, we will be talking about two different types of household production method. So, the first one is the Averting Expenditure Method which is also known as the Defensive Expenditure Method and second will be discussing the travel cost method.

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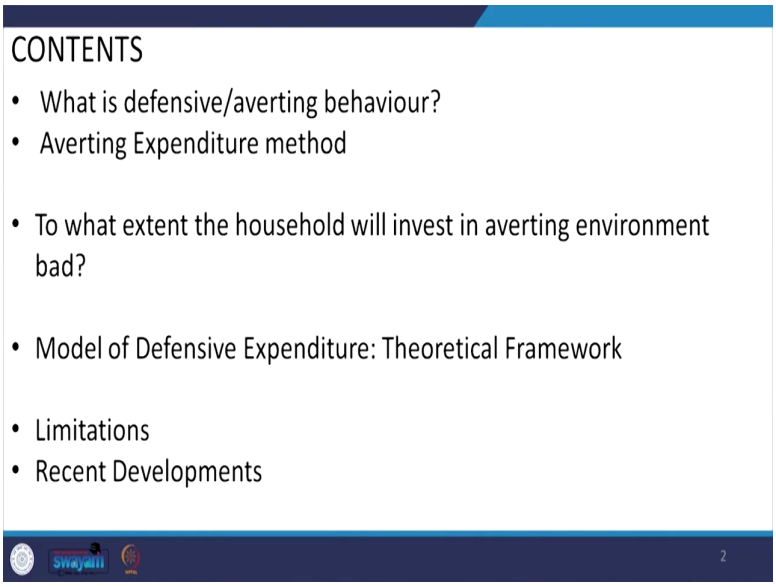

So, under this averting expenditure method will be defining what is the meaning of it and then we will be talking about: what are the different examples where we can use this averting expenditure. So, once we define what is the behaviour that is defensive behaviour, then we will be able to understand what is the defensive or averting expenditure method. Because once you are showing this behaviour then it is related to the expenditure itself so, will be making these two things clear.

And then, we will be discussing to what extent this household they will be interested in investing for averting the environmental bad. And on this aspect we will be talking about a theoretical framework and will be talking about a model of defensive expenditure. And then we will be discussing what are the broad limitations of this method and also focusing on the recent developments in this method itself.

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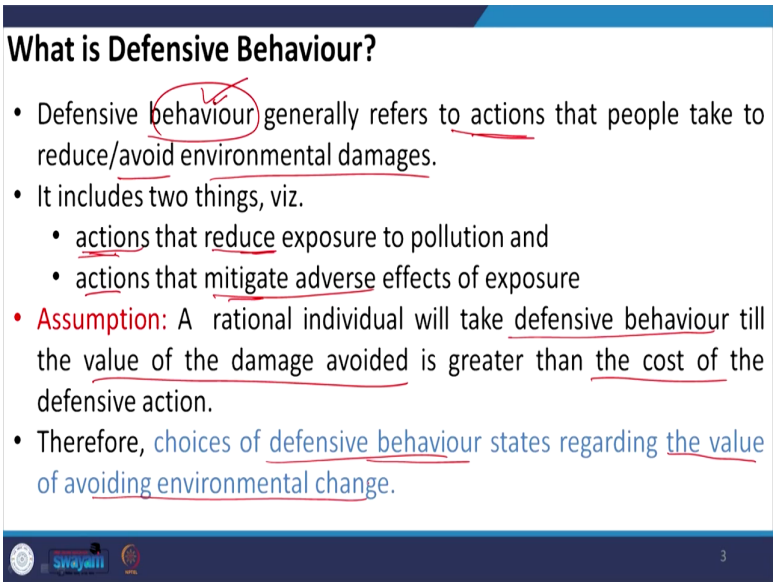

So, let us start with the very mini**.** So, what is defensive? Behaviour itself. So, when you are saying it is defensive behaviour that means, our behaviour is intended for defending something or in order to avoid something bad. So, if this is that we are interested or we are to defend or we are to avoid a particular bad then our behaviour must be like that or our behaviour will be expressing the same thing that how to defend how to avoid the bad.

So, typically you can say that this defensive expenditure or defensive behaviour refers to your actions; that the individuals they adopt they will show off their actions to reduce or to avoid the environmental damage or environmental bad. So, when you are talking about behaviour obviously, so here what we are talking about we are emphasizing on this word behaviour and how this behaviour is targeted or transformed into actions. So that these actions avoid or reduce the environmental bads.

