**Managerial Economics**
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**Lecture - 70**
**Oligopoly and Game Theory**

Then, we will talk about the kind of strategy.

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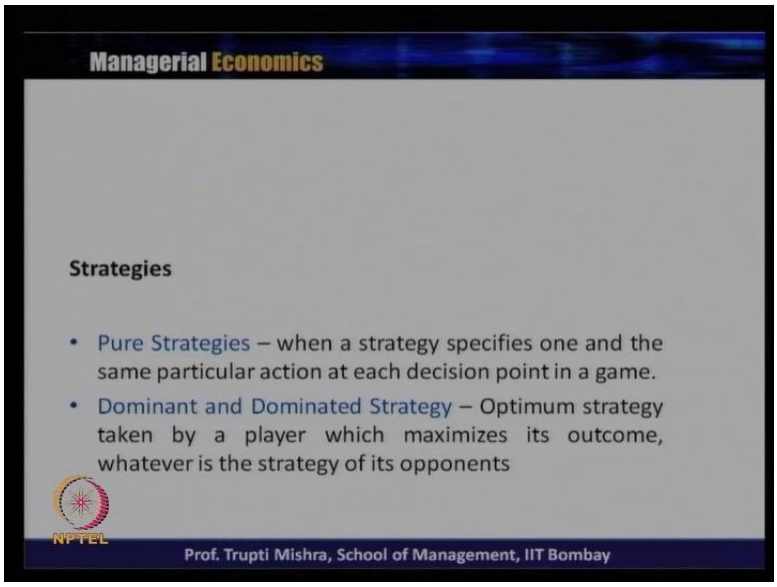


So, the first strategy comes here is pure strategy. What is pure strategy? When a strategy specifies one and the same particular action at each decision point in a game that is generally known as the pure strategy. So, if the strategy specify if whether it is about taking a decision on output, taking a decision on sales, taking a decision maximizing profit, taking a decision on advertising, whatever the strategy whatever the decision point. If the same particular action is going to follow or the strategy specify the same particular action for each decision point, this is generally known as the pure strategy.

Then, we have dominant and dominated strategy optimum strategy taken by player which maximize its outcome whatever the strategy of its opponent. So, what is dominant strategy? The optimum strategy that is taken by the player which maximize its outcome irrespective of whatever may be the strategy of the opponent. So, whatever the optimum strategy taken by one firm keeping in the view, whatever may be the strategy by the other firm, if that is giving the best outcome that is generally known as the dominant strategy.

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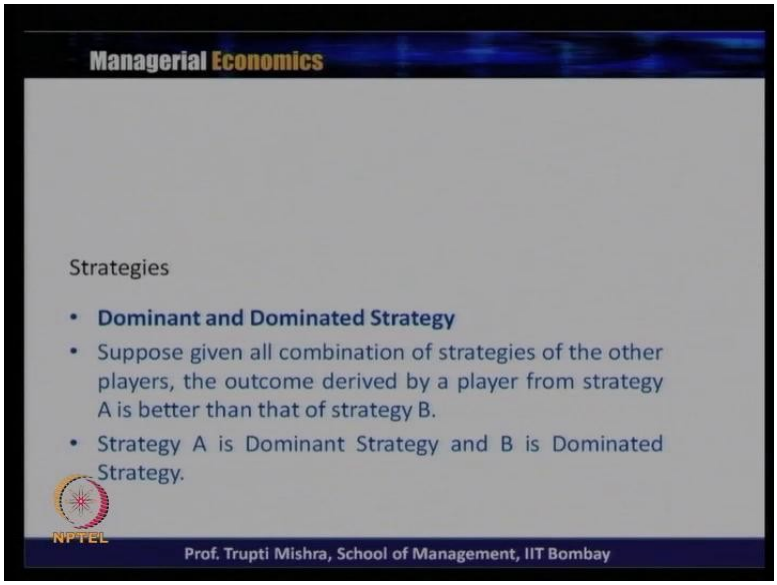


So, we will just take an example to understand this dominant strategy. Suppose, given all combination strategy of the other player, the outcome derived by a player from strategy A is better than strategy B. Generally, strategy A is the dominant strategy. So, given all possible combinations of strategy of the other player, if the outcome by a player from strategy A is better than strategy B. In this case, strategy A will be known as the dominant strategy and strategy B is the dominated strategy. Why strategy B is the dominated strategy? Because it is not the best looking at whatever the strategy taken by the rivals or whatever the strategy taken by all the possible strategy taken by the opponents.

