Managerial Economics
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Lecture - 69
Oligopoly and Game Theory

In the last class, we were talking specifically about the group behaviour of the oligopoly's firms; and in that context, one methodology or the one tool emerged as to understand that how the firms they behave or how when they collude or when they are not, when they are competing, how it can be how it can be routed into a typical group behaviour, and what is the tool to understand this group behaviour is generally known as game theory; and in last class as I was telling oligopoly is a market structure, which talks about economics of cooperation, either positively when they collude with each other and also negatively when they are competing with each other.

So, today we will understand game theory, a specific tool to understand the group behaviour and how the firms behave; and when it comes to specific application of game theory, generally we understand the firm's behaviour, and we understand the different company behaviour in a typical oligopoly market. So, game theory has a tool. It has application for variety of the topics or the variety of subject, but specifically in case of economic analysis, we understand that to or we use that to understand the relationship between the firms, when they compete, typically when they compete and how they generally respond to rivals action or rival reaction to their price and output plan. So, to start with, we will talk about the equilibrium situation of the oligopoly, and how we will see the need and how there is a need for the game theory? We will see from there.

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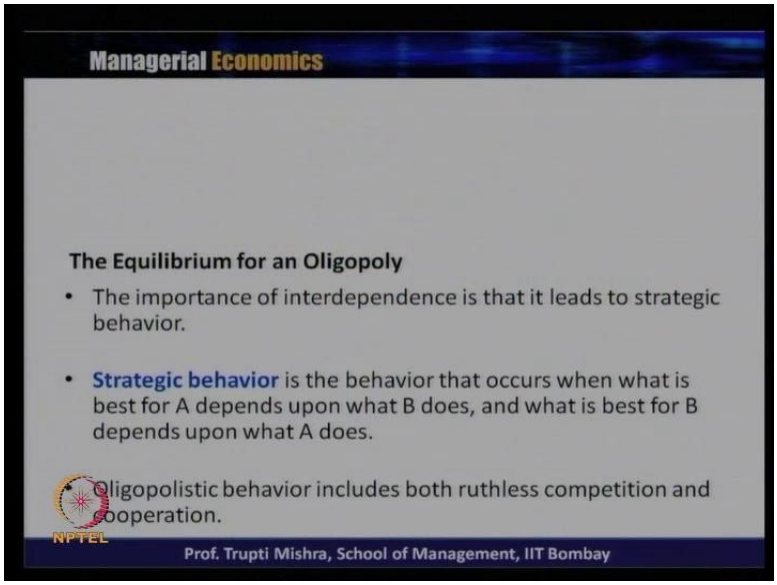

So, when you talk about the equilibrium, in many cases equilibrium is absent in case of oligopoly, because the interdependence, there is interdependence between this firm when it comes to the action and reaction of the firms related to price and output decision. So, there is importance of interdependence in case of the oligopoly's firm. And since, there is interdependence; generally it leads to strategic behaviour.

What is strategic behaviour? Strategic behaviour is the behaviour that occurs when what is best for A depends upon what B does, and what is best for B depends upon what A does. So, strategic behaviour is where the end output or whether profit price output decision or whether the strategy of one firm is not dependent on their own price and output decision or the strategy decision. Rather it is dependent on what is the strategy, what is the output price decision taken by the other firm.

So, in laymen understanding, strategic behavior is one, when what is best for A depends upon what B does and what is best for B depends on what A does. Oligopoly's behavior if you look at it, if you remember, also in the last class what we discussed. Oligopoly's behavior includes both ruthless completion and cooperation. So, when it comes to collusive oligopoly, it is about the cooperation and when it comes to non-collusive oligopoly, it is generally the competition.

Since, its cooperation, since its competition, the behavior is strategic behavior because it is strategic behavior in the sense that the firms well-being depends upon what the other firms does. So, if there are two firms, it is a case of what the duopoly market. If there are two firms,

what is best for one firm that depends upon how the other firm is doing in the market. Whether other is increasing the price, decreasing the price, increasing the output, decreasing the output, what kind of advertising company are using, what is the after sale service they are giving. Based on that, it depends that how is the, what should be the profit or what should be the output, what should be the price for the previous firm.

