Managerial Economics
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Lecture - 71
Oligopoly and Game Theory (Contd…)

So, we will continue our discussion on game theory. Last class if you remember we discussed about the different assumption of the game theory. What is the need of game theory generally in which case what is the usefulness of the game theory is there in the economic analysis? Then, we discussed about the structure of a game, and then we took a small example to understand. What is the dominant strategy? What is the maxmin strategy? And what is the minmax strategy? And how generally equilibrium is achieved when there are two dominant strategy. Then, we introduced the concept of Nash equilibrium. And, Nash equilibrium if you remember this is the best action given by the player whatever the irrespective of whatever the opponent does that is the best strategy; that is the generally the Nash equilibrium.

So, taking the, taking the example of both the firms to advertise or not to advertise. What we discussed in the previous session, the same example we are going to take to understand this Nash equilibrium.

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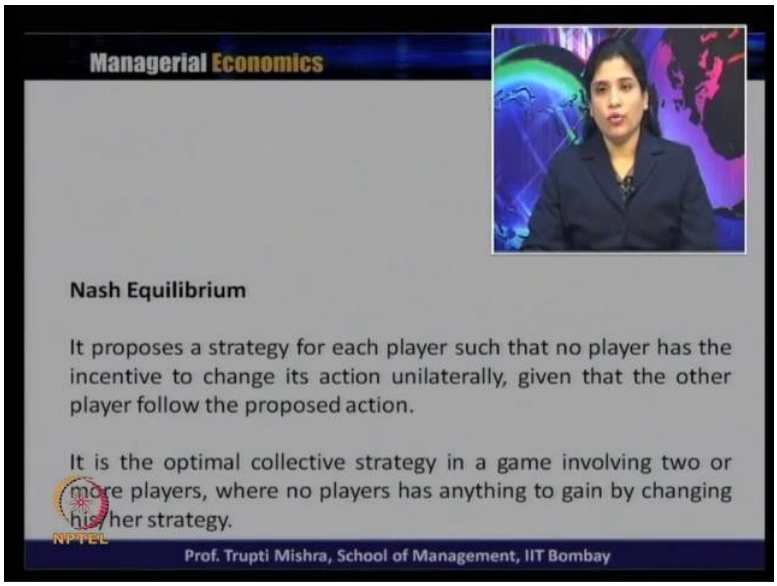

So, just to a quick recap Nash equilibrium is a strategy for each player as such that no player has the incentive to change its action unilaterally, given that the other player follows the proposed action. So, generally this is a state of equilibrium, this is a state of balance. Beyond which whatever the effort the player they are going to put it is not going to change their

payoff and that is why this typical combination is called as the Nash equilibrium. It is generally the other way to put is that it is the optimal collective strategy in the game involving two or more players, where no player has anything to gain by changing his or her strategy. So, this is the point this is the optimal collective strategy. This is the optimal strategy for both the firms; beyond which whatever may be the change no player has to gain anything by changing the strategy.

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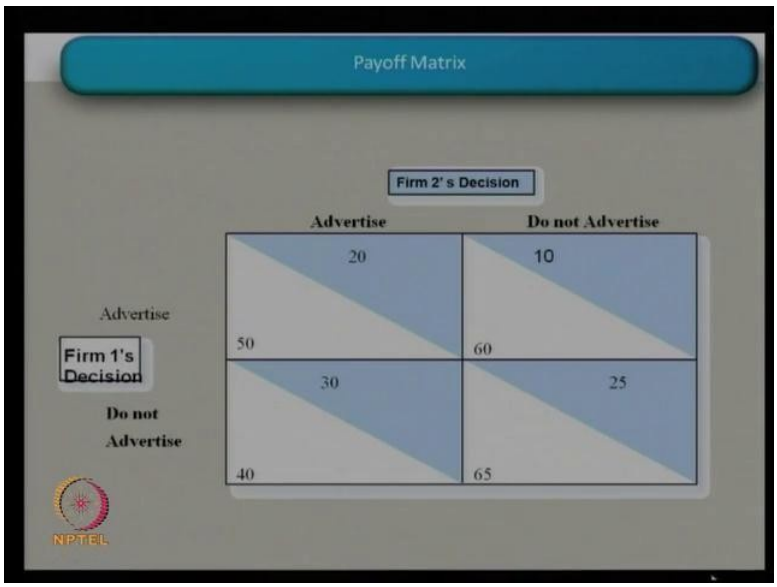

So, we will take the same example to understand this Nash equilibrium.