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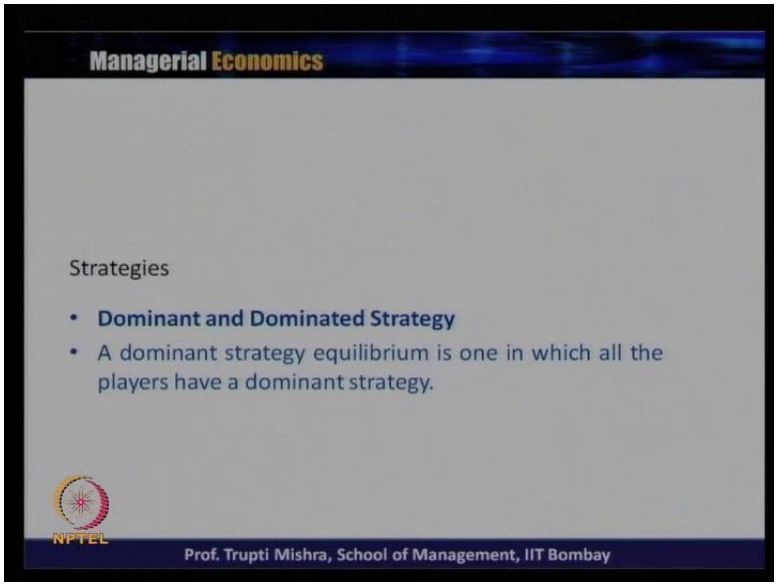

So, a dominant strategy equilibrium is one in which all the players have a dominant strategy. So, it is not about the Nash equilibrium. It is about the dominant strategy equilibrium and dominant strategy equilibrium is one where all the players, they have at least one dominant strategy and through that, we reach to the dominant strategy equilibrium. So, suppose one player is having a dominant strategy, other player is not having. We cannot get dominant strategy equilibrium in that particular game.

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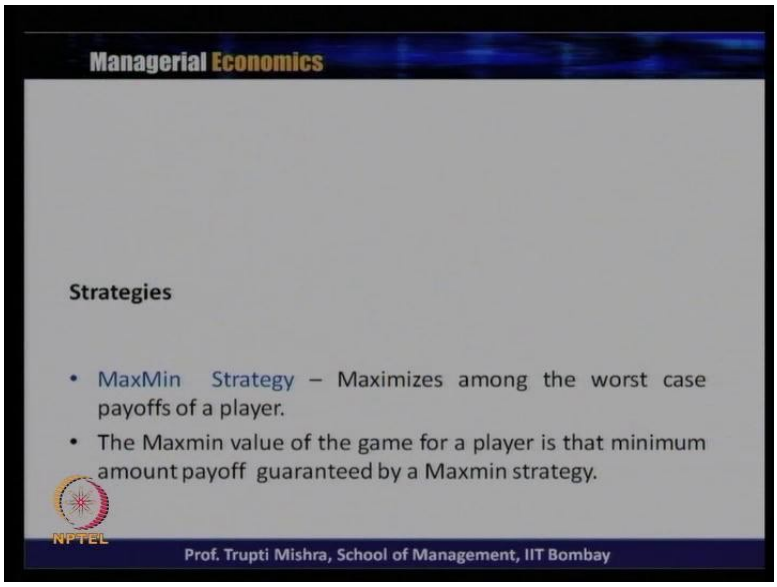


Then, we have maximum strategy. Maximum strategy is the one which maximize among the worst case payoffs of the player and Maxmin value of the game for player is that minimum amount payoff guaranteed by a Maxmin strategy. So, Maxmin value of the game for a player that is at least minimum the player is getting if they are playing this particular strategy.

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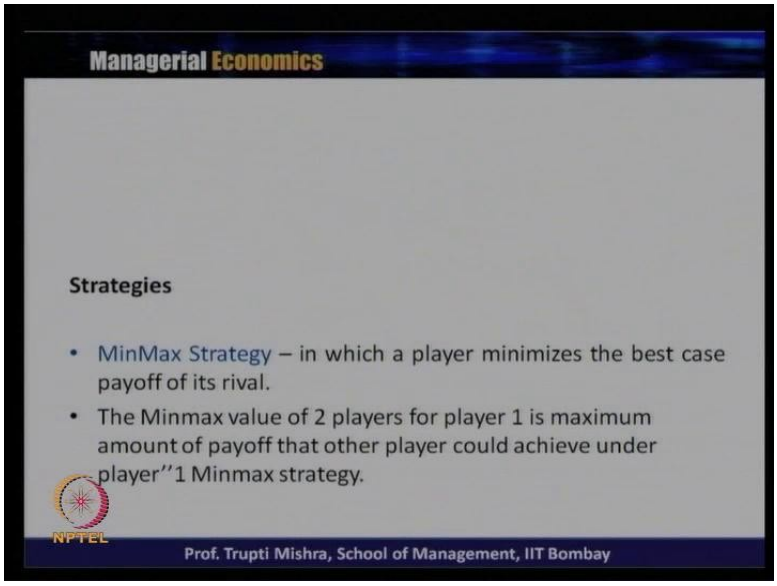