So, if there are case of duopoly market, there are two firms, A and B. To simply put it strategic behavior is one where what is best for A depends upon what B does and what is best for B depends upon what A does. Now, that can be considered as the strategic behavior.

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Now, there is one evidence that there is limit pricing. What is limit pricing? If you remember in case of the oligopoly's market, we are discussing about the price leadership model where the dominant firm or the low cost firm, they set the price in such a low level that it is difficult to survive for the small firms or the inefficient firm and in that case, they goes out of this market.

So, in order to do this here, this is a kind of strategic behavior comes from the low cost firm or the dominant firm because in term of that, they are restricting the entry. They are creating a barrier to entry to the small firm and that is best for the dominant firm because it gives more market share if the small firm leaves the market. So, this is one of the activity that comes under strategic behavior is that when the price leaders of the market, whether it is A dominant firm or the low cost firm, when they charge such a low price, that makes really difficult for the small firms to survive in the market.

Similarly, we have the price retaliation like whatever the price decided by the market forces, that will not be accepted by the firm and they will charge a price where at least it is not going to make an equilibrium output or equilibrium price and they are going to charge a price and with that price, may be it leads to them to get a larger market share or larger profit. So, this again strategic behavior means the price is such that or the typical firm will charge a price that is having a largest market share. They will charge a price which is not conducive to the market.

Then the capacity expansion. So, capacity expansion is where the large scale firm, they generally operate to a scale operation and when they do a scale operation, they always do at a lower price. So, that when the other firms they try to come into the market, they cannot compete with a high cost firm, low cost firm and they with a low price, rather they have to operate in a high cost.

So, capacity expansion is one where the large firm is not leaving the scope for the other firms to expand in the market and also, they always charge a price which gives them less profit, so that it is not incentive for the other firms to operate in the market and that is why they do an entry restriction through the capacity expansion and similarly for the market saturation also, so that if you look at it, the large firm is continuously going on producing a product and they when the new firm enter into the market, they also change their product style.

So, the new firm has to compete with the existing product of the large firm and also, the new product of the large firm. So, in that way that creates a barrier to enter that it is not about the existing product, also the new product which is given by the by the same brand name. So, if the large scale firm is operating in the market for a longer period of time and also whatever the new product comes from their market; obviously, people they knows the brand, they knows the company and they will have more affinity for that typical product rather than new product in the market.

So, whether to compete with a new firm, the existing firm, go for a new product or about the capacity expansion or about the price leaders retaliation or about the limit price, there are these are all comes under this strategic behavior. Why this is called as strategic behavior? Because all these activities, not only get more market share, more profit for this typical firm rather all this activities are done, so that the other firm should not get into the market or the other firm should not get more market share or more profit.

So, here the activity is not for only the firm itself, rather for how to restrict the market share, how to restrict the profit of the other firm and that is why this is known as the strategic behavior. So, in this case, all this firm what is best for them is not dependent on whatever the activities taken by them, rather what is the best for that firm depends also on how the other firms, they are behaving in the market . So, since it is the case of economics of typically in the oligopoly, it is the economics of competition and economic of cooperation. The strategic behavior is important because the valuing of the one firm is dependent on how the other firms, they are doing in the market.

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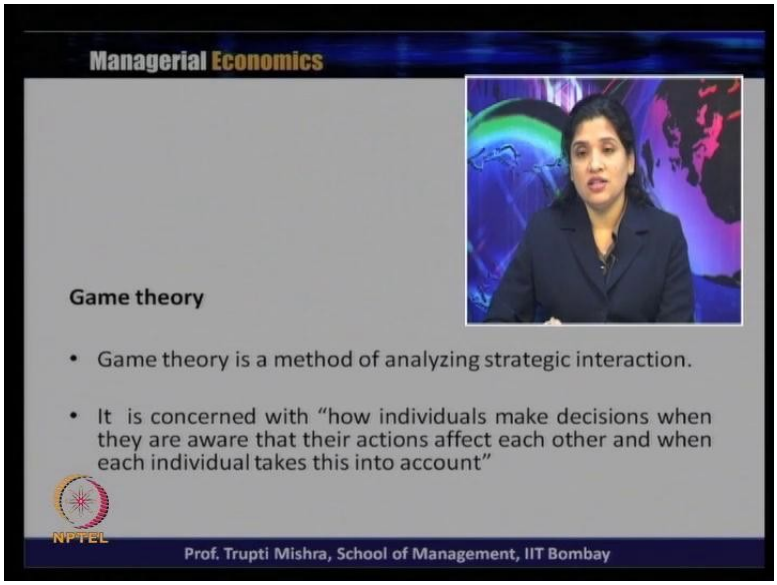

