Petroleum Economics and Management
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Module - 08
Oligopoly and Game Theory
Lecture - 37
Oligopoly and Market structure

Hi everyone, welcome to the NPTEL course, Petroleum Economics and Management. I am your instructor, Dr. Anwesha Aditya. So, we are in module 8 of our course, where we are going to discuss Oligopoly and Game Theory. So, today is our lecture number 37 and Oligopoly and Market structure. Ok.

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Now, you have already motivated our course by saying that see we need to study the market structure of the global oil industry and as we have already discussed in earlier module that OPEC plays an important role in determining the world oil price. So, we have already discussed the observation from the existing literature, we have seen the empirical data on whether OPEC is a successful cartel or not.

So, for that we need to study the market structure of the global oil industry. So, we will be studying the cartel model, the price leadership, dominant firm model. So, as I

mentioned earlier also that is an example of collusive oligopoly. So, we need to know the what is oligopoly?

So, if you remember in the previous lecture, we already gave an overview of different types of market structure, we have compared different types of market. So, in today's lecture, we are just focusing on what is oligopoly, what are the types of oligopoly? Because I did not include that in the previous lecture because of time constraint.

So; that means, these two lectures is basically they you can consider them together, you can listen to these two lectures together, they are in continuation of one another. So, then after discussing about the different types of oligopoly like the collusive and competitive oligopoly, we will be studying how to find out the equilibrium in oligopoly and why do we need an application of game theory to study the oligopoly model.

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So, first we already know in oligopoly, there are small number of large firms. So, that means, there are few firms; that means, that is why we are writing small, but these few firms each of them have significant market power. So, that correspond to large, large means each of the firm they are large in size, large in size means they have ability to influence the market price; that means, they have significant market power.

So, few firms with significant market power is called an oligopoly model and a special case of oligopoly we have already discussed when there are only two firms is called a duopoly. We also have discussed about the examples of oligopoly market.

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Now, as in the previous lecture also we saw when if you remember we prepared a table where we compare different types of market and one of the component was strategic interaction and we saw that strategic interaction is absent in all other types of market. Some extent strategic interaction is there in monopolistic competition, but there is no strategic interaction at all in perfect competition or monopoly.

So, this strategic interaction aspect makes oligopoly different from all other types of market structure, because it is a very important element because the firms and their strategies or actions are interdependent in oligopoly market. Whether the firms produce homogeneous or differentiated product whether there is free entry or exit that is not that important, but the strategic interaction is very important.

And that is why you see earlier also I have taken this example if a monopolist can maximize profit by either choosing or by choosing either choosing price or by choosing quantity the outcome will remain unchanged. In case of oligopoly the outcome will change if the oligopoly firms they are choosing price or quantity we will have completely opposite outcome ok.
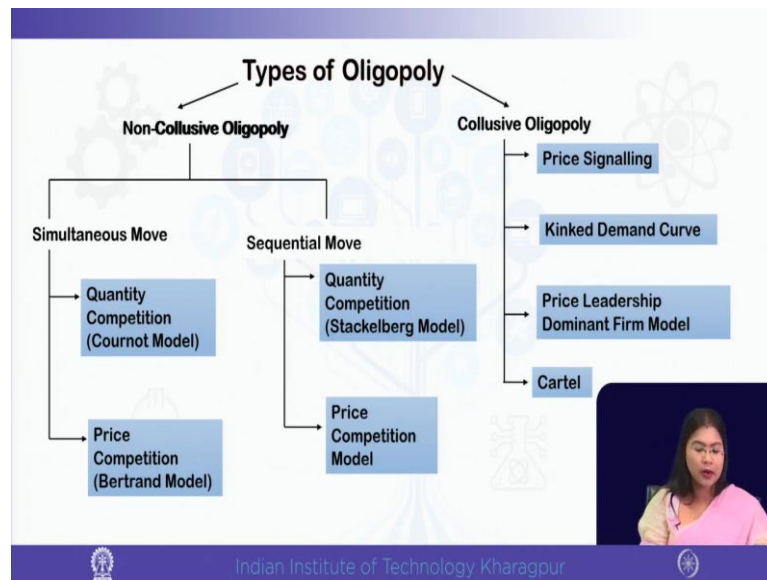
So, it is the strategic interaction that makes oligopoly completely different from all other types of market structure. Now, earlier also in discussing about whether OPEC is a cartel or not I think in module 4 we already discussed the different types of oligopoly model. So, oligopoly can be either collusive oligopoly or non collusive or comparative oligopoly; that means, it is not necessary that always the oligopoly firms will compete with each other.

