Petroleum Economics and Management
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Module - 09
Fundamentals of Petroleum Business
Lecture - 42
Collusive Oligopoly: Price Leadership

Hi everyone. Welcome to the NPTEL course, Petroleum Economics and Management and I am your instructor, Dr. Anwesha Aditya. So, we have come to module 9 of our course, where we will be discussing the Fundamentals of Petroleum Business. Today is the first lecture of module 9 and this is our lecture number 42 in the entire course. So, we will be discussing about the collusive oligopoly price leadership model.

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So, if we just give a motivation of our this particular module 9, you see we will be devoting as I mentioned in the course outline that we will be studying the market of the global oil industry. So, we have already discussed the role of OPEC in controlling the world oil price because we have already devoted lot of time in analyzing the world petroleum price from 1970s to till date in module 3 and then we have discussed the role of OPEC in that.

So, there we have seen the observation from the existing literature, we have also dealt with data and we have discussed whether OPEC is a successful cartel or not. And what we saw that the literature is also ambiguous because most of the economists find that though we take the name of OPEC as a cartel, but till cartel has not exerted the price power, cartel could have increase the price much more than they actually have done means OPEC cartel.

And the ambition of OPEC has been limited, its mainly driven by Saudi Arabia and other major OPEC members because they have a high reserve to production ratio. So, they have a long term plan to sustain their foreign exchange earning or revenue earning or oil rent from petroleum products.

So, that is why they do not want to raise the price very high because we have discussed many times that there are instances where OPEC or especially Saudi Arabia has controlled the price of oil like if you take the example of the great price collapse of 1985, 86 or if you take the example during the Gulf War or the breaking down of USSR in 1990 and 1991.

So, these are the instances where actually Saudi Arabia and other OPEC countries have increased the oil supply without their intervention oil price would have increased much more. So, it is not that always OPEC has or Saudi Arabia has increased the oil price because within OPEC Saudi Arabia has a leadership position we have already discussed.

And now we need to study the market structure because what we have done so far is we have observed the views from the literature we have also dealt with empirical data we have seen the supply of oil from the OPEC countries and non-OPEC countries. But we have seen that very recently US has emerged as a major supplier of oil and Saudi Arabia is in the second place its mainly because after the shale oil revolution that US oil supply has increased.

So, these empirical observation we have already discussed we have seen how the OPEC countries and other oil exporting countries they are dependent on oil rent in their GDP share. But we have also found that in the recent years just few years back the countries are also diversifying especially the Middle East countries have also started diversifying after seeing the experience of Venezuela.

So, these empirical observations we have already discussed, but we have to also study the market structure of the global oil industry. So, with this idea in mind we have devoted some modules to study the global oil industry market structure theoretically. So, if you remember we have already discussed that a cartel is an example of collusive oligopoly. So, we need to study the oligopoly model.

So, with this motivation we have designed modules 8 and 9 in module 8 we have discussed about different forms of market structure. We have compared market structure ranging from perfect competition to monopoly and we have analyzed quite detail the characteristics of oligopoly.

So, what we have seen that in oligopoly market the strategic interaction among the firm is the main distinguishing feature which is not there in other types of markets right. And that is why in oligopoly market the firms need to take into account the strategy of the rival the strategic variable or the choice variable the timing of decision these are very important.

So, that is why we study oligopoly in a game theoretic framework. And if you remember we have also devoted some time in discussing. The very basics of game theory we have already defined the very important solution concept of Nash equilibrium we have defined we have discussed the properties of Nash equilibrium that it may not be unique it may not be efficient.

And we have discussed the very famous prisoners dilemma game because that has important relevance and significance for the petroleum market. So, as we will be studying further ok because what happens you see what is the motive of becoming means colluding what is the motive behind colluding? Obviously, there should be some incentive. So, the incentive must be higher profits right.

So, if you remember there are two types of oligopoly model collusive or competitive oligopoly. In competitive oligopoly the firms are competing among themselves very much and in oligopoly model when they compete, they engage into cut throat competition they want to undercut the rival.