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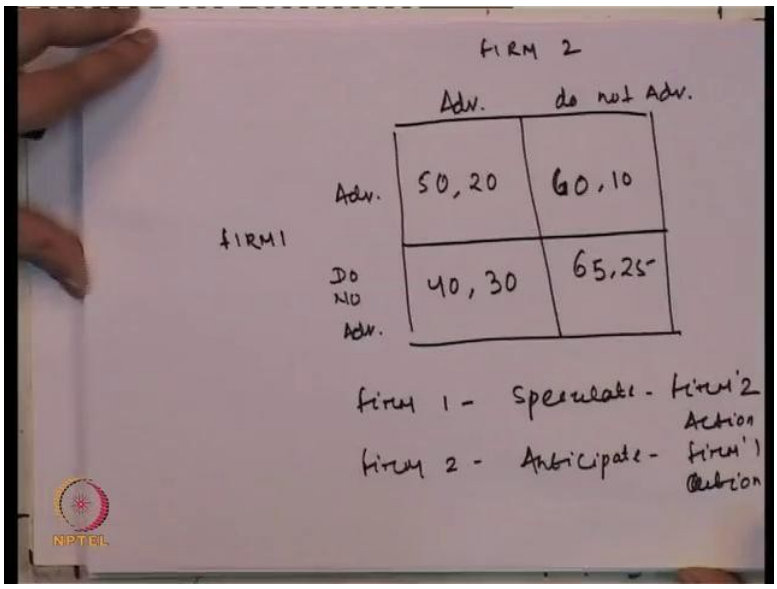


And, here there are two firms. Firm 1 and firm 2 and it is a choice between them that whether they should advertise or whether they should not advertise. So, we will take the case of firm 2 here. We will take the case of firm 1 here. It is whether they should go for the advertisement, whether they should not advertise. Here again we have taken the advertise and do not advertise.

So, when both the firms they are advertising. Firm 1 get a share of 50, firm 2 get a share of 20. When firm 1 advertise and firm 2 is not advertising. Firm 1 is getting 60 and firm 2 is getting 10. When firm 1 is firm 2 is advertising firm 1 is not advertising he gets 40; firm 1 get 40 and firm 2 get 30. And when both of them they are not advertising. They get a payoff of 65 by 25. Now, how we can decide their Nash equilibrium. Now, what firm 1 will try to do? Firm 1 will try to speculate firms 2 action action. And, in return what firm 2 will do? Firm 2 will also try to anticipate. What is firm 1 action?

Now, to start with let us see what, what the firm 1 will 1st do? So, to start with firm 1 will presume that that firm 2 is going to firm 2 is going to advertise. If firm 2 is going to advertise it is better for the firm 1 to advertise because in that case they are getting a payoff 50. If he is not going for advertising even if firm 2 is going for advertising he is getting a payoff of 40. What is best for him? Best for him to go for the advertisement because he will presume that anyway since it is the case of the market share the optimal output at the end of the day is that there should be increase in the market share.

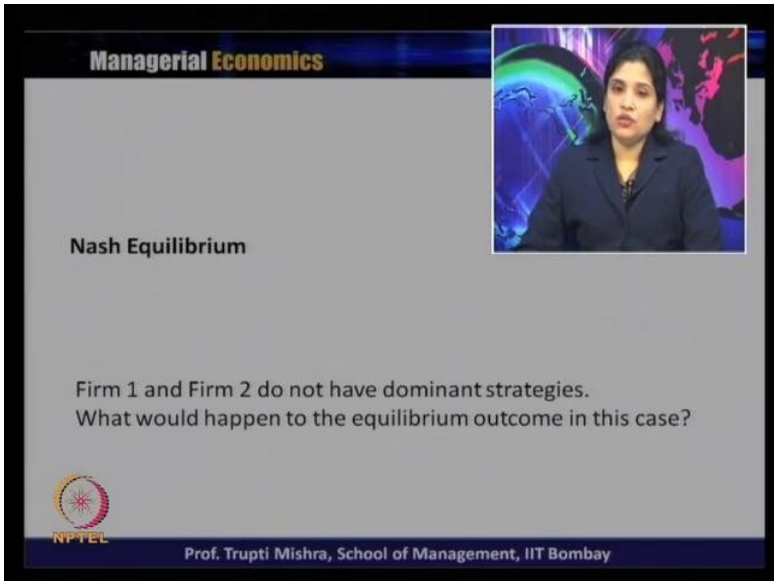
And, market share how it will increase if firm they are going for the advertisement. So, in this case if firm 1 always presumes that the firm 2 is going to advertise. And, if firm 2 is going to advertise then in that case if firm 1 also advertises he gets a market share of 50 Whereas if he is not advertising; even if firm 2 is advertising he get a market share of 40. So, since 50 is greater than 40. It is always best outcome or the best payoff to go for advertisement.