Then Minmax strategy in which generally player minimize the best case payoff its rival. So, whatever the best case payoff the rivals, this particular player try to minimize this and the Minmax value of 2 players for player 1 is maximum on the payoff that other player could achieve under player 1 of the Minmax strategy. So, Minmax value of 2 players for player 1 is maximum amount of payoff what that can be achieved under the player Minmax strategy.

We will understand all this strategy by just taking the example. We will start with the dominant-dominated strategy, Maxmin-Minmax strategy and also, we will see whether we have a Nash equilibrium just taking this example.

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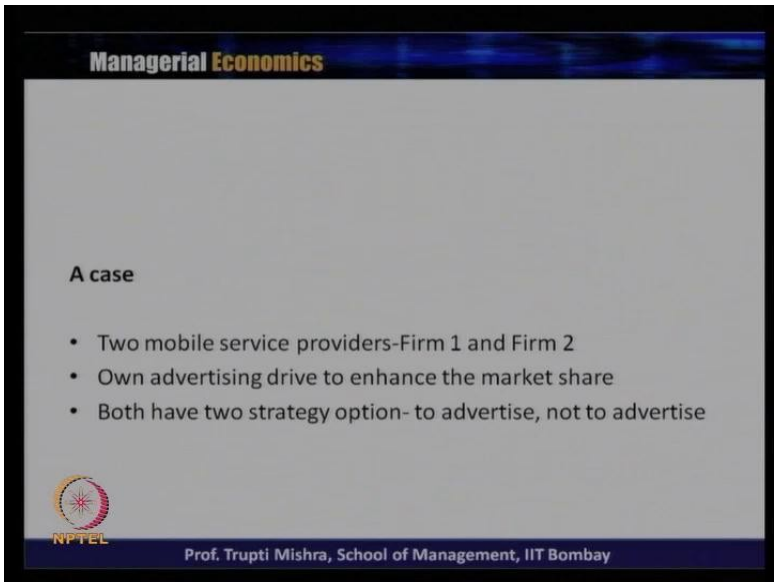


So, there are two mobile service providers in the market. One is firm 1 and second one is firm 2. They have their own advertising drive to enhance the market share . So, both have two strategy option- either to advertise or not to advertise. So, two mobile service providers, one is firm 1 and other is firm 2, they have their own advertising drive to enhance the market share. Both have two strategy options- either to advertise or not to advertise.

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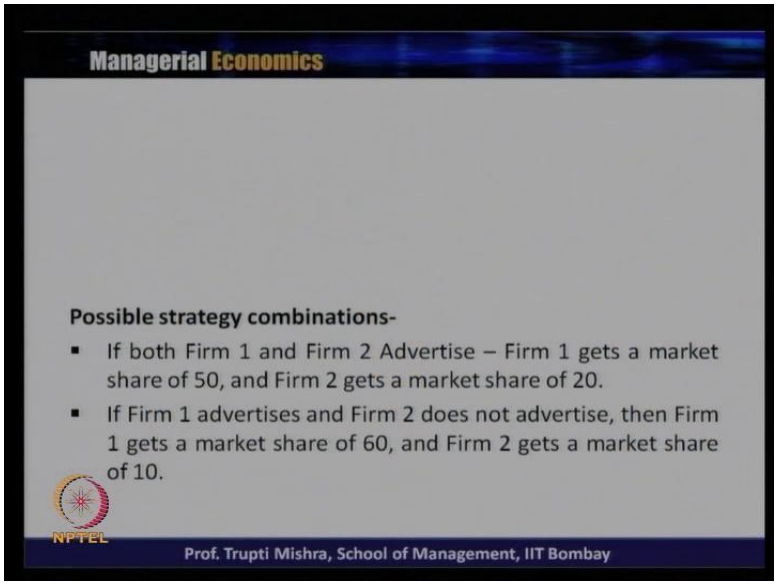


Now, what would be the possible strategy combinations? If both firm 1 and firm 2 advertise, firm 1 get a market share of 50 and firm 2 get a market share of 20. So, if firm 1 and firm 2 both of them are advertising, the outcome is he has to maximize the market share by advertising. So, in this case, if both of them are advertising, firm 1 get a market share of 50 and firm 2 get a market share of 20.