In this behaviour, which is reflected in the actions or which are transferred into actions it inversed two things: the first thing is that this actions that can be reduce the exposure to the pollution so pollution is a kind of bad and it is a standard example an environmental economics that you are using. And second thing is that the actions that can mitigate the adverse effects of exposure.

So, remember that we are talking about the behaviour and then we are talking about actions. So, in this actions, we are talking about two different actions: the first one is actions that can reduce the exposure to the to the pollution. And second thing is that actions that can mitigate the adverse effect of the exposure of the pollutions. So, these are two different things.

So, how these are two different things? So, suppose you are talking about the first one; that is actions that reduce the exposure to pollutions suppose say you are suffering from or you are very sensitive to the air pollution and you are so, it is likely that you will be suffering from asthma. So, that means, during the ambient period like in the morning or in the in the evening so you will be trying; you will be trying to avoid to the outdoor experiences will not go to outdoor right.

So, not going to outdoor is you are is your actions. So, this action will be reducing the exposure to the pollution and that is why we can actually safe save your health or you can avoid suffering from asthma. And the second one is that actions that can mitigate the adverse effects. So, the first one is reducing the exposure and the second one is mitigating the adverse effects of exposure.

So, in this case what we can do? We can actually do some exercise maybe investing in terms of time and in terms of money by consulting a doctor right. So, that this effect sorry, this your actions in terms of medication or consulting a doctor can actually be reflecting your intensity or your ways to be to be healthy and not to suffer from any kind of asthma, so that we can also do.

So, here the assumption is that a rational individual he or she will be taking the defensive behaviour till the value of the damage avoided is greater than the cost of defensive action. So, it is natural that if we are saying the individuals are consumers are behaving in a rational manner then they will be following this generally they will be following this principle that this they can actually display this defensive behaviour and they will be continuing this defensive behaviour till what time till the value of the damage avoided. They will be thinking that if they are going to the outdoor then this these are the damages in terms of illness or if it is like a property these are the likely damages that will happen because of this external factor like your pollutions.

And if the value of the damage avoided is greater than the cost of defensive action whatever the actions they are taking into account in order to save their property or in order to save their own health then this is how they will be reacting or they are actions will be ah like that.

And therefore, regarding this defensive behaviour so, the choices of the defensive behaviour it actually states the value of avoiding the environmental change. So, here we are saying that this defensive behaviour, it reflects nothing but how individuals or the consumer they are valuing the valuing by avoiding the environmental change itself right.

So, in this regard after understanding this defensive behaviour itself, now we will be discussing what is defensive expenditure. So, if you are thinking that all be proven to this air pollutions and I may suffer from this any diseases like asthma and your actions are actually reflected or your actions you are doing some kind of action in order to reduce or in order to mitigate the bad like your air pollutions.

So, for that reason you are making some expenditure. So, what is the expenditure here? So, you may think that that I will be spending some time by not going to the outdoor and exposure to the air pollution. So, it is a an expenditure in terms of time. And more moreover you can if you are talking about the case of property then you are making some expenditure in terms of let us say by purchasing some goods or equipments so that your property can be safe from the pollutions.

So, in that way if your if your behaviour is defensive, then this defensive behaviour is leading to defensive expenditure or which is also known as the averting expenditure. And this is the basis of the defensive expenditure method. And again are you understand this defensive expenditure is an example of household production functions.

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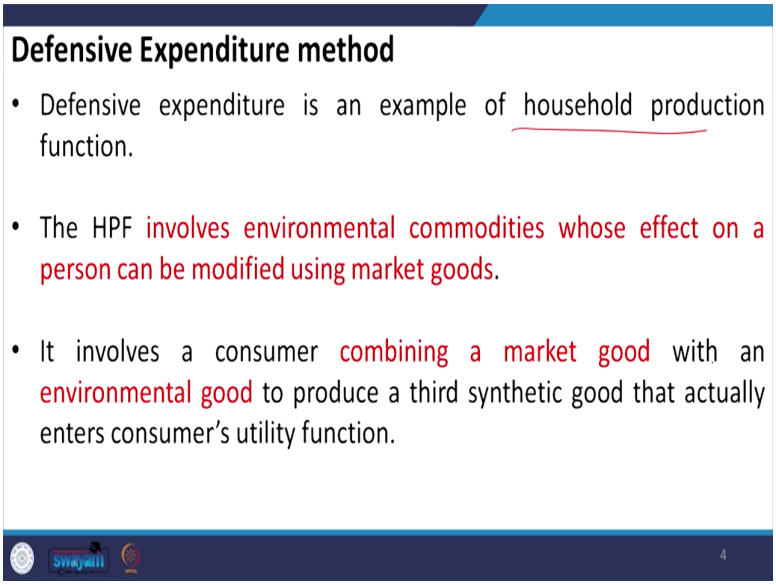