So, here it comes, game theory to analyze this strategic behavior. So, game theory is a method which is generally being used to analyze this strategic interaction or the strategic behavior. It is concerned with how individual make decision when they are aware that their action affects each other and when each individual takes this into account. So, when one individual firm takes a decision, they know that whatever the decision they are going to take, it is not only affecting their own firm but also affecting the other firms. So, in this case, game theory generally analyze the situation when the individual firm is concern or the game theory is concerned with the analysis that how individual firm takes their action or how individual firms react to the situation when they know that this particular action is not only affecting their own firm, also it is affecting the other firms there in the market. So, it is mathematical tool that generally help to study the strategic situation or the strategic behavior.

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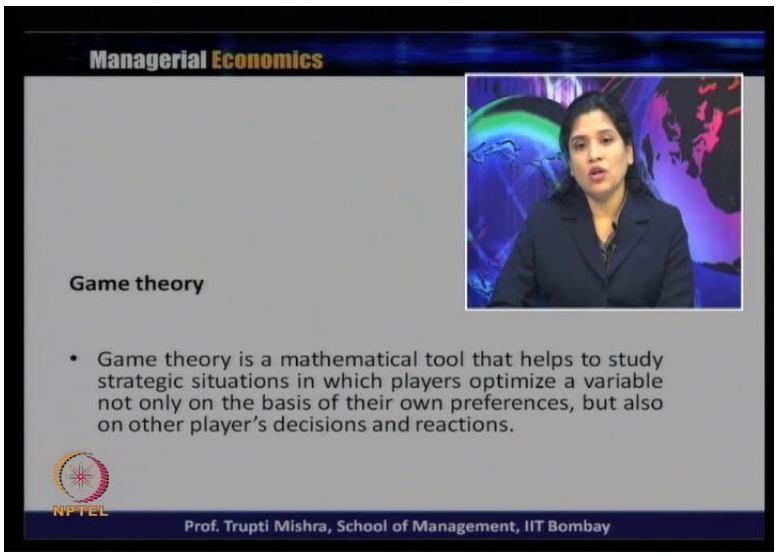

So, game theory is a mathematical tool in a, to put it simply game theory is a mathematical tool which use to understand the firms behavior in oligopoly market structure. So, it helps to study the strategic situation in which players optimize a variable, not only on the basis of their own preferences, but also on the other decision and the reaction.

So, it is here the optimization situation, it is not on the basis of their own opportunity, in own constant also what is the opportunity of the other firm or what is the constant of the other firm. So, here we can call it that here this tool is getting used by the individual players or tool is getting used by the economics to analyze that how firms, they optimize their outcome, end outcome not on the basis of their own opportunity and constant, also the other firms present in the market, their opportunity and their constant.

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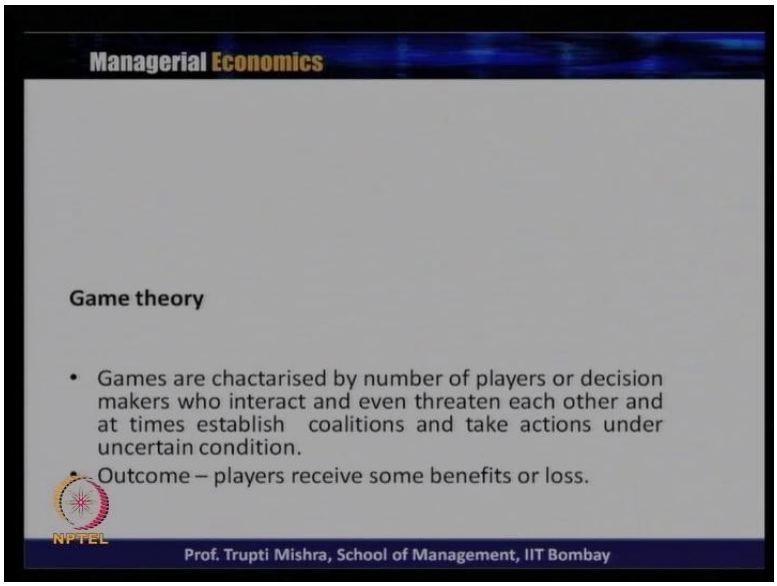