If firm 1 advertises and firm 2 does not advertise, the firm 1 get a market share of 60 and firm 2 get a market share of 10. So, when both of them are advertising, firm 1 get 50 and firm 2 gets 20. When firm 1 only advertises and firm 2 does not advertise, then firm 1 get a market share of 60 and firm 2 get a market share of 10.

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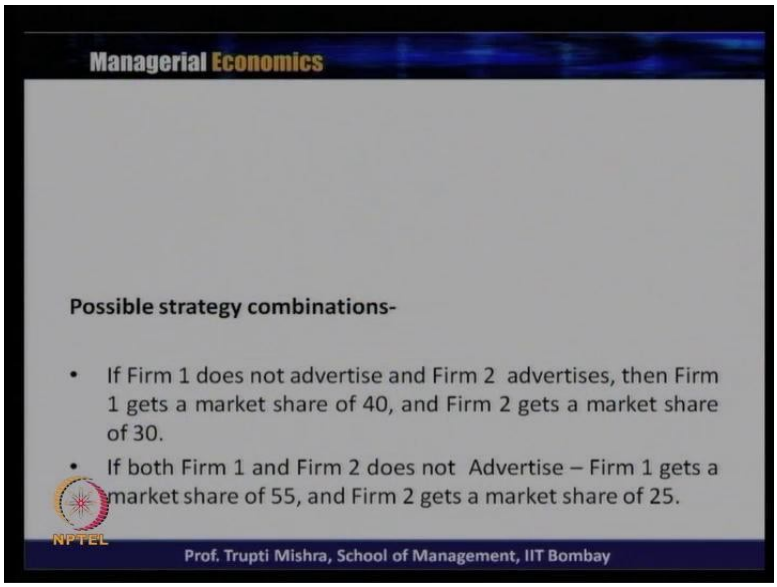

If firm 1 is not advertising and firm 2 advertises, then firm 1 get a market share of 40 and firm 2 get a market share of 30. If both firm 1 and firm 2 does not advertise, then firm 1 get a market share of 55 and firm 2 get a market share of 25.

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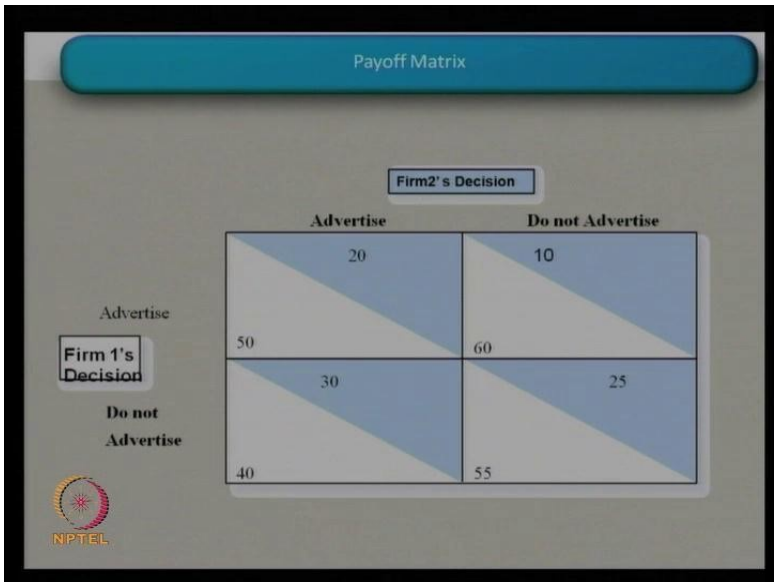


Now, this is the payoff matrix. On the basis of their strategy, now we will take this payoff matrix to understand what is their dominated strategy, what is their dominant strategy, what is the Maxmin strategy, what is their Minmax strategy and whether they are reaching the equilibrium or not, whether they are reaching the Nash equilibrium or not.

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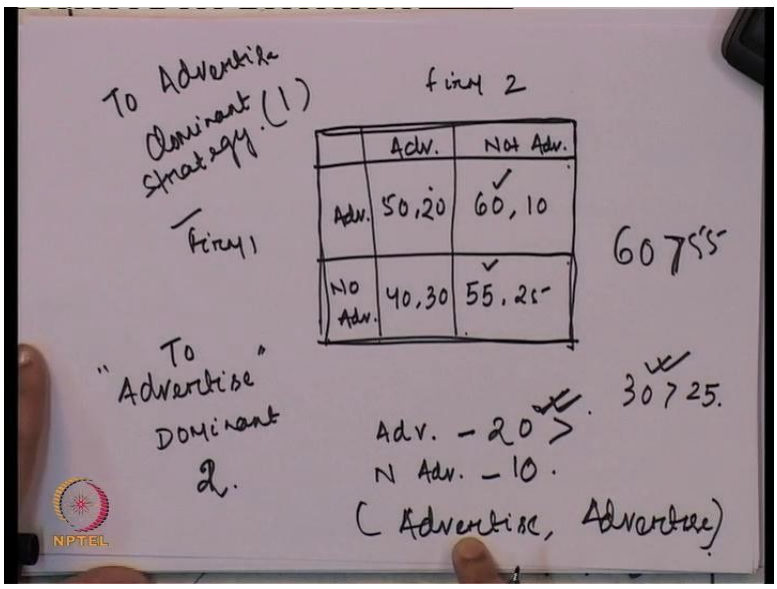