So, in the revealed preference method we talked about we are not needing actually this Aquaguard RO right. What we are needing? We are interested in the quality of water pure quality of water or pure water so that is why we have purchased. So, whosoever is actual valuing that health and valuing the water quality they are interested or they are purchasing the Aquaguard RO for they are drinking water consumptions right. So, that is why this defensive expenditure is an example of your household production functions

So, again this household production functions it involves some environmental goods or commodities, whose effect on the person can be modified by using some market good. So, here we are using the market good that is Aquaguard and the environmental commodities effect that is the effect in terms of bad water quality can be avoided.

And again, as we have already discuss that here the for this region for this defensive expenditure method the what the consumer is doing? The consumer is combining a market good with an environmental good. So, that a synthetic kind of good can be produced and it must be reflected in the consumers utility functions right.

So, this is the example that we have given that how the how the market good and the environmental good can be combined in order to produce a third synthetic good and that reflects the consumers utility

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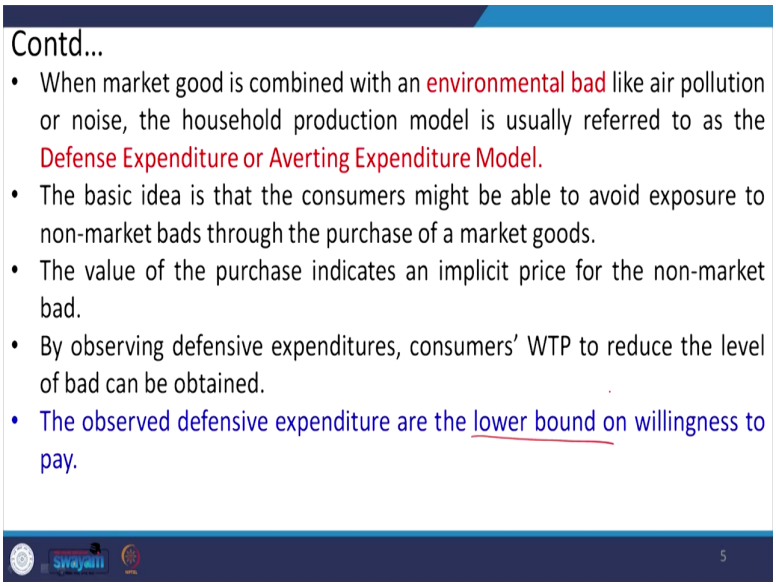

And again, when this market good is combined with some environmental bad because we are more concerned about bad rather than good so, the environmental bad is the pollutions air pollutions or noise pollutions. So, the household production function in this context can be referred to referred as the expenditure defensive expenditure or averting expenditure model.

So, the very basic idea or basic assumptions or basic idea of this method is that the consumers might be able to avoid the exposure to any kind of non market goods or bads and they can avoid this expenditure sorry. They can avoid this exposure to the non market bads through the purchase of a particular market goods and the example that we have discussed we can just link that how this example is and satisfying the model.

So, here the value of the purchase indicates nothing but it indicates some implicit price. So, who is implicit price this purchase or your behaviour consumers behaviour in purchasing the Aquaguard is showing. So, it is indicating the implicit price for the non market bad itself.

So, it is not explicitly stating that the price of the Aquaguard is equivalent to the value of the water quality rather it is implicitly stating the price of this non market bad. And by simple observation of consumer's expenditures or consumers behaviour towards different expenditure the consumer's willingness to pay to reduce the level of bad can be estimated.

And this observed defense expenditure are said to be the lower bound on willingness to pay. So, what is the meaning of this lower bound? Because; obviously, when the consumer is purchasing the Aquaguard that means, he is or she is willingness he is or she is willing to pay in order to avoid the bad that a water quality and this is the lower bound that means, it is the minimum amount of willingness to pay he or she is displaying.

But this level this amount of willingness to pay can be more. But his behaviour or her behaviour in terms of purchasing the particular market good in order to avoid the environmental bad is reflecting the minimum or lower bound on its willingness to pay for avoiding the same. So, another example we can take into account. So, here we are talking about the traffic area.