So, games typically in case of the game theory, here the games are characterized by the number of players or the decision maker to interact and even threaten each other and at times establish the coalitions and take actions under uncertain condition. So, generally here in the game theory, games are characterized by the number of players or the players may be the decision makers. Players may be the firm and who interact with the other firms who even threaten each other at time to establish the coalitions. Typically, if you talk about price leadership model, it is about the bargaining strength. So, in this case, bargaining strength also one firm generally push the pressure that if you are getting agreed to the price, I am going to charge a price independently which is no way going to give you the benefit.

So, in some times the players or the decision makers, they threaten each other to establish the coalition and take also the action under the uncertain condition. So, the price leader has also taken the action when there is uncertainty in the market, what is the price to be followed and what is the output to be produced.

Now, what is the outcome? The players or the so-called decision makers. They interact in a different way, in a positive also in the negative. When the positive, they come into a coalition. When it is negative, they get into the competition. Now, what is the end outcome? The end outcome is they get some benefit or they get some loss. So, if it is output, they get revenue profit share. So, if there is a decrease in the profit that is loss, if there is an increase in the profit that is gain or the benefit. If there is a decrease in the market share, it is loss and if there is an increase in the market share, it is benefit or it is gain. Maybe we can call it revenue or profit, again when it is good for the increasing direction, its benefit. When it goes in the decrease direction, it is a loss.

So, players, they get into a situation where they compete with each other, cooperate with each other in a specific situation with a set of constraint and the outcome is positive. Positive leads to benefit, the outcome is negative. Negative leads to loss. So, there are different types of moves taken by the different players in various games that is systematical. Also, that is systematic and also structurally designed and they take different moves. They take, there moves can be in the simple way, we can call it the activity.

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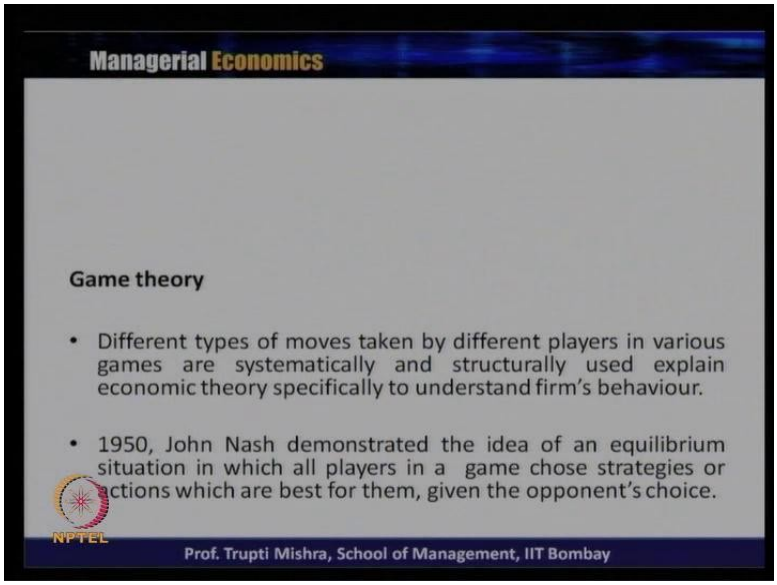

They take different actions, different moves which are systematically and structurally used to explain the economic theory specifically to understand the firm's behavior. So, different types of moves taken by different players in various games are systematically and structurally used to explain economic theory specifically to understand the firm's behavior. 1950, John Nash demonstrated the idea of an equilibrium situation in which all players in a game chose a strategies or actions which are best for them, given the opponent's choice. So, this game theory specifically when it applied to economic analysis, the first development here using the game theory to economic analysis, the first development or the first concept development came from Nash in 1950 and later on, he got a noble prize for his contribution to this economic theory in the form of the Nash equilibrium.