So, we will just take this payoff to understand these different strategies. So, let us call this is firm 2, this is firm 1, this is advertise, this is not going for advertise. This is again advertise, this is not going for advertisement. So, when both the firms are advertising, then firm 1 get

market share of 50 and firm get 2 get a market share of 20. When firm 1 is advertising and firm 2 is not advertising, then firm 1 get 60 and firm 2 get 10. When firm 2 is advertising and firm 1 is not advertising, then firm 1 get 40 and firm 2 get 30. When both of them are not advertising, then firm 1 get 55 and firm 2 get 25.

Now, we will understand what is Maxmin, what is the Minmax, what is the dominant strategy or whether they are reaching equilibrium or not. We are assuming that firm 1 and firm 2 both have to be rational. Now, we will understand this from the firm 2 point of view. Now, if firm 1 is advertising and firm 2 will choose strategy advertising and here they are getting 20 rather than 10. So, if firm 1 is advertising and firm 2 has two options, either they have to advertise or they have to not advertise. If they are advertising, they are getting 20. If they are not advertising, they are getting 10. So, since 20 is greater than 10, if firm 2 is going for advertising, they are getting a better payoff by advertising.

Now, we will analyze the case for firm 2 when firm 2 is not advertising. So, here if firm 1 is not advertising, then it gets 30. If he is advertising, then he gets 30, but if he is not advertising, he is getting 25. So, in this case, again 30 is greater than 25. So, what is the dominant strategy for here because whatever firm 1 does, whether advertise or not advertise, always advertising is the best option for firm 2 and since, advertise is the best option for firm 2, to advertise is the dominant strategy for firm 2.

Now, how it is a dominant strategy? Because when firm 1 is advertising and firm 2 is also advertising, they are getting a payoff of 20 rather than not advertising. When firm 2 is not advertising, it is getting a payoff of 30 by advertising which is more than the payoff which is not advertising. So, whether firm 1 advertise or not advertise, always the payoff is maximum for firm 2 when they are advertising like 20 and 30 and that is why to advertise is the dominant strategy for firm 2.

Now, we will analyze this from firm 1 perspective. Now, suppose firm 2 advertise. What firm 1 will do if he is advertising, he is getting 50. If he is not advertising, he is getting 40. So, if firm 2 is advertising, if firm 1 is advertising, he is getting a better payoff rather than not advertising and when firm 2 is not advertising and firm 1 is advertising, he is getting a payoff of 60. Firm 2 is not advertising and firm 1 is not advertising, then he get a better payoff of 55. Since, 60 is greater than 55 and in both these cases, whether firm 2 advertise or not advertise, firm 1 is getting a better payoff in advertising.

So, when firm 2 is advertising, this is the payoff. When firm 2 is not advertising, this is the payoff. When firm 1 is advertising that is where for firm 1 is also to advertise is the dominant strategy. Dominant strategy for firm 1 also. How do you interpret this? Dominant strategy irrespective of whatever the action are taken by the other firm to advertise is the best possible action or the best strategy by the firm. So, in this case, dominant strategy for both the firm, what is the dominant strategy for firm 1 to advertise what is the dominant strategy for firm 2 to advertise.

Since, both the firms have the dominant strategy, we get a equilibrium and the equilibrium gives us a strategy that is advertise. This is the payoff or this is the strategy advertise both the firms and this gives us the equilibrium. Since, both of them have the dominant strategy, this is generally the dominant strategy equilibrium. Then, we will understand the Maxmin and Minmax strategy taking the specific example.