Now, we will understand from the prospective of the firm 2. Now, how firm 2 will react to this or how firm 2 will behave in this case? So, firm 2 knows that same, same thought process again or the same speculation again, that since it is about the market share. Market share increases whenever there is a increase in the advertisement the more it reaches to the consumer more is the market share. So, in this case firm 2 will also think that anyway firm 1 is going to advertise because he has to increase the market share. And, if firm 1 is advertising, if firm 2 is advertising

it gets a share of payoff because their payoff is 20. If firm 1 is advertising and firm 2 is not advertising that gets the share of 10. So, since 20 is greater than 10 this should be prefer or this should be the best outcome best strategy. So, for firm 2 also the best strategy or may be the decision of the firm 2 has to advertise.

Now, what is the Nash equilibrium? Nash equilibrium is since whatever the strategy taken by firm 1 irrespective of whatever the other firm is doing. If it is matching with the strategy whatever is taken by firm 2 irrespective of what firm 1 is doing. So, this is what? This is a similarity that both the firm they are going to advertise whatever the other firms they are doing. So, in this case it Nash equilibrium is Nash equilibrium for both the firm is to advertise and advertise. So, this combination of firm 2 and firm 1 is generally leads to Nash equilibrium because the whatever the best for b irrespective of whatever the best for b irrespective of what a does or whatever best for a irrespective of whatever b does if that equal then we get the Nash equilibrium.

So, Nash equilibrium is in this case specific case; whatever is firm 2 is doing irrespective of firm 1 that strategy is advertised and whatever is firm 1 is doing irrespective of firm 2 the strategy again to advertise. That is why to advertise and to advertise this combination leads to the Nash equilibrium. So, taking the same example we can understand that how generally when the both the company they are into a competition or they are into taking a decision making that whether they have to go for it not for it. In that case generally they look at what may be the opponent choice, but here they have to when they have to reach a decision; they have to see that irrespective of whatever the other company is doing or whatever the other firm is doing. What they are getting out of it? Now, in this case both the firms they have the dominant strategy. (Refer Slide Time: 09:22)



The dominant strategy for firm 1 is to advertise. The dominant strategy for firm 2 is also advertises. But maybe, we will get a case where firm 1 and firm 2 they do not have the dominant strategy. Now, what would happen to the equilibrium output in this case? Because it may it may happen that the payoff changes or the payoff is in such a way that there is no dominant strategy for one of them. Suppose one is having a dominant strategy; the other is not having a dominant strategy. In that case, what is the Nash equilibrium? Because Nash equilibrium is ideally the dominant strategy of 1 when it is matches the dominant strategy of the others, we get the Nash equilibrium.

But if any case if the there is absence of dominant strategy of one of the firm or may be the other firm in this case. What should be the equilibrium output? So, we will just change the payoff slightly, and we will see in this case when there is no dominant strategy. How the equilibrium output is achieved? So, we will just change the payoff matrix for firm 1 and firm 2. So, this is advertise, this is not advertising. This is advertising, this is not advertising. So, this is the payoff in the 1st case. This is the payoff in the 2nd case. This is the pay off in the 3rd case. This is the payoff in the 4th case.