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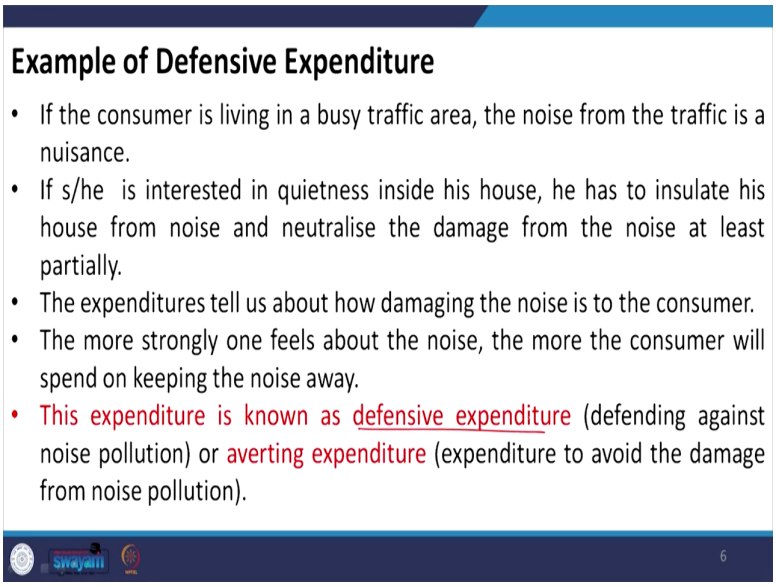

So, let us suppose say the consumer is residing in a busy traffic area. And obviously he or she will be interested to avoid this noise from the traffic; because his it is a nuisance for his family and kids. So, what the family? This family would be interested. So, the family members they would be more interested in the quietness inside the house because they cannot do anything to the traffic it is an external factors which cannot be actually controlled by this particular households.

Obviously, this is a policy discussions and it is meant for the public itself where the interventions on the particular private particular household is very minimal or negligible. So, what the this household can do? So, he can actually maintained quietness inside his house and in order to do this because outside there is a traffic then obviously this traffic noise will be actually coming to entering into the house inside the house.

So, in order to this quietness what the this household can do? The household can insulate his house from the noise and in neutralize the damage from the noise at least partially right.

So, again it depends to what extent he can the household can neutralize the damage it depends upon the cost of the equipment he or she is purchasing and in the market there are different quality whether 100 percent neutralization of this damage is guaranteed or partial neutralization of this damage is guaranteed. And this expenditure when the household is purchasing some equipments in order to insulate its house so that the traffic noise outside cannot enter into the inside rooms.

So, this expenditure will be telling about how damaging the noise is to the particular household, that is why it is showed by that he is interested in spending his money in order to control or in order to avoid this noise.

And again if the this noise is so bad and the household will be feeling so strongly about this noise nuisance then obviously, he will be feeling more and the consumer will be spending more on this on this insulating equipments and in this example this type of expenditure than this particular household is doing it is known as this defensive expenditure that is defending against the noise pollution and it is also known as the averting expenditure that means, expenditure to avoid the damage from the noise pollution to his family itself.

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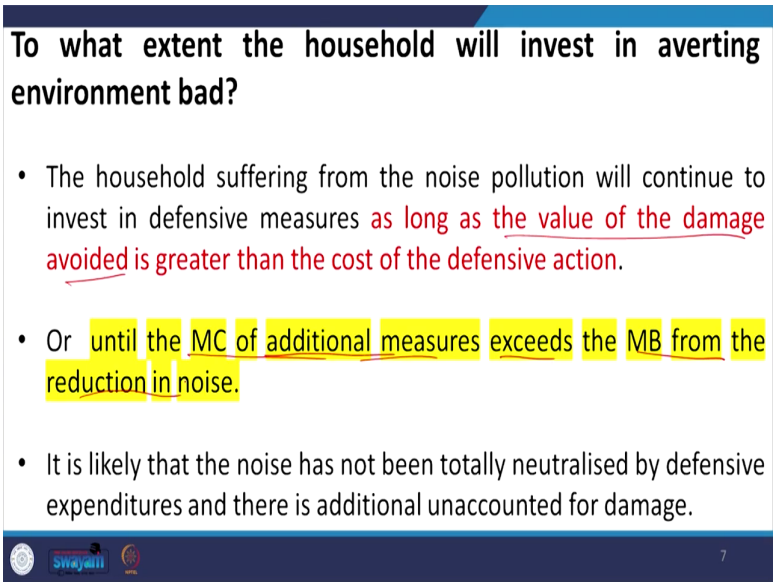

So based on this, understanding now let us understand to what extend the household will be interested or household can invest in averting the environmental bad is there any limit or is there any threshold so that the household will be knowing that to these extend we can we can spend or we can invest in order to avoid this environmental bad.

So, the thumb rule is that, the household who is suffering from this noise pollution he will be thinking to continue to invest in this expenditure up to a point. So, what is the point? The point are as long as the value of the damage avoided is greater than the cost of defensive actions right.