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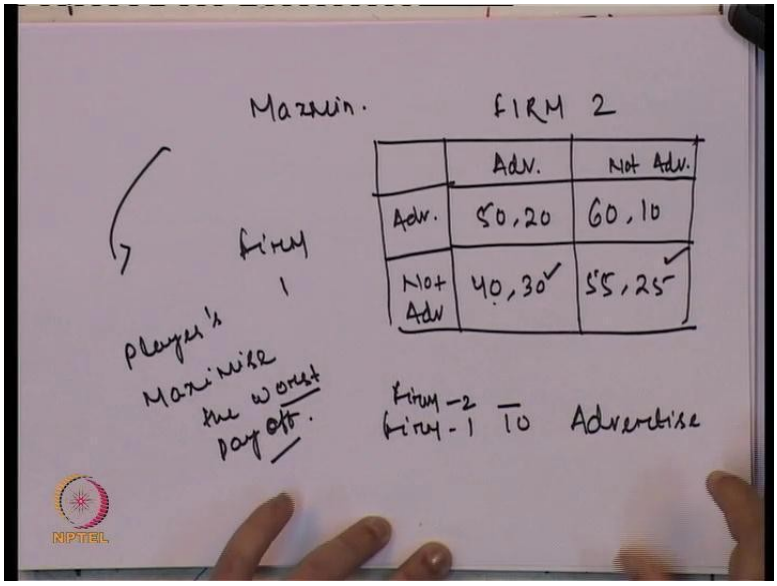


So, to start with, we will do the Maxmin. We will just do the payoff matrix once again to understand this. So, advertise not advertise, advertise not advertise. So, this is firm 2 and this is firm 1. So, this is 50, 20, 40, 30, 60, 10, 55, 25. Now, to understand Maxmin, what is Maxmin? Players will try to maximize the payoff. The worst payoff, maximize the worst payoff.

Now, how this worst payoff will come? That will come from the strategic behavior. What worst can happen for firm 1 if they advertise? They get 50. If they are not advertising, they

get 40. They try to maximize that they should advertise because they are getting a highest payoff . So, for them what is the Maxmin strategy? The Maxmin strategy is to advertise.

Similarly, when the other firm is not advertising, what is the payoff for them? If they are advertising, they get 60. If they are not advertising, they are getting 55. So, for them what is best? Again, if they are advertising when the firm 2 is not advertising also. So, this is the pay off, that is 50, 40, 60, 55 related to the two kind of strategy when they are advertising and when they are not advertising. They will try to maximize the value, they are trying to maximize the payoff. So, the worst payoff can be 40. If they are not advertising and firm 2 is advertising and if they are not advertising when firm 2 is not advertising, but since they have to maximize the profit. They will take always the highest payoff and that is why the Maxmin strategy for firm 1 is to advertise. Similarly, we will understand for firm 2.

Now, for firm 2, if the firm 2 is advertising, they get 20. They are not advertising, they are getting 30. Similarly, if they are not advertising, they get 30 10 and if they are not advertising, again they are getting 25. So, what is the Maxmin? They have to maximize the payoff here. What is the Maximize here between this advertising and not advertising? It is 20 and 10. So, if they are advertising, they are getting 20. If they are not advertising, they are getting 10 and since, they have to maximize the outcome, since they have to maximize the payoff, they will always take this because this 20 is the highest payoff.

Similarly, when it comes to firm 2, when firm 1 is not advertising, if they are advertising, they are getting 30. If they are not advertising, they are getting 25 and since, 30 is more than 25, they have to maximize the value and they will take 30. So, it is always the Maxmin strategy. For firm 2, it is also to advertise. Then, we will understand the Minmax strategy. What is the logic for Minmax strategy? The player will try to minimize the payoff for the opponents by their own strategy or by their own action. So, to put it simply, when firm 1 will decide whether to advertise or not advertise, they look at which one will give the minimum payoff to the opponents because that will be chosen by them and that is why they look for that how to minimize the payoff of the opponents rather than how to maximize the payoff of their own firm.

What generally they look it in the Maxmin strategy? So, Minmax strategy, their focus is to minimize the payoff of the rivals or to minimize the payoff of the opponent.

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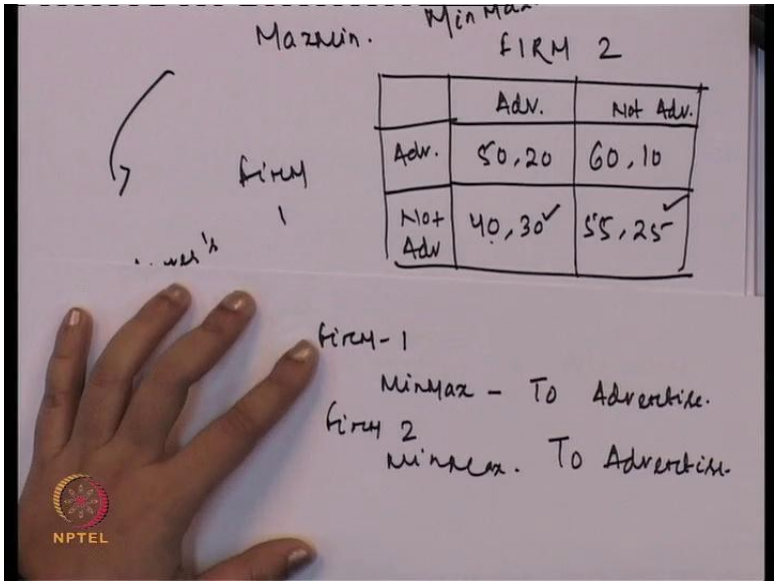