And the situation can be so, extreme that even with two firms a duo poly model we can have a zero profit like perfect competition. So, that was the case in a Bertrand model we

have discussed that, but that is not the only solution the firms can also collude and that can lead to higher profit.

But you see so, so, you see the means, the circular flow means the firms if they operates individually they will be earning less. So, that is why they may have incentive to collude. So, that they can earn higher profit, but after colluding often they deviate and we have seen it with data also.

The OPEC countries often when they meet and agree for some level of output often they end up supplying more than the agreed upon output level and that also is one of the reason why OPEC could not increase the price that much because if all the individual members are increasing the prices a bit.

So, total out means sorry if the individual members are increasing their supply a bit total supply will increase and price will fall. So, you see they if they collude because they want to earn more profit individually, they are earning less profit. So, that is why they want to collude and set the price, but there are non-OPEC suppliers of oil also. Now, after they collude for getting higher profit again, they deviate from the collusion because of the prisoners dilemma like incentive because there will be unilateral incentive of cheating.

So, if they think that if I increase the output slightly, I will be able to capture greater market share and I will earn more revenue because these countries are very much dependent on oil rent as their large part of GDP comes from oil rent. However, in the very recent years there is diversifying which is a very good sign. So, it is very interesting the prisoner's dilemma is a very interesting case study to study the world oil industry.

Now, we need to know how the price the world oil price is determined ok and what will be the supply by the OPEC countries and non-OPEC countries. We have seen that with data, but we need to also know the theoretical model.

So, with this idea in mind in module 9 we will be studying the market structure theoretically how the equilibrium price is determined by the leader firm; that means, the oil cartel that is OPEC and then how much the quantity supplied by the OPEC and what will be the non-OPEC supply and what will be the total supply.

So, with this idea we will we have designed module 9 and in module 8 we have studied the background that is used for studying module 9. So, you see the modules are also interlinked and there is a sequence there is a flow of thoughts while designing the modules.

So, in today's class let us focus on the collusive behavior of oligopoly model what are the different types of collusive oligopoly and mainly we will be focusing on the price leadership model because we have already devoted one lecture in discussing the OPEC and OPEC class market structure.

So, we know that OPEC is like a leader. So, the price leadership dominant firm model actually best suits the OPEC structure. So, we will be studying the cartel and the price leadership model in detail.

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Observations of Oligopoly Behavior

- In some oligopoly markets, pricing behavior can create a suitable environment and collusion may occur. This happens in collusive oligopoly.
- In other types of oligopoly structure, the firms are very aggressive and engage in cut throat competition.

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So, let us start with the collusive oligopoly behavior. So, in our nutshell if we summarize our discussion of module 8 on the oligopoly behavior. So, what we can conclude? In some of the oligopoly markets the pricing can create a suitable environment and the firms may collude. So, that leads to a collusive oligopoly like we have already taken the example of cartel price signalling and the price leadership model.

But there are other types of oligopoly market where the firms they engage into competition and they are very aggressive. So, when the oligopoly firms are competing,

they are very aggressive and they engage into cutthroat competition they want to undercut its rival. By doing so, often they also lose means they also earn less profit they could have earned more profit, but they often do not do that they undercut the rival to some to the extend that they also are earning less profit. Ok.

So, the reason is the prisoner’s dilemma incentive. So, if they deviate they will be earning more. So, its unilateral incentive of deviation. However, the situation can change if we bring a dynamic framework because still now, we have been studying the oligopoly models in static framework, but often we do see collusion in reality.

So, if we now bring a dynamic framework. So, what will happen in long run? The firms may have or the even the in game theory structure also the players may have incentive to collude because in one short game when the players know that the game will end.

So, they have incentive to deviate, but if there is some punishment scheme which can be implemented in future if the game is played repeatedly. So, then collusion may be sustained I have also talked about the folk theorem. So, we do not have time to study all these theoretical models, but those who are interested should actually go for a more advanced course on game theory and oligopoly structure.

So, the example of competitive oligopoly as we know that the price competition simultaneous move price competition, Bertrand model simultaneous move output competition, cournot model sequential move output competition, Stackelberg model. So, these are all examples of competitive oligopoly.