What is Nash equilibrium? This is the kind of equilibrium in the market using the game theory, typically analyzing the firm's behavior. Here John Nash, generally he developed this concept of Nash equilibrium and here all players in the game chose the strategy or the action which are best for them against the opponent's choice. So, what is best for one firm depends on whatever the action taken by the opponents or whatever the reaction are happened by the opponents due to this specific action.

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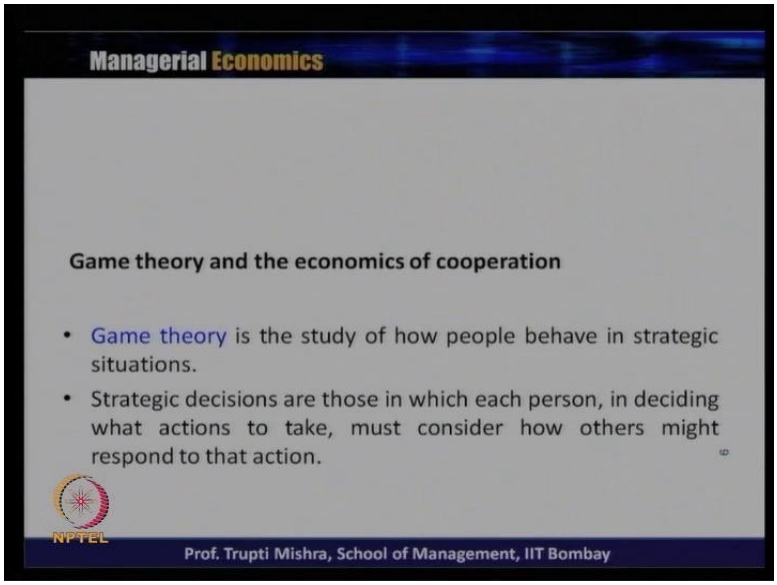

So, game theory is typically a study of how people behave in the strategic situations. So, to make it understand very simpler from the layman understanding, game theory is a study of how people behave in the strategic situations. What is strategic decision? Strategic decisions are those in which each person, in deciding what actions to take must consider how others might respond into that action. So, strategic decision are those in which each person, in deciding what action they have to take, they must consider how the others might respond to that typical action. So, as the number of firms is in an oligopoly's market is small, each firm has to act strategically one is small number and also.

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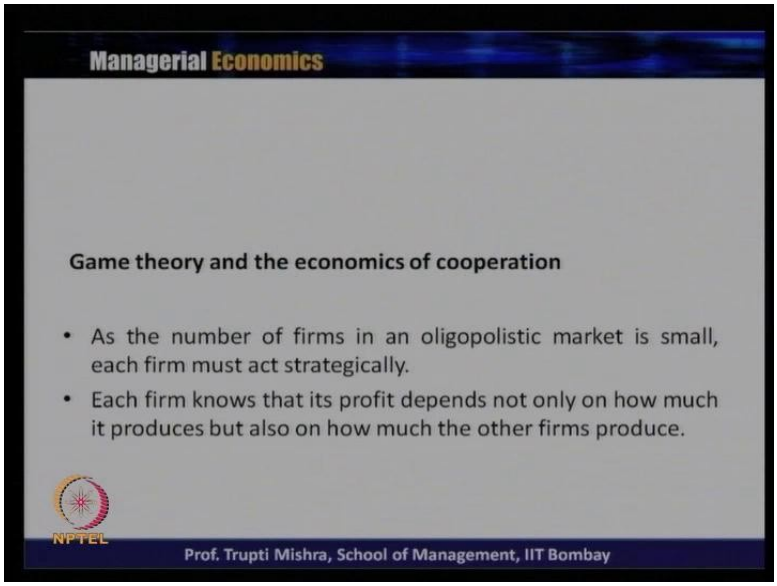

Secondly, they are interrelated. One firm is related to the other firm, either they are competing with each other or they are colluding with each other to maximize the joint profit.