So, if you will if you will take now about the Minmax, we will take for firm 1. Now, what can be the Minmax? When it comes to firm 2, when they are advertising, what is best to firm 2? They have to also that is 20. When they are not advertising, what is best for firm 2? That is 30, but if they are not advertising, the other one is getting 25.

So, now what he will do? Firm 1 will try to advertise, so that firm 2 is also advertising and they are getting a less payoff rather than not advertising, because if firm 1 is not advertising, it is getting a highest payoff in both the cases, whether firm 2 advertise or not advertise, but if firm 1 is advertising, whether firm 2 advertise or firm 2 is not advertising, still they get a payoff which is lower than their counter part and that is why the Minmax strategy for firm 1 has to be advertised.

Similarly, we will now understand from firm 2 perspective. Now, for firm 2, if they are advertising, what is the payoff for firm 1? That is 50 and if they are not advertising, that is 40. When firm 2 is not advertising and the firm 1 is advertising, they are getting 60 and not advertising, they are getting 55. So, since 50 is less than 60 and 40 is less than 55, firm 2 will feel that it is better to advertise because they are getting a lower payoff whether they are advertising or not advertising. So, in that case the Minmax strategy for firm 2 will be also to advertise because if they are advertising, that gives the less payoff to the firm 2 rather than not advertising. So, this is how we understand this dominated strategy and Maxmin and Minmax strategy.

Now, in this case, in the particular case, if you look at all the strategy whether it is dominant whether it is Maxmin or whether it is Minmax, all the strategy they are to advertise for both the firm. This may not happen in all these cases. There may be also whatever the dominant strategy of that may not be the dominant strategy of B or it may happen that there is a dominant strategy for one player, but there is no dominant strategy for the other player. So, in this case, the possibility is that we will not get a dominant strategy equilibrium where there is a dominant strategy for both the players.

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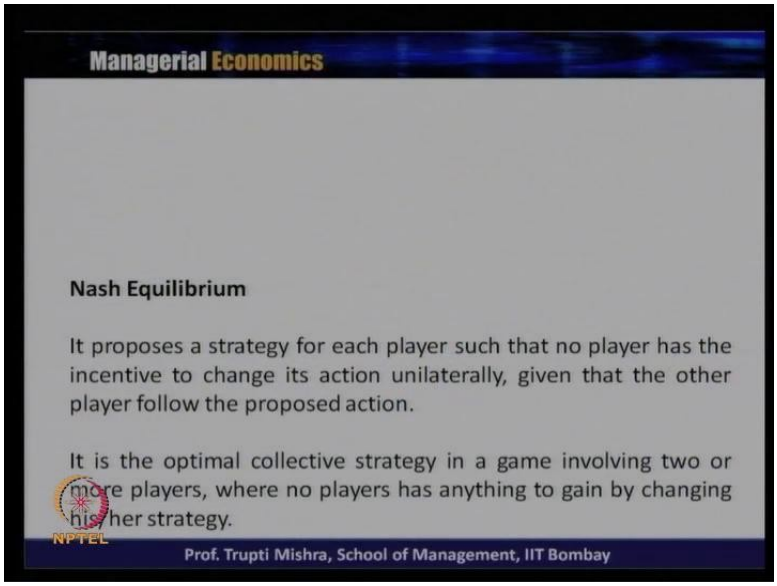


Then, we will talk about Nash equilibrium. Nash equilibrium generally propose a strategy for each player such that no player has the incentive to change its action unilaterally, given that the other player follow the propose action because again equilibrium is a state of balance, equilibrium is a state of rest. Beyond this, there is no incentive for the other firm to go for this equilibrium because that is the place where they get the maximum profit or maximum positive outcome.

So, generally Nash equilibrium propose a strategy for each player such that no player has change incentive to change its action unilaterally, giving the other players to follow the proposed action and it is an optimal collective strategy in a game involving two or more player where no player has anything to gain by changing his or her strategy.

So, we will understand this Nash equilibrium taking our previous example. We will take out the payoff matrix where it is a case of two firms that is firm 1 and firm 2 and they have two options to advertise or not advertise and the final output is in term of the payoff that is whatever the outcome they are getting.

