Foundation Course in Managerial Economics
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Lecture - 38
Oligopoly – Game Theory

Welcome back to our discussion on oligopoly. In this module we are going to talk about game theory. Game theory is a very important tool in understanding how different individuals or different decision makers how they make decisions or how they make strategy depending on the moves when they are specially involved in interaction with other decision makers and they try to they have some objective in mind and they make decisions to attain that objective and how do they take into account the decision of the other stakeholders there and game theory is a very interesting and important tool which helps us in doing that.

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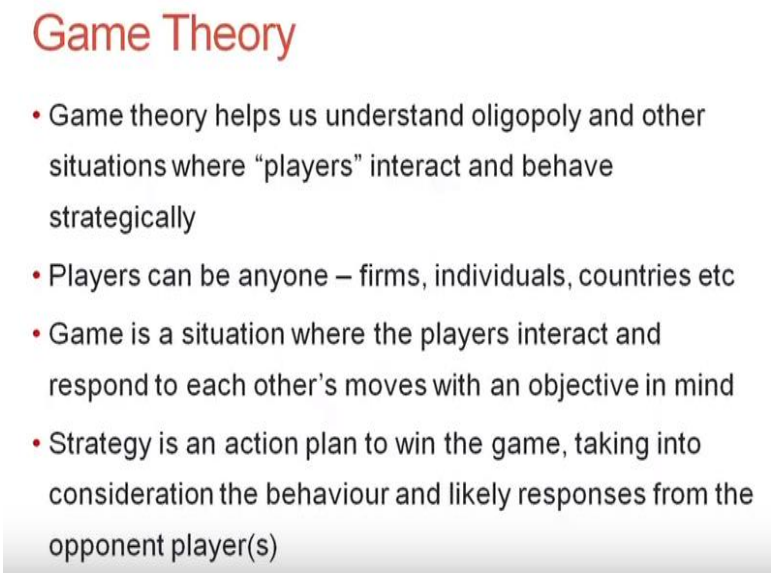

So game theory helps us understand oligopoly and other situations where players interact and behave strategically. The reason that we are doing game theory in our discussion of oligopoly is because as we have I have iterated a number of times that oligopoly is a situation where each of the players in the market or each of the producers in the market continuously keeps a watch on what the rivals are doing and accordingly they act on their self-interest and they take into account all information they have or understanding they have of their rivals and decide on the price to charge and output to produce in the market and so since it involves a strategy making process for

the firms, game theory is an important tool which will help us understand the minds of the oligopoly players better.

So players can be anyone. Players could be firms, it could be individuals, it could be countries etc. So we are going to do some game theory examples in the following modules and we are going to see that how this tool can be applied not only in case of economics and not only in case of understanding firms but it can be actually applied to whole lot of situations.

So game is a situation where the players interact and respond to each other's moves with an objective in mind and strategy is an action plan to win the game, taking into consideration the behavior and likely responses from the opponent player or players. So game is a situation where they interact and respond to each other's moves and strategy is how they make decisions.

Strategy is what the players in any situation, players in a game or say the producers in the game of competing for maximum profit in a market setup how they plan strategies or what is their action plan, what is their decision making process so that they may emerge as winners in the game.

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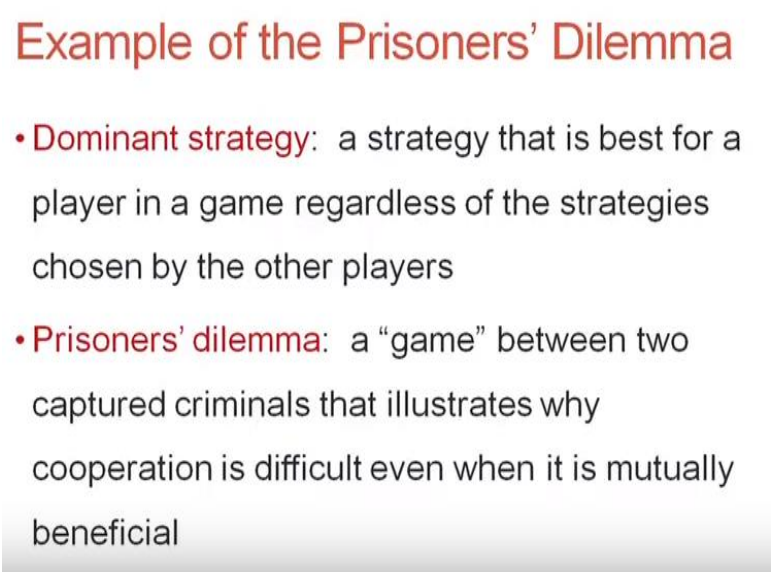