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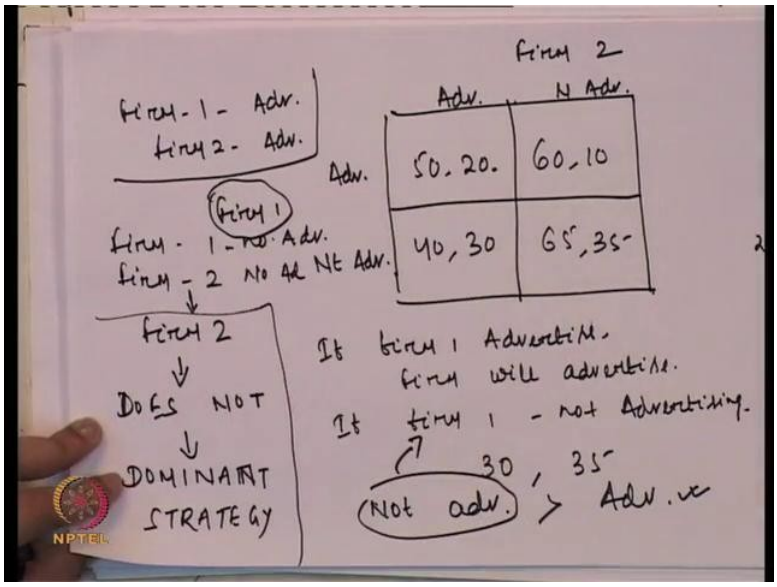

Now, we will start it again, how to whether we can reach the equilibrium looking at the strategy taken by firm a and firm 2. Now, suppose if firm 1 advertises. Now, what firm 2 will do? Firm 2 will also advertise, because it gets, it gets a better payoff in case of advertising like 50 and 40. Now, sorry it is 20 and 10, because 20 he gets by advertising by not

advertising it is gets 10. Suppose, if firm 1 is not advertising. Now, here you need to look at the options that whether it is still profitable for the 2nd firm to go for the advertising. So, if firm 1 is not advertising

Now, what the firm 2 will do? Firm 2 will also not advertise because the payoff what they are getting from not advertising is higher than the whatever the payment they are getting from the advertising. So, in the previous case since this was 25 the pay off. It is profitable for the firm 2 to advertise even if firm 2 is not firm 1 is not advertising. But in this case if firm 1 is not advertising and firm 2 is advertising they are getting a payoff of 30. If they are not advertising when firm 1 is not advertising then they are getting a 35. So, not advertising payoff is greater than advertising and that is why they will prefer not to advertise, when the firm 1 is not advertising.

So, if you look at here. If now if you look at if firm 2 is advertising and this is for when firm 1 is advertising not advertising. What firm 2 should do? So, in this case when firm 1 is not advertising; firm 2 is also going to a strategy where it is where the 2nd firm is also not advertising. Similarly, if you look at now if the firm 2 is advertising and if firm 1 is also advertising. And, if firm 2 is not firm 2 is not advertising, when firm 1 is not advertising. So, in this case specifically if you look at firm 2 it depends upon what firm does. So, if firm 1 advertise. Firm 2 also advertise. And, if firm 1 is not advertising, firm 2 is also not advertising. This leads to the conclusion that firm 2 it does not have a dominant strategy because the strategy are different whenever the opponent changes the whenever the opponent changes the strategy; even the other firm also they have to change the strategy. So, we reach to 1 conclusion here that firm 2 do not have a dominant strategy. Now, we will analyze the case for firm 1.

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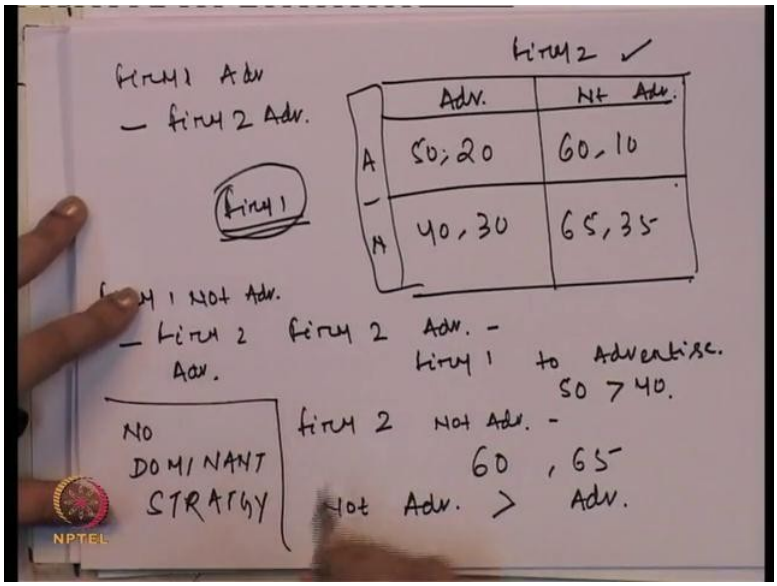

So, we will just take the payoff matrix for the reference. So, this is firm 2 advertising, not advertising. This is firm 1; again this is advertising, this is not advertising. And the payoff are 50, 20 40, 30 60, 10 and 65, 35. So, we have already reached to a conclusion that firm 2 does not have a dominant strategy because it is dependent on firm 1. If firm 1 advertise it advertise firm 1 is not advertising, it is not advertising. Now, we will analyze for firm 1 1. If firm 2 advertise then it is better for firm 1 to also advertise. Why it is better for firm 1 to also advertise? Because 50 the payoff of advertising is greater than 40 which is the payoff for not advertising.