So, here we will add one more new assumption and the new assumption is here that firm 1, you just typically expensive advertising agency and since, the advertising agency is doing advertisement for them that increase their cost of production and here, the firm would try to shift the burden to the consumer in term of increase in the price of the product, so that the company gets lesser market share when it advertise as compared to when it does not advertise.

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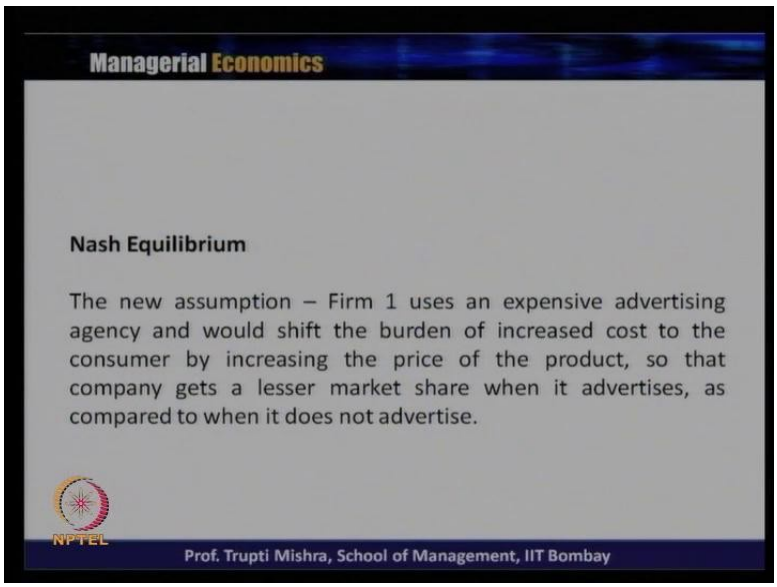


So, since they are shifting the burden of the increasing cost to the consumer, it is obvious that the market share will decrease because when price increases, even if it is a good product, still some amount of the quantity demanded decreases. So, that will increase the price of the product and that will decrease the market share and company gets a less market share when its advertise compared to what when it does not advertise.

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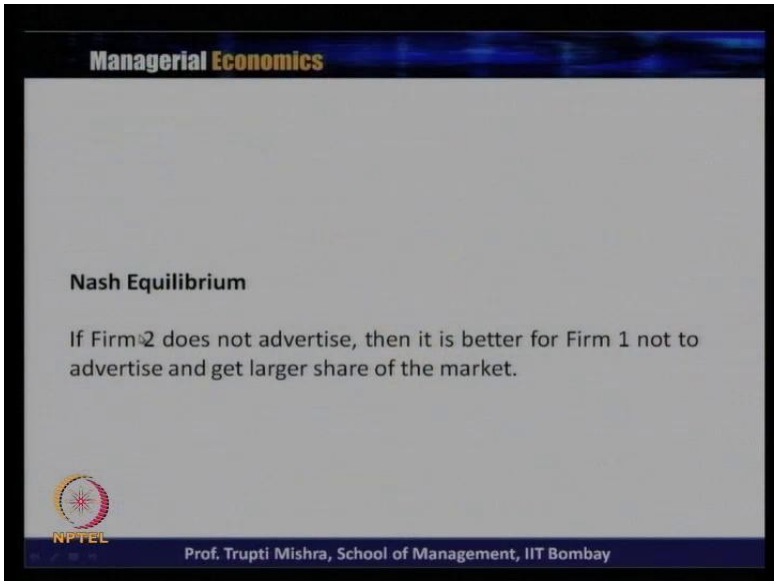


So accordingly, our payoff matrix will change; and if firm 2 in this case does not advertise, then it is better for firm 1 not to advertise and get a larger share of market. Now, here in one case, firm 1 is doing an expensive advertising and they are passing the cost to the consumer and second case, in continuation to that they are getting a less market share, but if firm 2 does not advertise here, then it is better for firm 1 not to advertise and get a larger share of market.

So, here what is the best action for firm 2? They are doing the advertising because firm 2 is also doing the advertising; if firm 2 is not doing the advertising, now what is the best choice for firm 1? Best choice for firm 1 is not to advertise, because if they are not advertising, they do not have to spend for a advertising agency, there is no increase in the cost of production, there is no increase in the market price, there is no decrease in the market share; and if there is no decrease in the market share, this is the best possible action at the best possible strategy for firm 1.

So, we will continue our discussion on Nash equilibrium. Taking this specific example, we will talk about the different types of gain, we will talk about the pralines dilemma and we will talk about that how this game theory is applied specifically to few of the oligopoly's model in our next session.