And Bertrand model is a extreme case where even there are two firms in a duopoly structure also we can have the perfectly competitive solution price is equal to marginal cost. But let us now focus on the collusive behavior of the oligopoly firms because collusion may lead greater profit.

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Collusive Oligopoly Markets

- Collusion may yield greater profits. That gives incentive of collusion.
- Explicit and implicit collusion is possible.
- Explicit collusion may be prohibited. Implicit/tacit collusion and international collusions are more common.

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So, if you remember just the prisoner's dilemma game if both the prisoners do not confess. So, they will be earning more is not it. We have already discussed that both confessing in the prisoner’s dilemma is the unique Nash equilibrium whereas, both do not confessing is the pareto efficient outcome.

However, that is not the Nash equilibrium because that does not qualify the Nash equilibrium test both the prisoners have unilateral incentive to deviate from not collusion because of the rule of the game that the prosecutor says that if you do not confess and the other one is confessing.

So, the confessor will go completely free and you will be jailed for all the 6 years for the major crime and minor crime. So, it is this unilateral incentive of deviation and they lack trust also they cannot trust their partner because each one of them they are interrogated separately and they cannot communicate during the interrogation process and it is a one-shot game that is why they think that if I am not confessing and my partner is confessing.

So, I will be jailed I will be punished for all the 6 years. So, that is why they both of them end up confessing, but now imagine a scenario where they could have communicated. They could have met and communicated then they could have sustained with the not confessing strategy right.

Because by not confessing they were jailed for only 1 year and they got higher freedom of 5 years because the major crime could not be proved without anyone confessing right. So, both of them not confessing is the pareto efficient outcome which can be sustained if the game is played repeatedly, but once again as I mentioned if we have a finite stage game it is difficult to sustain collusion because if you know that at the last stage you know that this is the last stage of the game. So, you have incentive of deviation ok.

And then you fold back. So, the deviation will start from the very first stage, but in infinitely repeated game it can be sustained forever right because you do not know what will be the last stage.

We human beings we are not immortal, but we do not know the last stage right. So, that is why often we also can sustain collusion and that leads to this collusive oligopoly markets because the firms may be also tired of undercutting each other.

So, suppose you consider a very aggressive competitive oligopoly model where the firms are undercutting their rivals and the and by doing so, as we are discussing that they are earning less. So, after few periods what will happen in oligopoly, you see oligopoly you have defined where there are few firms each with significant market power ok.

A special case of oligopoly is duopoly when there are only two firms. So, this few firms may be say they start with a competing attitude and they undercut their rivals and after few periods they see that by doing that they are not earning higher profit and they are become tired. So, they can decide to collude ok because collusion may yield greater profit. So, this is the incentive of collusion. So, that is why we often see collusive oligopoly market structure.

Now, collusion can be explicit or implicit also, but if you remember we also discussed that explicit collusion is often prohibited legally. Like if for example, we have already discussed about the US antitrust law we have discussed the Competition Act of India because what happens if collusion can lead to increased market concentration or market power and we have already discussed what happens then the consumers surplus will fall because as the firms collude and they decide they maximize their joint profit they can set up the price higher.

So, price will increase output will fall. So, if the output falls more and more. So, from the perfectly competitive output then there will that will be a loss for the society. So, consumers surplus will fall because the consumers are paying a high price some consumers are out of the market right.

So, that is why you see often the laws of a country can prohibit the firms to collude because of increased market power and increased concentration of market power. But at the same time as we discussed earlier also often the firms can collude tacitly there can be implicit collusion.

So, we will be taking some examples as we move forward or often, we seek international collusion because then if the firms in different countries they can collude. So, they will not come under the jurisdiction of any particular country's legal framework. So, and see the example of OPEC you already know that the different countries the oil exporting countries they join hands together right. So, they are not coming under the antitrust law or competition law of any particular country.

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So, often we see either implicit collusion or tacit collusion and international collusions these are more commonly seen collusive oligopoly markets than explicit collusion within a particular domestic country. Now, what are the examples of collusive oligopoly? So, one typical example of collusive oligopoly occurs in price signalling model often what happens as I was discussing say there are few firms ok.