This is one situation. 2nd when firm 2 is not advertising. In this case if firm 2 is not advertising, if firm 1 is advertising they get a payoff of 60. When firm 2 is not advertising and firm 1 is also not advertising they get a payoff of 65. So, not advertise is the payoff of not advertise is greater than the payoff for advertise. Now, what is the best for a firm 1 here the or may be if you can conclude here that if firm 1 should advertise, if firm 2 is advertising. And firm 1 is not advertising, when firm 2 is not advertising.

So, we can say again here that firm 2; firm 1 is also having no dominant strategy because it is dependent on whatever the strategy taken by whatever the strategy taken by firm 2. So, if firm 2 is advertising, firm 1 is also advertising. And, if firm 1 firm 2 is not advertising firm 1 is also not advertising. So, in this case also if you look at there is no dominant strategy for firm 1 because it is not the best whatever the best that depends on dependent on the rivals action. And, in this case there is no specific action. It is all the dependent on the whatever the best that is dependent on the rivals action. So, in this case if you look at neither firm 1 nor firm 2 they have a dominant strategy. Now, how we should reach or how we should find out the equilibrium output over here or whether it is possible to get the Nash equilibrium.

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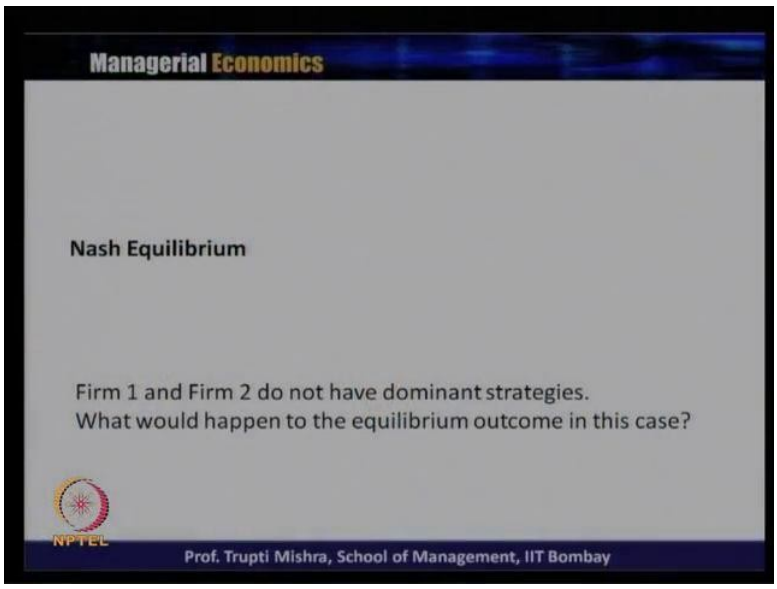

So, we have, we have checked a situation we have analyzed a situation where firm 1 and firm 2, they do not have the dominant strategy. What would happen to the equilibrium output in this case.

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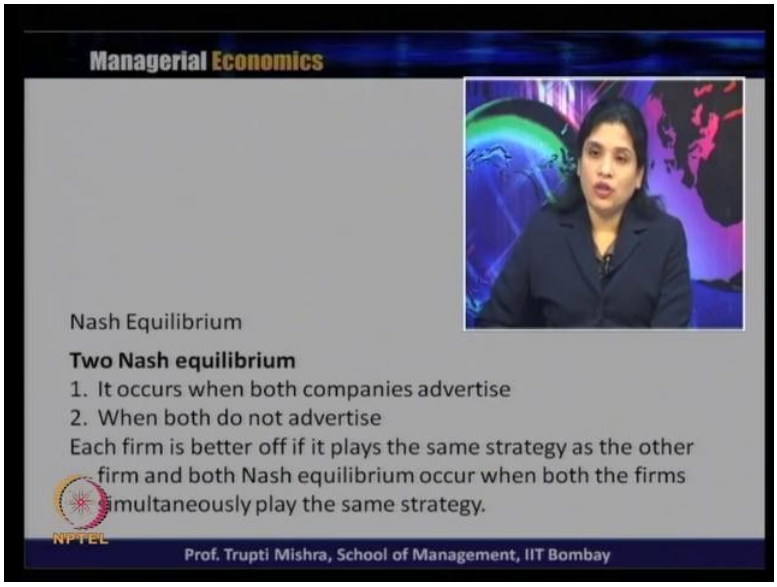