So this is called strategy and to understand that first let us take a very traditional example that is taken in case of game theory which is the prisoner's dilemma. So let me explain the game and so in case of a game there is let us these are some this is a definition which one it would be helpful if we understood this definition is what is a dominant strategy? So we know what a strategy is and what is a dominant strategy?

A dominant strategy is a strategy that is best for a player in a game regardless of the strategies chosen by the other players. So it is a strategy that is best for a player in a game regardless of the strategies chosen by the other players. And the prisoner's dilemma that is the game that we are going to discuss in this module is a game between 2 captured criminals that illustrates why cooperation is difficult even when it is mutually beneficial.

So why cooperation is difficult even when it is mutually beneficial is something we already saw through the example of the 2 firms Vodafone and Airtel that we took in the earlier module and we saw why there is mutual distrust and there is among the 2 firms they act on their own self-interest and they end up producing higher amount of output than the monopoly outcome and they end up getting a lower amount of profit. So this we already have seen in the case of the market outcome and this prisoner's dilemma game is going to illustrate why it is difficult to collude. So let us go to the game.

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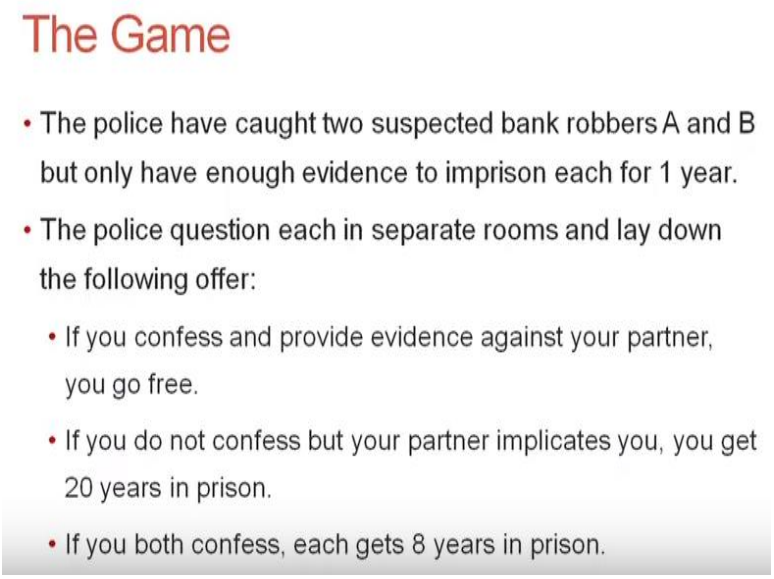

Now what is a game? The game is the police have caught 2 suspected bank robbers A and B but only have enough evidence to imprison each for 1 year. So these are hardcore criminals and they have been caught but the police does not have enough evidence. So the police questions each in separate rooms and lays down the following offer.

If you confess and provide evidence against your partner, you go free. If you do not confess but your partner implicates you, you get 20 years in prison. If you both confess, each gets 8 years in prison. So what happens here is these are 2 criminals who have, the police have kind of idea that

they have committed a whole lot of crimes and but they do not have enough evidence to implicate them.