And they say for example, the price of a product is just a hypothetical example price of good x is 100 rupees per unit. And suppose the firms think that one firm thinks that it can increase the price if it increases the price to 150 rupees that will yield higher profit ok. But the firms cannot enter into an agreement with the rivals because that is prohibited by the legal framework of the country with the Competition Act.

So, what they can do? This particular firm can do the firm can increase the price say from 100 rupees per unit to say 120 rupees per unit and can inform the press that the firm is raising the price in order to means gain enjoy more profit. And that should be taken as a signal by the rest of the few firms say there are three four firms in the market.

So, the rest of the firm should also follow because this rest of the firm may think that this first firm that is firm one wants to collude implicitly there is some indication of the tacit collusion it wants to increase the price. So, all the firms can follow. So, in this way you see all the firms can set the price 120 and then again in the next step they can increase the price to say 140 or even 150.

So, instead of agreeing to this price 150 explicitly they can just follow one another. So, one firm can increase the price with the expectation that the other firms will also follow. So, they will be able to sustain a high price and enjoy more profit. So, this is one example of price signaling model. So, price is taken as a signal.

So, if the firm is increasing the price with the expectation that the other firms will follow. So, often we see this type of implicit collusion, but it may not be sustained for a long time if the firms then they may lose market share depending on the elasticity also or availability of substitute product.

So, but this is one type of commonly seen collusive behavior. Another type of collusive behavior is as we are discussing is the price leadership model where you as the name suggest you see there is some leader firm which has a majority of market share. Ok.

The leader firm should be able to cater to a major share of market supply. So, that firm can emerge as a price leader. It can happen that this leader firm can have a low cost can be a low cost firm. It can have a cost advantage as compared to the follower firms or the rest of the firm.

But the leader is not the monopoly you see because the leader firm alone cannot supply the entire market demand. So, there are non means, apart from the leader there are some other firms also. So, these firms can act as means, they individually supply very small amount. So, they can act as perfectly competitive firm.

So, often this leader firm sets the price its own profit maximizing price and the rest of the firms the small firms who act as perfectly competitive firm they decide their output level taking into account the price which is decided by the leader firm. So, the leader firm now is the profit means, it is the price maker and the follower firms become the price taker. Another very similar type. So, I will be discussing about the types of price leadership in the next slide.

But before that you see another type of collusive structure is cartel as we have already discussed. So, in cartel few firms they together maximize profit. So, it is also sort of price leadership because the cartel when they collude and they act as a single unit. So, they also act as a leader and there are non-cartel suppliers who act as follower or they are the price taker. So, we will be discussing these two market structure.

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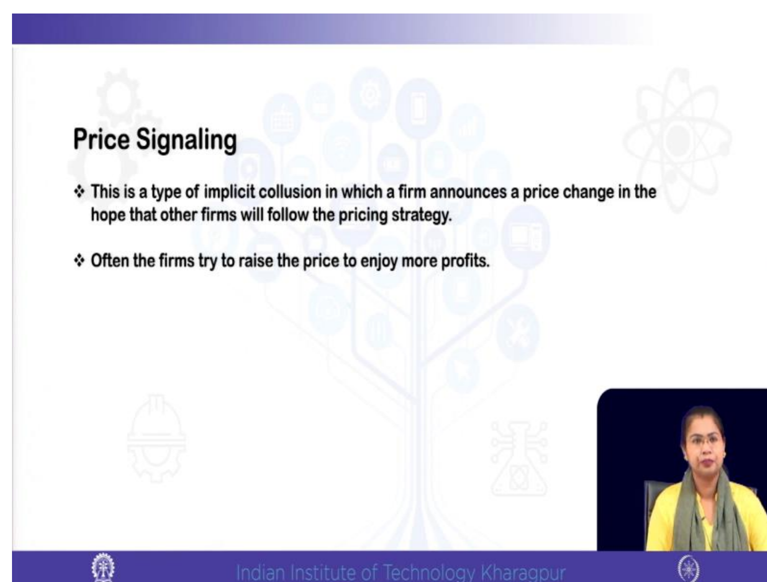

So, I have already given the example of price signaling.