So, since the number of firm is small and also, they are interdependent to each other, they have to act strategically and each firm knows that its profit depends not only how much it produces, but also how much the other firm produces. So, if you narrow down the strategic action in case of the interdependence between two firms, what is the profit of the firm, it is not dependent only what it produces or how much it is selling. Rather it is also dependent on the fact that how much others, they are producing, how much the other firms they are producing in the market and how much they are selling.

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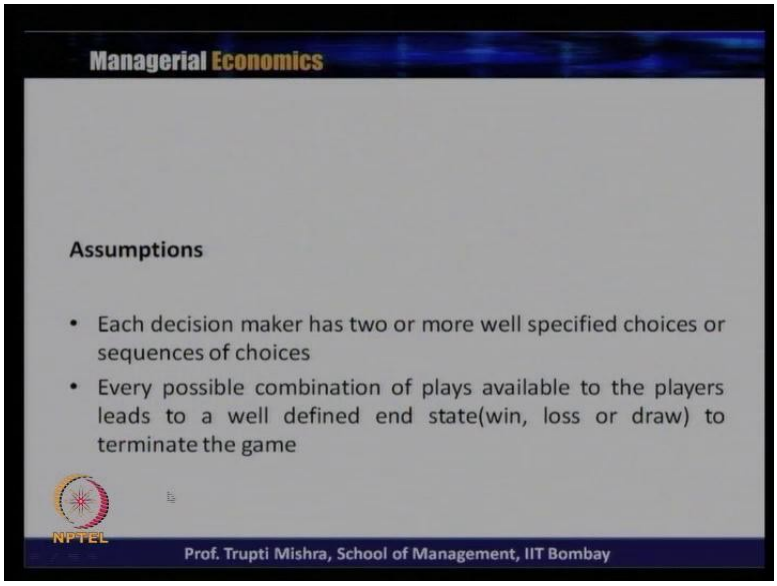

So, each decision maker or the each firm has two or more well specified choice or the sequence of the choices. Every possible combination of plays available to the player leads to a well defined end state, either it is win or it is loss or it is draw to terminate the game. So, when it comes to specific game, what are the assumptions we need to take? Each decision maker has two or more well defined choice or the sequence of choices. Either they have to go for choice one, choice two or in a sequence that first I will go for choice one, first I will go for choice two. So, that is well defined and whatever define that and that has to be only taken by the player, not the other choices.

Then, whatever the possible combination of plays are available, it will lead to some kind of outcome. When it is positive, it is win. If it is negative, it is loss and when it is a mix of rather when there is no definite outcome of this, then it leads to the draw kind of situation.

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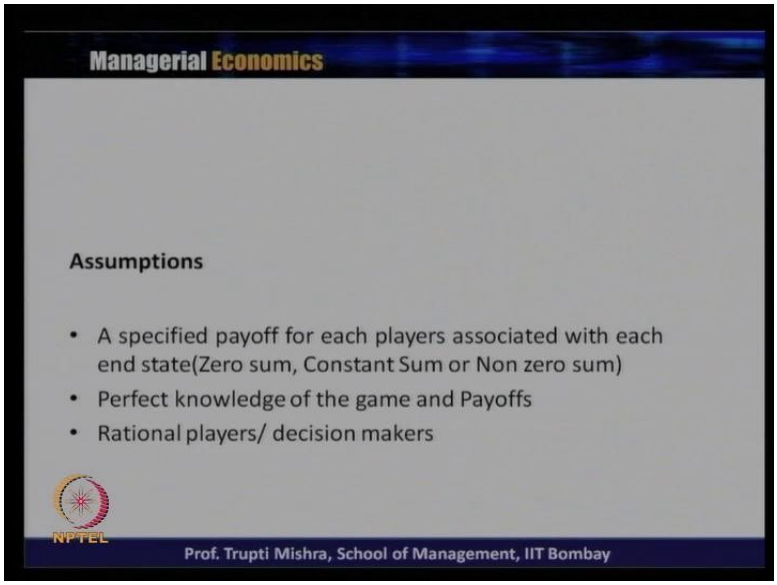

So, specified payoff or the specified outcome from the game for each players associated with each end state, either it leads to zero sum or it leads to constant sum or it leads to non zero sum. We will talk about this zero sum, constant sum and non zero sum game when you talk about the types of game in details, but for the understanding here, let us understand that whatever the specified payoff for each player associated with some kind of end state. So, there is some end out come when the payoff is associated with each of this player.