So, he can invest or he can continue to invest on such expenditure till he will be finding that the value of the damage avoided is at least greater than the cost of defensive actions. And if the value of the damage avoided it just equivalent to the cost of the defensive actions at that

point the consumer or the particular household he can think about that what to do that whether we need to think about some alternative or still continue as it is.

A technically you can say the same thumb rule can be expressed in terms of this technical terminologies. So, this particular household can continue investing such type of the averting expenditure, until the marginal cost of additional measures he is taking in order to defend this noise exceeds the marginal benefit from the reduction in noise.

So, this is same thing that here we are talking about the marginal cost of additional measures that if so that is the value of in terms of purchasing the equipments one more equipment. And if this is this marginal cost of additional measures exceeds the marginal benefit in reducing the noise, then the consumer will be thinking that whether to continue with further investment or to stop.

So, this is what we can say that to what extent or what is the guideline or what is the general principle the individual or household will be following to limit the this behaviour of ah averting behaviour or in terms of averting expenditure.

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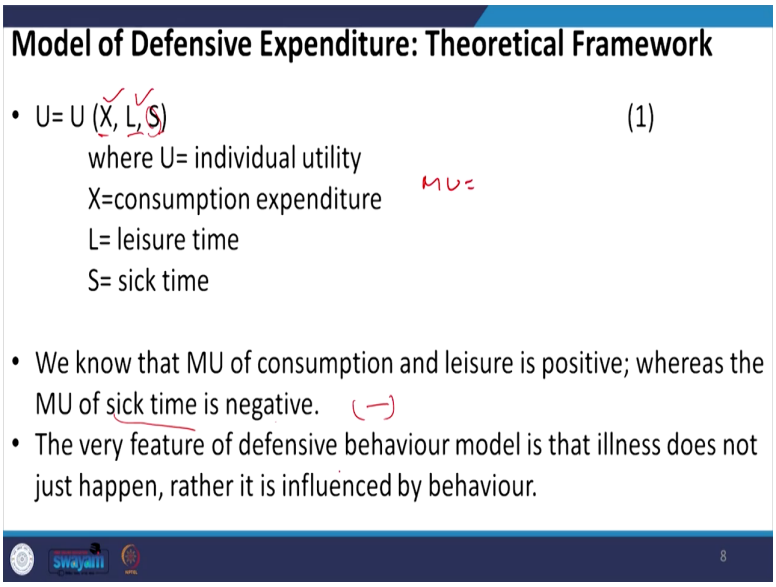

And after understanding this we can actually think about a theoretical framework. So, that will be giving a kind of model for defensive expenditure. That what kind of variables or what kind of assumptions or what kind of hypothesis that we are we must take into account in order to in order to estimate this non market valuation of averting expenditure.

So, now here this theoretical framework is based on the utility on the utility functions of the consumer obviously. So now, for the same household we are talking about. So, now, the utility function of this household is represented by this function that is utility is a function of or individual utility of this household is a function of X L and S.

So that means, here utility of this individual will be depending on the consumption expenditure he is making in x y z the any types of goods and services he is consuming and his utilities also depending on the leisure time his available his availing. And the third type or the

third variable that is also impacting his utility is how many times the person is suffering from any kind of sickness right.

So, here the utility other things keeping constant that is the standard assumption assuming this (Refer Time: 21:45) various assumptions. We are saying that utility function here utility function of this individual household is reflected by this three variables that consumption expenditure in terms of goods and services is consuming and what is the leisure time he is enjoying and how many times in terms of hours how many hours or how many days the person is falling sick.

And as you understand from this utility functions, we know that the marginal utility of consumption and also the marginal utility of leisure. So you are finding this utility is this one so you can find out the marginal utility of this consumption as well as the leisure.

So, if your finding this marginal utility from the total utility this is the total utility of the individual then you will be finding that this marginal utility of ah for this both the variable consumption as well as the leisure it is positive, obviously it will be positive. And so that means, how do you interpret this that means, if you are increasing the consumption expenditure by one unit then your utility will be increasing that is why your this is positive.

So, likewise if you are increasing the leisure time by one unit then obviously your utility will be increasing it will be giving positive result. But if you are talking about this third one if we are falling sick by one more time or one more hour or one more in terms of some yards that is in the time measurement then this marginal utility of sick time is will be obviously negative. So, this is what we need to actually remember and it is rational to find.

And again the very characteristics of this defensive expenditure model is that the illness does not happen we cannot say that illness just happens without any reason no it cannot happen if you are rational then we have to actually think about we have to search for what is the cause of this illness. And the rational individual he or she actually things about and sources what are the factors because of which he is falling sick for how many days.