Here we will get to Nash equilibrium; we will not get a individual Nash equilibrium for the entire situation. Here we will get 2 Nash equilibrium. 1 Nash equilibrium it occurs when both companies they advertise. When firm 1 and firm 2 they are advertising both of them they are

advertising we get 1 Nash equilibrium. And, when both of them they do not advertise we get another Nash equilibrium. So, when the dominant strategy of 1 is not matching with the dominant strategy of others or maybe there is a absence of the dominant strategy for both the firms over here. We will not get a individual Nash equilibrium for the entire game rather we will get 2 Nash equilibrium.1 Nash equilibrium occurs when both company advertise. And, 2nd Nash equilibrium occurs when both the firms they are not advertising.

And, here each firm is better off if it play the same strategy as the other firm. So, if 1 firm is advertising the other firm should also advertise. And, if the other firm is not advertising this firm also should not advertise. And, simultaneously both the Nash equilibrium occurs when both the firms simultaneously play the same strategy. So, it is not that when 1 firm is advertising and the other firm is not advertising the Nash equilibrium will come rather Nash equilibrium will come when both the firms simultaneously play the same strategy. If one is advertising the other one is also advertising, And, if 1 firm is not advertising the other firm is also not advertising. And, Nash equilibrium come Nash equilibrium comes when both the firms they play the same strategy at a particular point of time.

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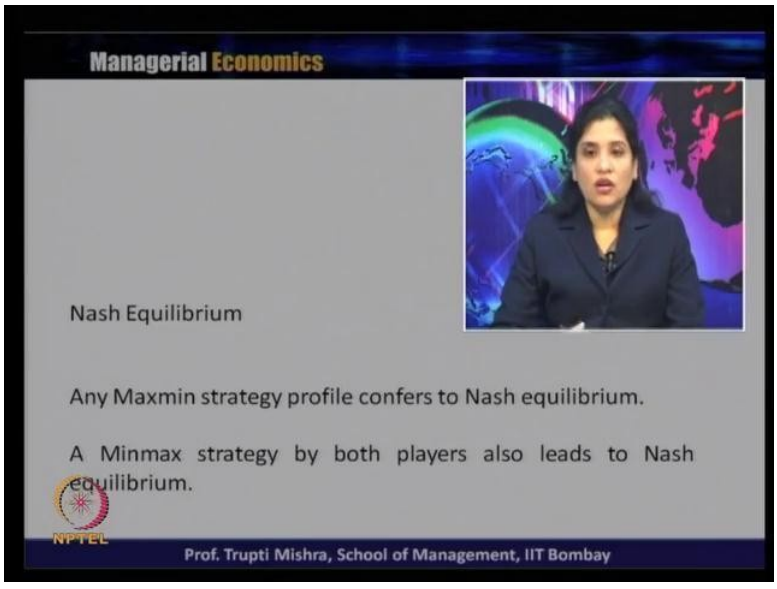

So, any maxmin strategy profile confers to Nash equilibrium because maxmin strategy generally this is the maximization of the worst payoff that confess to Nash equilibrium. And, also the minmax strategy where both the player also lead to Nash equilibrium. So, in the 1st case maximizing the worst payoff by both the players that will need to Nash equilibrium because it is basically in that case the player chooses a strategy which maximizes the payoff among the worst payoff; so that, in that case also, we can get a Nash equilibrium. And also, in

case of minmax strategy, where the strategy is not to maximize something of the own pay off rather to minimize the payoff for the others. And, that is why the minmax strategy for both the players if you look at because one firm generally try to minimize the payoff for the others. And, at the same time the other firm is also trying to minimize the pay off for the other firm. And, in this case generally that also leads to a kind of a Nash equilibrium.

Then, we will discuss interesting generally, which is more common it is a kind of game generally followed to understand the human behavior rather than typical profit maximizing firm. And, how this specific game is also a part of if you look at also a part of the economic theory; because it is basically individual but when we generalize this to the individual firms or the economic agents generally they behave in that situation.