You see this possibility of collusion also arises in oligopoly. We did not have this possibility of collusion in the other types of market that we have discussed ok. So, let us first start with the competitive oligopoly. So, as I mentioned in oligopoly model the outcome will be different if the two firms are taking decision at the same time or one firm is taking the lead and the other firm is taking the decision after the leader firm.

So, we will have completely different outcomes. So, we can categorize the non-collusive oligopoly model as simultaneous move and sequential move. Simultaneous move means when the two firms are choosing their either quantity or price at the same time. So, two firms are taking decision at the same time. So, if the two firms or. So, two firms I am saying. So, that correspond to a duopoly, but few firms you can interpret.

So, if the oligopolist firms they are choosing output at the same time. So, the resulting output competition and a quantity competition leads us to Cournot model. So, you can say that this is the first oligopoly model which was developed by Augustine Cournot in

1838, ok. So, to few firms they choose their output at the same time. So, they maximize profit by choosing output and they earn positive profit, ok.

However, we can also show that profits can further increase if the firms instead of competing if the firms collude. But we will see later when we study game theory and we study very famous prisoners dilemma game we will see that often the collusion cannot be sustained, because individual economic agent have may have incentive of deviation or incentive of cheating from collusive agreement, ok.

So, this is the first model which is called the Cournot model simultaneous move output competition. Now, in the same setting if the firms now change the choice variable from quantity to price, we get the resulting model is called the Bertrand model developed by Joseph Bertrand.

Now, the interesting thing is that in Bertrand model if the firms are changing the choice variable from quantity to price ultimately profits will be 0. So, in Cournot model the firms will earn positive profit in Bertrand model just everything else is same. Suppose, we continue with the same cost structure of the firm and suppose the demand is also same just we change the choice variable from quantity to price we get the Bertrand model and it is a very interesting one it shows the importance of choice variable ok.

And the resulting profit will be 0, you remember in the last lecture also when we classified, we compared our different types of market structure and one of the aspect was profit. So, we mentioned that in oligopoly market also profits can be 0. So, this correspond to this particular Bertrand model.

In other type of oligopoly models profits are positive. So, what happen? Say you take a simple example of duopoly suppose there are only two firms. Now, you see two firms means they have significant market power or the ability to influence market price, but till profits will be ultimately wiped out.

Why? Because if the firms are choosing prices simultaneously, we can see that the equilibrium outcome or to be more specific the Nash equilibrium which I will discuss later what is Nash equilibrium the equilibrium will be the prices will be equal and the prices of the two firms will be again equal to marginal cost ok.

So, the underlying assumption is that the firms are producing identical good. So, if the firms are producing identical good you see what happens? If a firm is setting a high price the consumers will buy from the low price firm. So, obviously, the firms will set the prices which are same. Now, ultimately what will happen the firms will be competing so much they will enter into cutthroat competition and they set the price which is equal to marginal cost.

If they will not go below any price below the marginal cost, because that will lead to negative profit or loss so, minimum price will be of course, equal to marginal cost, but then you may ask why the two firms cannot maintain a price which is greater than the marginal cost. So, they will be able to earn positive profit. It is because of the unilateral incentive of deviation, because each firm thinks that say even if they decide they agree to set a price up of the marginal cost.

So, each firm thinks that if I charge a slightly lower price, I will be able to capture greater market and I will be able to earn more profit. So, taking account taking into account these rivals behaviour the other firm will also think in the same part and the other firm will also think that let me charge a slightly lower price. So, in this way what will happen both the firms will come to the marginal cost ok.

So, price is equal to marginal cost which is nothing but the perfectly competitive outcome. So, you see the importance of strategic variable in case of oligopoly. So, even with two firms having great market share almost say 50 percent of market share there is a possibility that the firms will not be earning any super normal profit. So, it is a very interesting case. So, those who are interested can read about the case, but we cannot devote so much time in studying each of the model ok.