So, based on this understanding the very feature of this defensive expenditure model is that the illness cannot happen just as it. So, illness is rather influenced by the behaviour of the person. So, behaviour is one of the vital factor that can control the illness, how many times the person is falling sick it is because of his behaviour. So, if he is trying to avoid the illness it must be reflected in terms of his behaviour or in terms of his actions.

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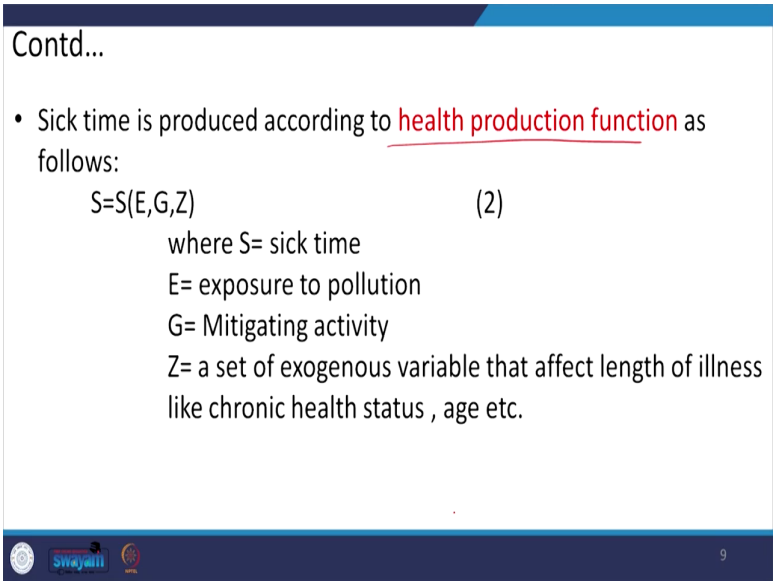

So, based on this understanding now the sick time or how many times the person is falling sick it can be produced according to this health production function. So, if you have to express the sick time in terms of this health production function then now we can say this sick time or S is a function of E G and Z. So that means, you are sick time is actually affected by the exposure your exposure to pollution and whether you are taking any mitigating activity or towards mitigating this the your sickness.

And the third one you are talking about the other exogenous variable just like age factor is there, so we cannot actually control these variables like your age or your chronic health status you are so from your from 10 years or 20 years. So, you cannot nothing cannot can be done and it is not because of the pollutions or this kind of environmental bads because of which you are suffering from sick right. So, this is something exogenous variable that we are a set of exogenous variable that is taken under this Z.

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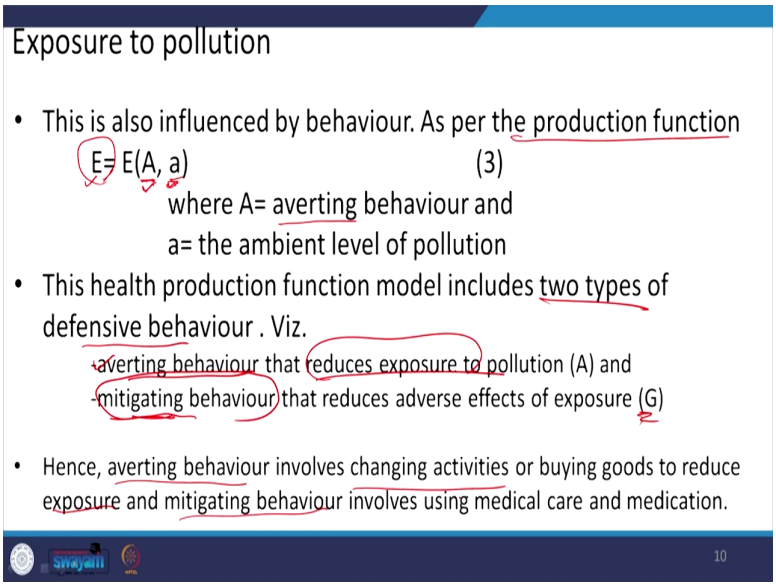

So, now understanding this, so we can actually think about the exposure to the pollutions. So, this exposure to pollution again it is influenced by your behaviour your choice, whether you need this exposure to this pollutions or you do not or whether your behaviour is so whether you are taking some actions in order not to be exposed to the pollutions. So, this is what we

can take into account from the or express in terms of the production functions. So that means, you are exposure to the pollution it is again depending upon certain variables.