It is assumed that the players, they have the perfect knowledge about the game and the outcome. Generally, the end outcome what we are calling as the payoff, they have to be the rational because if you remember all economic agents, they have to be rational. If they want to optimize their end outcome or they want to maximize their profit and the player has to be in this case, the player has to be rational or the decision makers has to be rational. They have to always make the rational choice. They cannot go for a buyer's choice.

Now, we will come to the structure of the game. So, previously we were discussing about the assumption. What are the assumption to be followed about the game? Now, we will discuss what should be the structure of the game. The first structure of the game is that about the player's individual firms. They can be the players.

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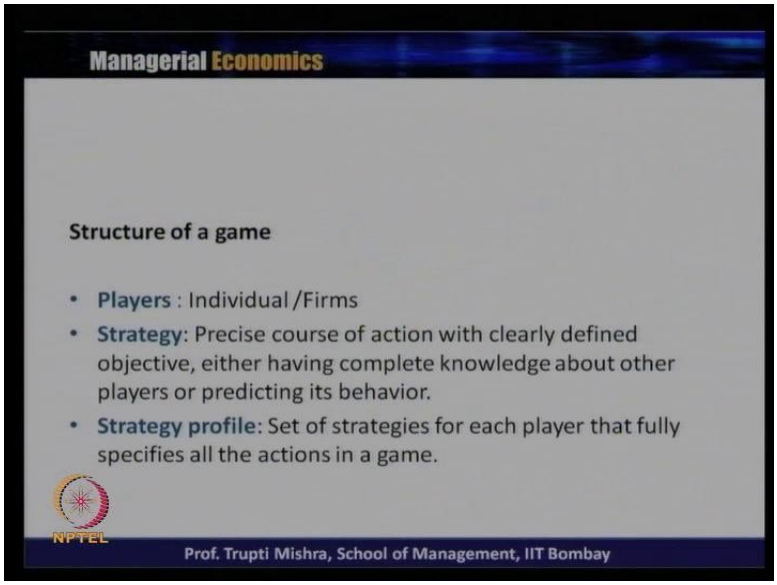

So, neither the decision maker, individual may be the decision maker. So, individual can be the players. Also, the firms can be the players over here. Strategy, now, what is strategy? It is the precise course of action with a clearly defined objective, either having a complete knowledge about the other players or predicting its behavior. So, strategy is the course of action taken by the firm with a clearly defined objective that if they are taking this action, what is the end outcome or what is the end output. Either to take this action, either they have complete knowledge about the other players or at least they can predict what will be the behavior of the firms when they are taking this action.

Strategy profile- It is a set of strategy for each player that fully specify all the action in a game. So, it is not about only one strategy taken by the player in the entire game, rather may be if the player is taking 4 strategy or the other player is taking the 6 strategy or the third player is taking 5 strategy, they are having a strategy profile which specify whatever the strategy taken by the players in the game and that generally known as a strategy profile. The action taken by the player in the game looking at what is the objective and at least assuming that how the players, they are going to behave with, when this action is being taken. There is a strategy profile that is least of action taken by the firm.

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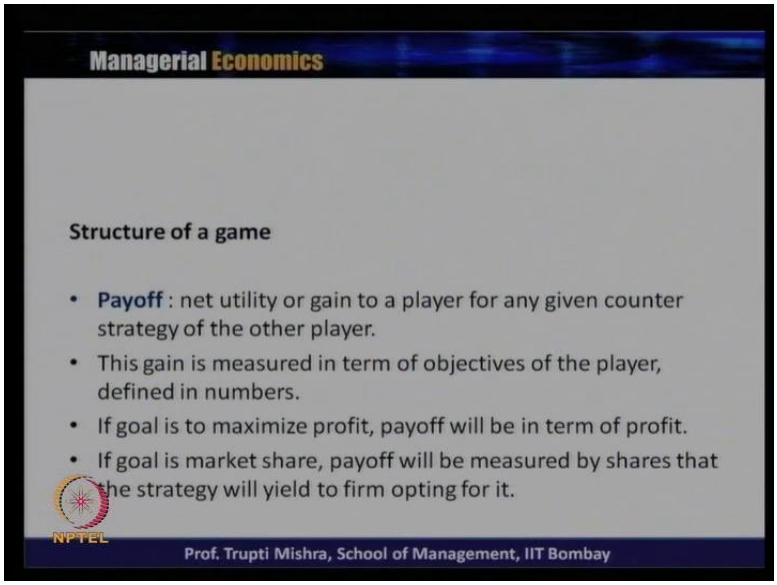