So, these are the two examples where the firms are taking a decision at the same time, but we can see that change in choice variable leads to different outcomes. Now, the other situation can arise in non-collusive oligopoly where one firm can take the move first. So, suppose one firm decides the output and chooses the output how much to produce and the other firm can follow the leader firm ok. So, this is called the Stackelberg model this was developed by economist Stackelberg.

So, in Stackelberg model the first mover the firm which is taking the decision first enjoy super normal or positive profit. So, we have the Stackelberg model and follower firm

will have positive profit, but will be less than the first firm's profit ok. And two firms can also choose their prices sequentially. So, these are the examples of competitive oligopoly or non-collusive oligopoly.

So, we see that the if the oligopolist firms they compete with each other the competition can be so tough that the end result can be 0 profit like they can go up to perfectly competitive level. Now, in perfect competition it is well understand that the firms are price taker there are large number of very small firms. So, obviously, they will earn 0 profit. But you see even with duopoly when there are only two firms there is a possibility that the firms can end up earning no super normal profit.

So, it arises, because of the strategic interaction. So, just we change the choice variable and we get completely polar opposite outcome. So, that is why I focused on this case to show you the importance of strategic interaction which is absent in other types of market. Now, you see in oligopoly we have the possibility that the firms can collude they can join hands together and they can maximize their profits and that can often yield high profit than if the firms compete with each other.

So, that is why collusive oligopoly it is a very important component, because you do not see any possibility of collusive behaviour in other types of market. So, we have this collusive behaviour possibility only in oligopoly model. So, in collusive oligopoly you see earlier also if you remember in case of cartel we discussed about the antitrust laws. So, often collusion cannot be legal or maybe prohibited by the laws because that can lead to greater market power.

You remember in one of the classes we discussed what happens if the firms collude then there is increased concentration of market power. So, output will be less than the perfectly competitive output level. Deadweight laws will be high, price will be higher, consumers surplus falls. So, in many countries the antitrust laws are very strict which prohibits the firms for engaging into explicit collusion. But often we see tacit collusion or implicit collusion or we can often also find international collusion.

So, one example we already know is OPEC which is formed among different countries of the world, because see we do not have any global government right. So, countries can also form collusion or even firms belonging to the international market can also form

collusion ok, because they do not come under the rules or regulation of a particular geographical boundary or particular country.

So, now what are the types of collusive oligopoly? There are many examples or many types of collusive oligopoly. So, one type is a price signalling model. So, what happens in price signalling? In price signalling the firms can take the price as a signal. Often, we see that one firm increases the price.

So, the other firms in the market can take it as a signal that we should also increase the price, because though if the first firm is increasing the price the other firms can also think that it is a signal that we should increase the price ok. Often, we see that this price signalling happens ok.

So, if a firm is increasing the price; that means, it wants the other firms to follow it. So, that all of them will increase the price if price increases so, profit will also increase so, this is an example of a collusive oligopoly. See there is no explicit agreement it is a tacit understanding implicit understanding. Another similar related type of collusive oligopoly market structure is price rigidity or the kinked demand curve model where many times we see that price is fixed or rigid at a particular level let us say P*.

Often, we see that some new product is launched say a new smartphone is launched the price is fixed. Even if there is an increase in demand or decrease in demand suddenly price will not fluctuate much price is fixed in a band. So, what is the idea? The idea is that the firm believes that if the particular firm increases the price. So, its competitor will not follow it.

So, it will not increase the price ok. It keeps the price fixed, because it thinks that if I increase the price the others are not increasing the price. So, I will be losing my market share. It will also not lower the price, because it thinks that if I lower the price other firms can also lower their price. So, what will happen?

We will be earning loss. Therefore, a firm can more or less fix the price and the resulting demand curve will have a kink at that particular price P* and the marginal revenue curve will also be discontinuous. So, this is the kinked demand curve model, but it is also subject to criticism that how does this firm this particular firm which is rigid about the particular price say P* that how this P* price is determined.

So, it is not very widely used. Very important kind of collusive oligopoly model which we often find in reality is a price leadership dominant firm model. We often see this in reality. You can think of the example of Apple iPhone right it is the leader in the iPhone market say in US, because it has a large share.