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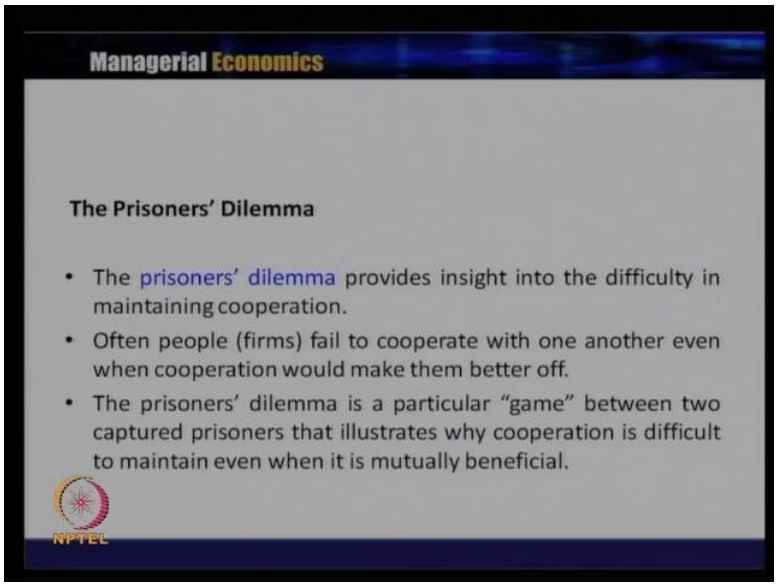

So, we will start like interesting case study or interesting kind of game where the basically the moral of this case study is that even if cooperation is profitable still they will not cooperate with each other because they feel that this is not going to the best for them. So, prisoners dilemma generally provides and insight into the difficulty in maintaining the cooperation. And, even if the cooperation is profitable still they find it difficult in maintaining the cooperation. And, which is the reason they never reach to the optimal solution they always get into a sub optimal solution. So, often people or when it comes to oligopolist firm. They fail to cooperate with one another even when they when cooperation would make them better off. So, they fail to cooperate whether it is a case of individual

economic agent or whether it is a case of a firm they fail to cooperate with each other, when the cooperation would make them better off.

So, this prisoners dilemma it is a particular game between 2 capture prisoners that illustrate why cooperation is difficult to maintain even if when it is mutual beneficial. So, this is the, if you look at this is the case study of 2 captured prisoners. And, when they, they were captured by the authority they knew that the cooperation is going to help them out the cooperation is profitable but it always is difficult to maintain the cooperation. Finally, they land into a situation, which is sub optimal but that is not the optimal solution or that is not best solution for them.

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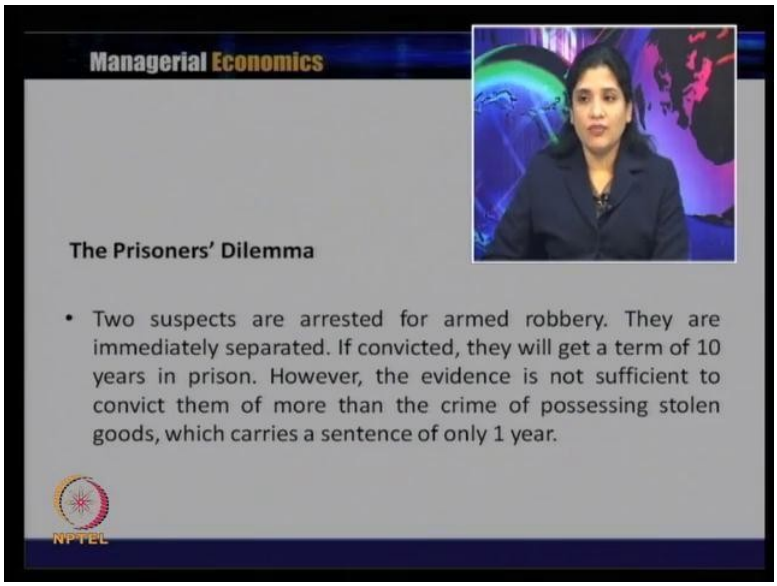

So, here two suspects, the story goes like this or the case study goes like this. Two suspects are arrested for a armed robbery. They are immediately separated they are taken into prison. So, the suspect they are arrested at for some robbery.