So, what are these variables where you are exposure to pollution is depending? So here expend your exposure to pollutions is impacted by the averting behaviour that is A capital A and the ambient level of pollution so that is alpha right. So, here your exposure to pollution it will be decided or if you are thinking about this two factors, if you are taking or not taking these two factors then these two factors will decide that you are exposure to pollutions right.

So, if whether if you are we are you are taking any behaviour in order to avoid your exposure to pollutions and what is the ambient level of pollutions? That is what is the concentration of the pollution in that particular area where you are staying or where you generally expose.

So, now this health production functions it is it includes two types of expenditure defensive behaviour. So, what are these two different types of defensive behaviour? It is including in this health production function the first one is the: averting behaviour that reduces the exposure to pollution it is represented in terms of A. And the second thing second is: the mitigating behaviour that reduces the adverse impacts of the exposure.

So, one is in terms of this exposure reducing exposure and it will be reflected in averting behaviour and the second one is your behaviour that is mitigating behaviour. So, that it will be reducing the adverse impacts or adverse effects of the exposure to and this is represented in terms of G.

So, now this averting behaviour, it involves changing activities right because obviously, how do you avoid a particular bad? It must be reflecting in terms of a behaviour so that means if your changing your activities or if you are purchasing something some goods to reduce the exposure that is what is reflected in terms of your averting behavior.

And what is mitigating behaviour? It will be involving some kind of medical care or the medications consulting the doctors, in order to avoid in order to reduce the adverse effects of the exposure right. So, this is how it is actually a talking about these two things.

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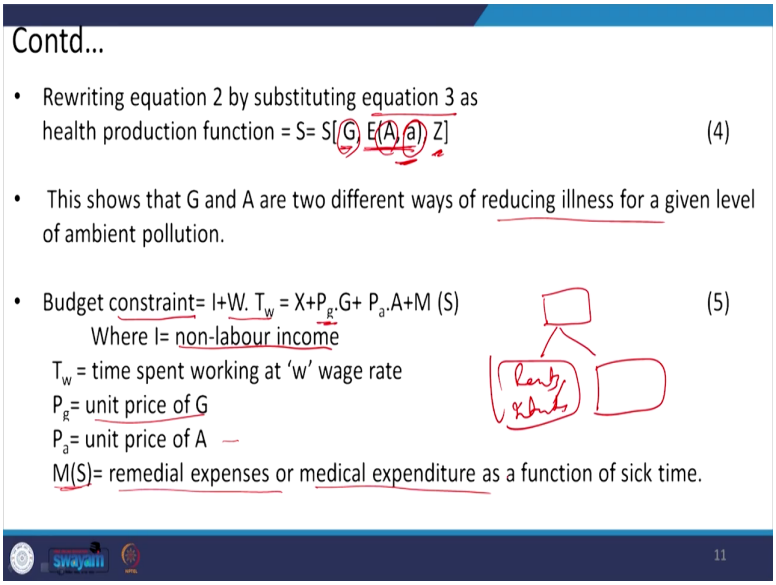

And again, if you are we if we have to rewrite this equations right, this health production equation because now we understood what is the exposure to pollutions right. And we will be now substituting this equation 3 in equation 2 itself in order to find the health production functions right.

So, now we are finding this what this one we are using substituting in this equation 2. And now this will be showing that these two variables one is G and the second one is A they are actually the two different ways for reducing the illness for a given level of ambient pollutions right. Because here this is the ambient pollution, given this ambient pollutions and other

exogenous factors these are the two variables which actually are the ways for reducing the illness for a for this level of pollutions.

So, after understanding this production functions, first we understood the utility functions of the individual then we express this in terms of the production functions then the next thing that we must understand if the budget constraint. So, how the particular individual he is allocating his time because here obviously time is related to the resources or income. So if so that is what this time is the is express in terms of the total income.

So, now the budget constraint would be the we need to take into account his non-labour income. So, let us suppose say the particular person in discussion, he has two source of income by doing by utilizing his time and doing some work and that is why he gets this ways.

And the second one is non-labour income that means, although he is not doing any exercise and not getting he is not getting any wages still he is getting some income may be in terms of rents, maybe in terms of interest so these are also incomes right. and the second one is the person is actually investing his time and getting some wages and that is what it is a part of his income.

So, in budget constraints we are talking about the first part that is in terms of I non-labour income. And the second a components of his income is how many times the person is or how many hours the person is working at this wage rate of W and obviously W into the time is your is the income from his labour. And this P g if the unit price of this g and P a is unit kinds price a and M S is remedial expenses or medical expenditure as a function of sick time.