Then payoff. Now, what is payoff? This is the net utility or the gain to a player for any given counter strategy of the other player. So, net utility generally this is the outcome or the utility or the gain to a player for any given counter strategy of other players and this gain is measured in term of the objective of the player defined in number. So, generally in the payoff, we get it in terms of the number and this is the utility or the gain due to any action or due to any strategy by the player.

This gain is in term of the objective of the player. So, suppose if the action is taken, either there will be increase in the market share, increase in the profit, and increase in the output or the revenue and again, what is the rival's action. On that basis, again whether there is a increase in the share or the decrease in the share, increase in the profit or there decrease in the profit or what has to be the basis of the revenue.

If goal is to maximize profit, payoff will be in term of profit. So, if the goal is maximized to maximize the profit, the payoff will be also in the same terminology. We have to do it in term of profit. If the goal is to increase the market share, the payoff will be also measured by the share that the strategy will yield to firm opting for it. So, if it is to maximize the profit, the payoff will be in term of profit. If it is maximized market share, the payoff will be in term of market share. If it is maximized revenue, the payoff will be in term of the revenue. So, depends upon that what is the goal of the firm. For taking this action that will decide what will be the payoff, what will be the measurement of payment or what will be the measurement unit of the payoff matrix.

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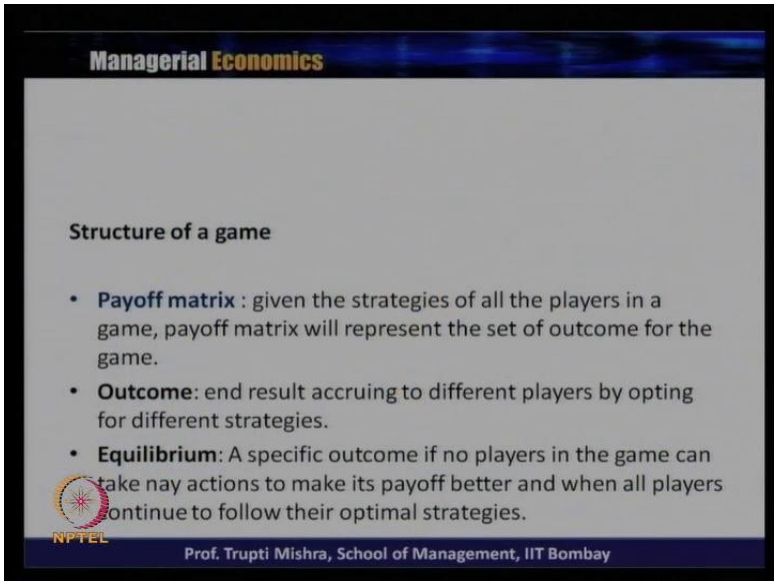

So, payoff matrix generally given strategy of all the players. In the game, payoff matrix will represent the set of outcome for the game. What is outcome? Outcome is the end result accruing to the different players by opting for a different strategy. So, whatever the strategy they take, what is the outcome that is generally known as the end outcome. That is the end result. Whatever is coming to the player by opting a specific strategy or specific action, some of that will give us the payoff matrix equilibrium, a specific outcome if no players in the game can take any actions to make its payoff better and when all player continue to follow their optimized strategy.

So, how we will get the equilibrium? This is the specific outcome if no player in the game can take any action to make it better. So, finally, when both the players, they reach to a specific outcome and after that whatever the mean is taken by any of this player, if it is not going to give any benefit to them, that is the equilibrium. So, it is a kind of state of balance beyond which whatever the action taken by the firm, it is not going to increase the share market. Share increase the revenue or increase the profit.