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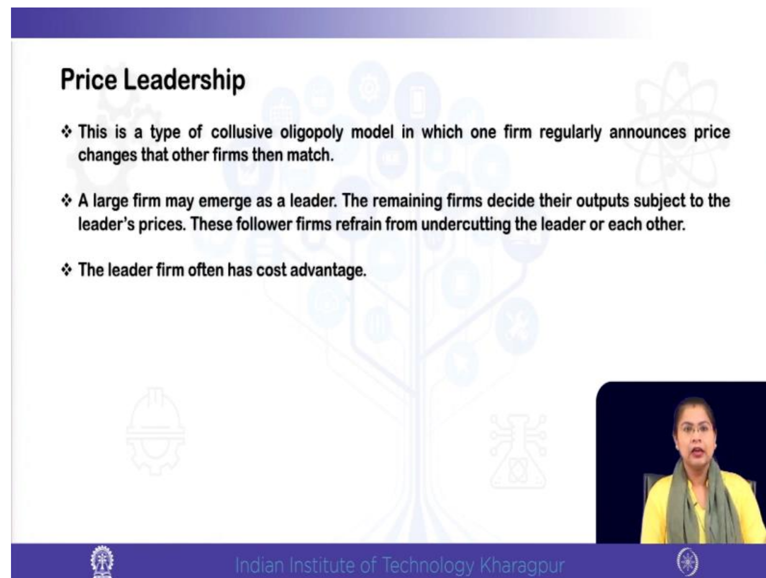

And see one example of price leadership is.

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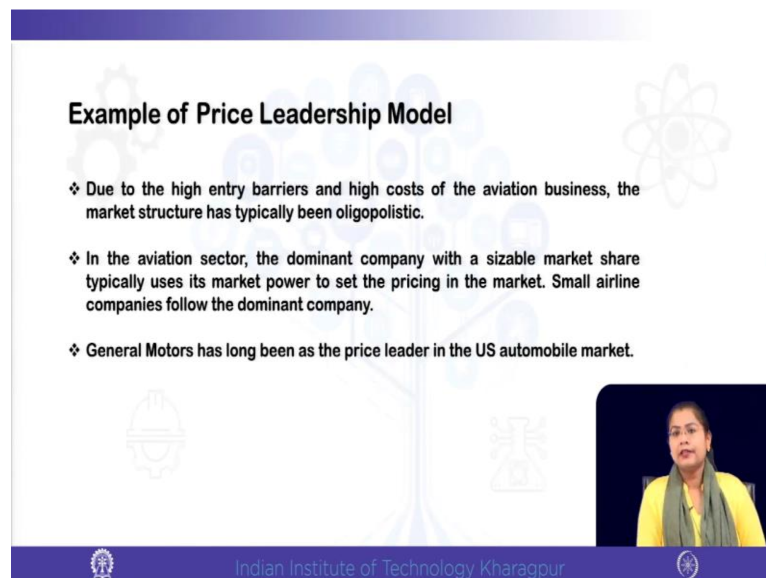

Often, we see price leadership market structure in the aviation industry because in the aviation industry we know we can understand easily that the there is lack of free entry because a firm needs to pay huge amount for entering the aviation business. So, there is high entry barrier and high cost in the aviation industry and market structure has been oligopoly.

So, in the aviation industry one large firm which we can refer to as the dominant firm which will have a high market share it usually is the price taker sorry price maker. This large firm the dominant company airline company with a significant market power is the price setter it sets the price or that is the price maker and there are the small airline companies who usually follow the dominant means a large airline company ok and they are they act like perfectly competitive firms and they are the price takers.

Another example of leadership model is the general motor in the US automobile market which has long been enjoying the leadership position ok. And as we are discussing that one form of price leadership can be a low cost firm other type include also barometric price leadership.