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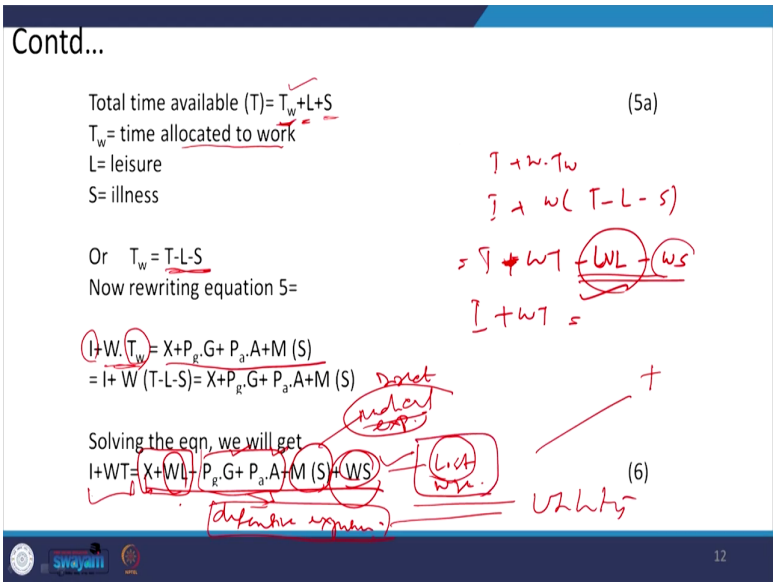

Then, actually we are after this budget constraint we need to actually talk about the time availability. So his time availability how the person is allocating his time? So, his time availability depends on the allocated time towards work, which is reflected in terms of T w. And how many times sorry how many hours he is pending towards leisure L?

And the third component of his availability time total time that is available to him is how many time how many times or what is the number of hours or day person is falling sick, that is why he is not actually available for work. So, based on this understanding now we can actually find do this just arithmetic that this obviously, this time allocated for work would be total time minus L minus S right.

So, if you have to rewrite this equation 5 that we are talking about. So, we can now replace this the budget constraint right. So, here if you are replacing it then you will be finding that in

the left hand side of the budget constraint. So, this is the income from non labour, and this is the income from labour hours right

And we are we are putting this in this. So, here it will be now in place of T w we are replacing this T minus L minus S we are doing this. And the next one will be X and then we are solving it we can solve it actually. So, here this is I plus w plus T w right, so we are doing this I plus T minus L minus S. So, this is the left hand side and here it will be W T minus W L minus W S right this is I minus.

So, what we are doing here? We are solving this and we are finding this I plus W T is; obviously, these are the these are the two variables that is shifted to the right hand side. So, after this we can see the right hand side. So, this is X plus this WT is there in the left hand side, this WL is coming here to the right hand side. And P g into G P a plus into A and MS plus this WS is from here, so we can just solve this equations.

So, by doing this exercise we can actually find out that what is the averting expenditure or where is this averting expenditure we are finding. And in this example this I plus WT is nothing, but your total income or total income of the individual. And this X plus WL this component is the consumption of goods as well as the leisure. And this P g and G and P a into A; this is as we have already discuss these are the two wage of averting behaviour right.

So, these G and A are this component is actually the defensive expenditure right. And the third one that is in terms of M S and W S. So, what is the M S? That is if you are falling sick then; obviously, you have to incur the medical expenditure, this is the medical expenditure as your falling sick medical expenditure.

So, this is your direct cost, when you are not taking some steps or your behaviour is not reflected in order to avoid this bad. And this WS is again the damage cost that is in terms of lost wage. Because, when you are sick then; obviously, you are not working and that is why you are losing this income right. So, this is what you are lost wages this is the indirect cost.

So, now the model is clear to us that what is the defensive expenditure right, from this if you are collecting all these data and you are doing this exercise. Then from a particular policy you can you can find out that whether this whether the policy need to actually take into account in order to avoid the bad right.

So, if in a particular area the water is very bad, right and this averting expenditure your finding by taking collecting the data. Then the next thing that we must actually think about the policy exercise then now the government at the municipality must actually step into in order to fix this problem. Because, this is what the defensive expenditure is. And it is why we are saying because it is it will be reflected in terms of the utility the individuals.

So, in the in the next lecture will be continuing from here. We will be discussing what are the limitations and what are the recent developments that we are finding from the literature in this method. And also will be talking about this lost wages; because of the illness. If you understand in the in the revealed preference approach the forth approach is forth method is the method for finding the illness right and lost wages. So, we will be we will be discussing this sickness value or lost value because of the person is falling sick will be discussing in the next class along with this continuation part.