They do not have enough evidence to put them behind bars and the evidence that they have is only going to put them behind bars for only 1 year and obviously these two are partners in crime so the police knows that they have enough evidence against each other. They know what the other has done and probably if they help the police they will be able to provide enough information or evidence to the police.

So what the police does is they the police puts each of them in 2 different cells. They the police puts each of them in 2 different cells with no contact between each other and this is the offer that the police gives to each of them. To both A and B the police says that look if this is the deal what evidence we have is going to put you behind bars for 1 year.

Now if you confess and you provide enough evidence to against your partner so that your partner is implicated, in that case we are going to let you go free. So you are free. You do not have to serve any sentence and your partner goes behind bars for 20 years. But if you do not confess but your partner confesses and partner gives us enough evidence against you then you go behind bars for 20 years and he goes scot free and if both of you end up confessing, if you have also confessed and the other have also confessed and give evidence against each other, each of you is going to go behind bars for 8 years each.

So this is what the police offers to the 2 convicts A and B. Now what are they going to do? What is in their best interest? So from the game itself as you have already probably understood that it makes sense for them both of them to keep quiet. Had there been a probably a cell phone to talk to each other probably they would really agree that let us both of us let us be quiet although that is also not I do not know if you put yourself in the shoes of those convicts would you be trusting your partner or not. Is he going to tell on me? Should I keep quiet or should I talk? So this decision is what they have to make and this is the game and let us see what it looks like.

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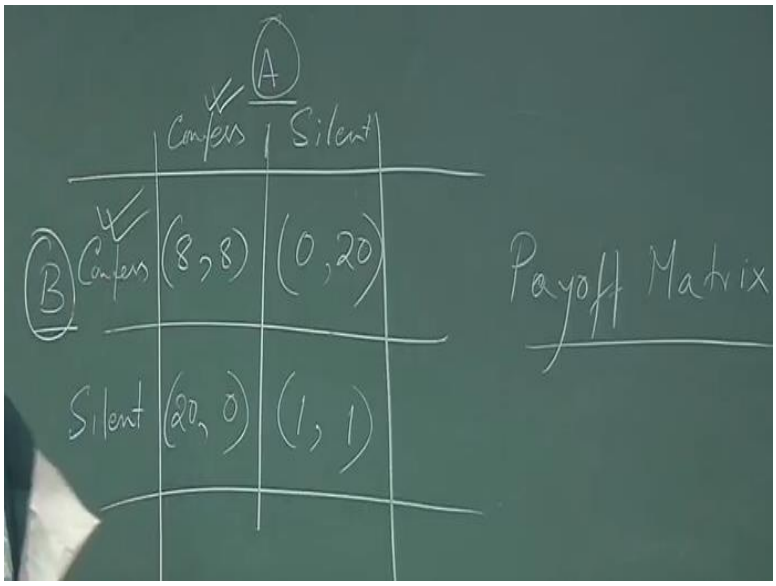

So there is prisoner A and there is prisoner B. So they are they are convicts okay. So and so they have A and B. So they have choices, A can A has the choice to confess or keep silent. Similarly B has the choice to confess or keep silent. Now what happens if both confess? According to what the police has offered to both of them if both confess then each gets a jail term of 8 years.

Now if A remains silent and B confesses then A gets 20 years in prison and B gets away scot free. So since B has confessed, so police will let him go without any punishment and A goes behind bars for 20 years. What happens when A confesses and B is silent? Just the opposite happens and B goes to jail for 20 years and A goes scot free.

And now when both A and B if they keep silent then both go behind bars for 1 year each. So from here it seems that it is probably in their joint best interest to keep silent. Now is it what they are going to do? Let us see. Now A is completely cut off from B and he cannot communicate with him so he just has to keep thinking what is probably B doing, what could probably B do and whatever B's action is, against that what action should I take? This is the way he is thinking.