So, other brands like Samsung can follow the pricing strategy of the leader firm. So, as the name suggest you see in this particular type of market there is a leader firm with substantial market share, but of course, it is not the monopoly, because it cannot supply the entire market demand, but it has a significant share say 60 to 70 percent and the remaining market demand is scattered by some smaller firms and the smaller firms can often act as a competitive firm.

So, what they do they take the price set by the leader firm as a signal, ok. So, they decide their output means they take the price set by the leader firm as given and decide what how much to supply ok. So, the leader firm here is the price maker. So, leader firm maximizes its profit by choosing either price or quantity like we already discussed and then the other firms the remaining firms which act as competitive units they take the leader firm's price as given and they decide how much to produce and that is how we find out the total output in the market.

So, we can also see examples of cartel which is an example of a collusive oligopoly and the cartel model resembles the price leadership dominant firm model very much to a large extent, because in cartel also we do see that there is a leader firm which acts as a cartel, but there are of course, non-cartel suppliers also like in case of you see OPEC. So, OPEC is also considered as an example of cartel, but we have already also discussed with the views from the literature whether OPEC is a successful cartel or not.

We will be discussing about that, but these two price leadership dominant firm model and cartel these are very similar to one another. In cartel also there is a leader firm which takes the which sets the price and the non-cartel small firms will take the price of the leader firm as given and then they decide how much to produce just like the world oil market. So, you see this is the more or less outline of an oligopoly industry.

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So, that means, now if you are asked what is the equilibrium outcome can we say definitely in oligopoly market. So, we have so many different types of oligopoly market collusive and non-collusive and under each category also we have very different types of situation depending on the timing of decision depending on the strategy variable right.

So, that means, the study of equilibrium in an oligopoly market its very complicated, because we have a possibility of wide range of interactions depending on the choice variable timing of action or whether the firms are collusive, they are colluding with each other or they are competing with each other. Therefore, we do not have any single model or unique equilibrium to describe an oligopolistic market.

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So, it is like you can think of oligopoly models like a game of chase right. So, at each stage in chase what happens your what will be your next move that will also depend on the move of your rival player right. So, due to the interplay of strategy and counter strategy oligopoly behaviour is essentially like a game of chase.

So, that is why after the development of game theory especially the concept of Nash equilibrium we started starting the oligopoly model under the game theory framework. See the first oligopoly model as I mentioned was by Augustine Cournot in 1838, but after the development of the concept of Nash equilibrium we study these models as an application of Nash equilibrium.

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And so, that is why for proceeding before proceeding further we will be studying very briefly about what we mean by Nash equilibrium and we will also define a game. We need to have some basic understanding of game theory to discuss the price leadership dominant firm model to also see the cheating behaviour.

Like if you remember we have already discussed in detail we have seen with data that how the OPEC countries they agree to a certain level of output, but they often deviate from that level of output they end up producing more. So, we need to also see why collusion may not be always sustainable.

So, that is why we will be also studying the prisoner's dilemma model. So, for the time being let us concentrate on the Nash equilibrium. So, for that we will be developing a game theory structure. So, what do we mean by Nash equilibrium? So, equilibrium in oligopoly means that each firm does the best given the competitor strategy. And this competitors also do the best given what the particular firm is doing ok. So, that is basically the Nash equilibrium in the oligopoly market ok.

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So, Nash equilibrium is the strategy profile where each economic agent does the best what he or she can do given the rival players strategy or action. So, I will define it in detail, because you need to understand what is strategy. So, why we say that it is doing the best how we can say. So, for that we need to move to our next lecture.

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So, what we discussed in this particular lecture, we defined an oligopoly market, we classified oligopoly into different categories depending on the nature of competition and collusion. And under each category we also have seen how the outcome may differ

depending on the choice variable or timing of move. And finally, we saw that oligopoly ah equilibrium is difficult to study, because there is no one single model.

So, that that is why we need to understand game theory to study oligopoly behaviour, because oligopoly models are like game of chase where at each stage when a particular firm is maximizing its profit it has to take into account the rivals' actions or strategies. So, we will be now devoting some lectures to study some basic concepts of game.

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So, to be consistent we are following the same Microeconomics book that we are thoroughly following in this course, but you can also look for any other Microeconomics related book even book on Industrial Organization to study the Oligopoly part.

Thank you very much. See you in the next lecture.