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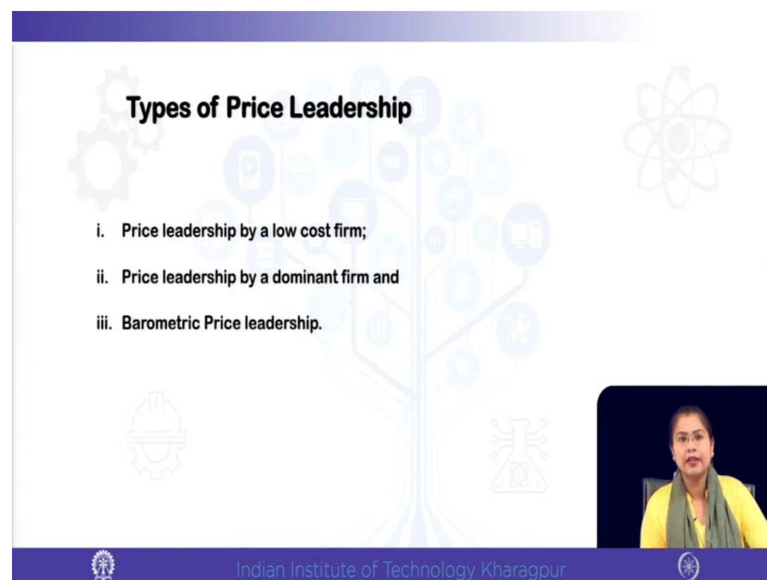

So, if you categorize the types of price leadership you see these are some examples or types one we have already discussed the leader firm can enjoy cost advantage. Like for example, you see the OPEC countries you can well understand we have already discussed that the Saudi Arabia for example, it has a cheap endowment of good quality oil and the oil is supplied along the coastal line.

So, the cost of transportation is also low and as we discussed that is one of the reason why the cost of transportation and storage is low. So, when the world was hit by the COVID-19 pandemic at the lockdown. So, we have already seen with the data that the

US benchmark oil price that is WTI it became negative, but the one that is followed by the Middle East countries the OPEC countries that is Brent.

Brent price also failed due to the demand shock, but the Brent future contract price did not become negative because WTI for the US oil market the WTI oil the storage and transportation cost is high because it is mainly extracted in the landlocked areas.

So, it has to have a long pipeline. So, the storage cost and transportation cost is very high that is why the firms were willing to pay the buyers if they were ready to take the supply because storing can be more costly than paying to the buyers, but it did not happen with Brent. So, you see often we see that the leader firm is a low cost firm. So, it has a low cost as at the same time it is a large supplier.

Ok. So, one example of price leadership is low cost firm the other example include the dominant firm which already have discussed. So, it has a majority of supply, but it is not the monopolist, but it is the price sector in the market it sets not only its own price, but also the market price. How?

We will be discussing in the next lecture and the remaining firms the follower firms they take the price set by the dominant firm as given ok and they decide their output level and we will be getting our total output.

And third type of price leadership is the barometric price leadership see.

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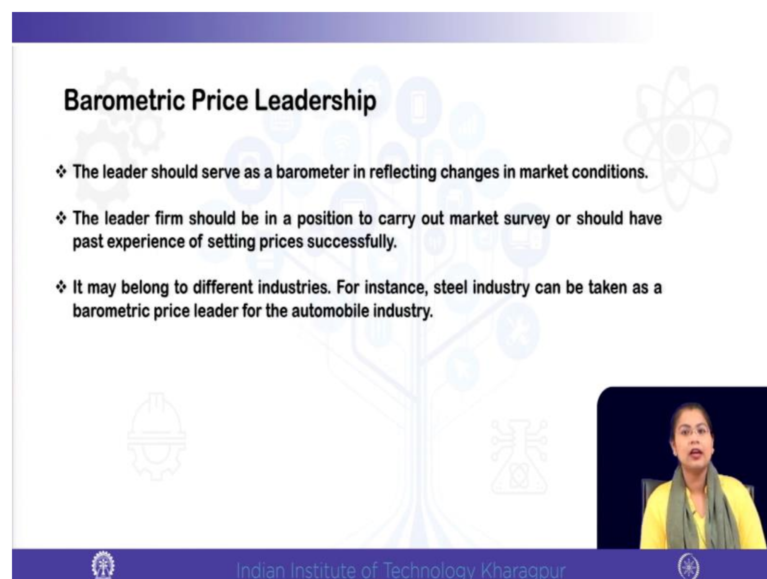

It is an interesting example in the barometric what is the barometric price leadership. We can define a barometric price leader; it should be the one who can whose behavior can reflect the changes according to the market condition. So, that means, a firm which has a proven past experience or proven track record of setting price which is very accurate and the firm should be in a position to do very good market research or market survey.