Now A knows that B has 2 choices, confess or silent. So A thinks if B confesses what is the best strategy for what is the best thing for me to do given that B confesses. Now given that B confesses A's payoff is now when I say payoff let me a quick diversion this is called a payoff matrix in game theory. This is called a payoff matrix. This is called a payoff matrix in game theory where we have the payoffs for different players in each of the quadrants.

So now coming back to this game now that A knows that B has 2 choices either to confess or to keep silent. What happens if B confesses? If B confesses then A knows that if I confess when B

has confessed, I am going to get 8 years in prison. If B confesses and I keep silent then I get 20 years in prison. So this is worse than this outcome so it makes sense for me to confess if B confesses.

But what happens if B keeps silent? If B decides to keep silent what should I do? So A again looks at his own payoffs and sees that if B keeps silent I get 0 years in prison if I confess and if B keeps silent I get 1 year in prison if I keep silent. So here among the 2 payoffs, I am worse off if I keep silent and I am better off if I confess.

So in the situation where B keeps silent, then also it makes sense for me to confess. So in either case no matter what my rival does or what my partner in crime does it makes sense for me to confess. So A ends up confessing. Now coming to B, how does B think? B thinks in exactly the similar way. B thinks in exactly the similar way.

So B thinks that B is going to look at the different payoffs and B also thinks exactly the similar way that A has 2 choices, confess or silent. So if A confesses then if I confess I get 8 years. If I keep silent I get 20 years. If A keeps silent then if I confess, I get 0 years. If I keep silent I get 1 year. So for B also it makes sense to sorry so in that case for B also it makes sense to confess in both the situations.

So no matter what its rival does it makes sense for B to confess and both of them end up confessing as a result of which both of them end up in this box. So both of them end up confessing and both of them end up with a jail term of 8 years which is worse than this situation where they would have got a jail term of only 1 year each. So this is what happens in case of the prisoner's dilemma.

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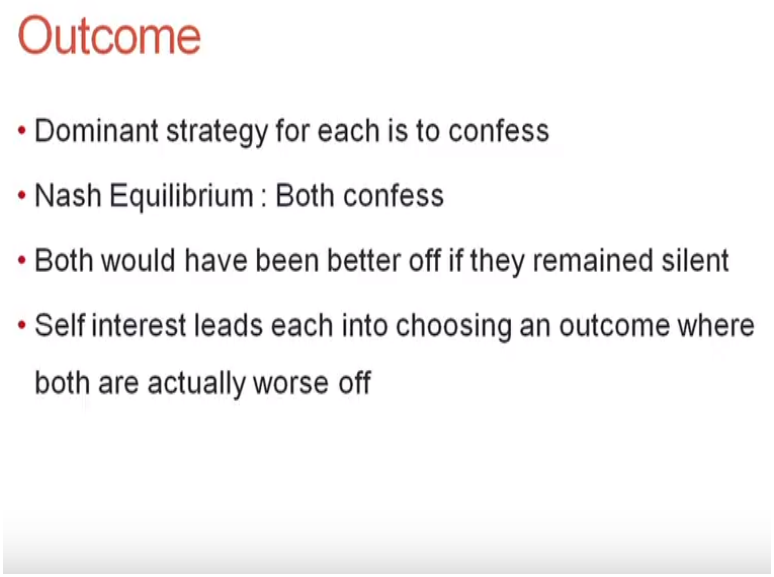

So the dominant strategy for each is to confess and Nash equilibrium is as per our definition of Nash equilibrium what happens in case of Nash equilibrium both the firms so each for the dominant strategy for each firm is to confess because that is if it confesses in both the situation confessing is the better choice, better strategy for A.

So that is the dominant strategy for each of the firms and Nash equilibrium is where both of them confess. Both would have been better off if they remained silent. Self-interest leads each into choosing an outcome where both are actually worse off. So self-interest leads each into choosing an outcome where both are actually worse off.

So this is the so this is the game theory in short and this as you can already probably relate to the oligopoly market outcome that we have already discussed this is the situation of the monopoly. This is the situation of the monopoly where had they cooperated then each would be earning a monopoly profit of 900 each.

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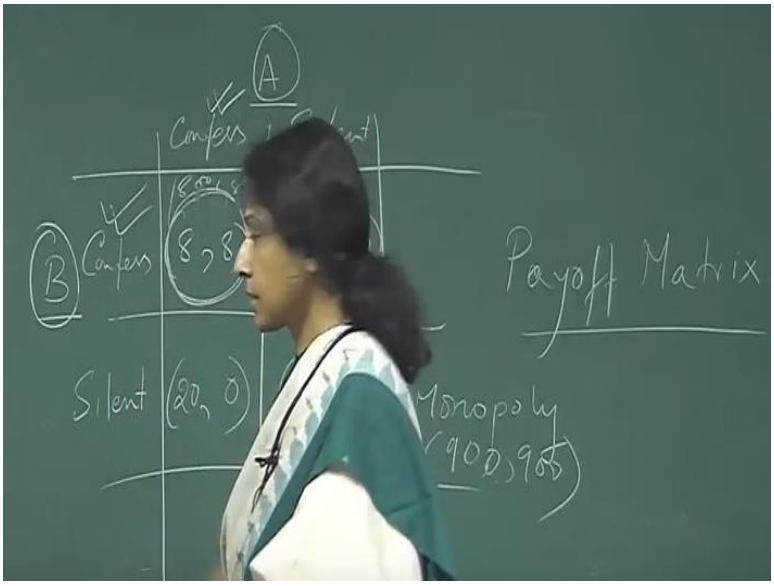

So the payoff would be 900 each but they cannot or each of them firstly they probably do not trust each other that the other is going to stick to the monopoly agreed monopoly output of 30 units so each of them is going to default and produce a higher amount of output and as a result of which both of them end up in this box which is the oligopoly outcome where each of them is going to get a profit of 800 each, so each of them is going to get a profit of 800 each.

So this is so it is very the oligopoly outcome is very similar to our outcome in the case of the prisoner's dilemma and this is the kind of dilemma that the different firms are going to go through when they compete with each other in a oligopolistic setup and they end up at a equilibrium, market equilibrium which is not the monopoly outcome and thankfully for the consumers because they get to pay a lower price and they get a higher amount of output and as the number of firms keep on increasing this payoff goes down and down and ultimately they are they the price is very close to marginal cost and output is very close to competitive output.

So this was our this was an introduction to the game theory. In the following modules we are going to take some examples of game theory and see what happens in different situations in a game theory and we are also going to look at repetitive repeated games what happens if the prisoners are repeated repeatedly caught.

So this could be one single situation where they are caught off guard and police have been able to catch them and put them into cells before they had any chance to communicate with each other. Also going back to this example imagine that they somehow, A and B somehow know that the police is going to pressurize them to own up and the police is probably going to pressurize

them to give enough evidence of talk about the crime and give evidence to the police and before going before getting separated both of them agree that I am not going to talk.

This is what they agree and then they are separated and then the police lays out this offer to each of them. In that situation is the outcome going to be different? Is the outcome going to be different? It is unlikely that the outcome is going to be different because each of the prisoners know that by any chance if the partner defaults then this defaults or if the partner cracks up and talks then he has to go to prison for 20 years.

So the amount of punishment that he is going to get if he keeps silent and his partner talks is so big that he would not take the chance and he is probably going to confess. So even if they have an agreement like in case of Cartel where even if they have an agreement of producing monopoly output they end up producing higher output.

Similarly in this case also even if the partners have discussed amongst themselves not to talk, probably they are going to talk because firstly there is distrust they do not trust their partner fully and secondly they are going to act on their own self-interest. So self-interest comes foremost and it makes sense for them to confess and this is going to be the Nash equilibrium in both the situations whether the two the two criminals get to communicate with each other before talking, before being taken away, before being separated or they do not get to communicate with each other before being separated.

So this is what the game theory game looks like and we are going to discuss a few more games in the following modules. Thank you.