So, that means, its behavior should reflect the changes in the market condition. So, it has a past record. So, it may not be a leader you see the in the barometric price leadership model the means leader means in the position of supplying a large share of output no that may not be the case.

But it should have a very good past record of setting the market price. And it should also change its behavior according to the changes in the market condition. So, if the market condition is down it will react by lowering the supply or if there is increase in demand.

So, it seems it carries out very in detail market research it will also respond accordingly it will increase supply because as you may already know we have studied in already initial module that for supply time is very important. So, even if demand increases you cannot instantaneously increase supply right you need to have a stock.

Now, if you see that the firm is able to do a very in depth market research. So, the firm may be our may anticipate that in the upcoming periods there will be surge in demand. So, the firm can accordingly expand its capacity or start creating its capacity. So, other firms will also interpret from means, they will also use the input from this barometer firm means it should able to know the market parameters right.

So, that is why it is called a barometric price leadership. And one interesting thing is that this leader firm should can also belong to a different industry. So, we can take the example of the steel industry, which can be taken as a barometric price leader for the automobile industry because we know for automobile industry steel is the major raw material.

So, often the steel industry can do good market research about the demand for the automobile market about the future of the automobile market. So, the automobile industry can consider the steel industry to be the barometric price leader ok. So, but this

is the limited example often we see either this low cost price leadership model or the dominant firm price leadership model.

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Price Leadership Dominant Firm model

- In some oligopolistic markets, one large firm has a major share of total sales, and a group of smaller firms supplies the rest of the market.
- However, the large firm can not be the monopolist.
- The large firm might then act as the dominant firm, setting a price that maximizes its own profits.

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So, we will be discussing we will be focusing on the price leadership dominant firm model for the rest of the module which will best resemble the OPEC market structure ok. And the cartel model actually can also be studied under the framework of the price leadership dominant firm model because they are also the cartel also act as a leader and there are the non-OPEC non-cartel suppliers which act as the follower.

So, what happens in the price leadership dominant firm model? One large firm has a major share of the total supply and, but it is not the monopolist because it cannot supply the entire market demand. So, there exists some small firms, but these small firms are insignificant supplier's means, they individually cannot influence the market price just like perfectly competitive firms.

So, the large firm then act as the dominant firm as the leader firm and it sets the price which maximizes its own profit see. Now, the thing is that this dominant firm the leader firm is not maximizing the profit of all the firms it sets the price so, as to maximize its own profit and this own profit maximizing price of the dominant firm is taken as the market price by the small firm and they decide their output accordingly and we will be getting the total supply in the market.

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Conclusion

- Collusive Oligopoly Market
- Price Signalling Model
- Price Leadership Model and its types

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So, what we have done in today's lecture? So, we discussed about the collusive market structure collusive oligopoly model. So, what gives rise to the incentive of colluding? Because individually the firms may not be able to earn a very high profit even though they are earning positive profit.

So, in oligopoly we know that the firms earn positive profit apart from the Bertrand model in other firms in other type of market structure they earn positive profit like in the Cournot model, Stackelberg model. But that is not the maximum profit because we can show that monopoly profit is the highest possible.

So, often this gives rise to the incentive of the firms colluding and we end up having collusive oligopoly market. So, the firms can collude and restrict the supply and so, that they can charge a high price and earn more profit. But they also sometimes deviate. So, we are discussing about all these the collusive behavior and in to this particular class we discussed about some examples of collusive oligopoly.

So, we have discussed about the price signalling model, the examples we have discussed about the price leadership model and the type of price leadership like the barometric price leadership, the low cost price leadership and the dominant firm price leadership model.

And another type of collusive oligopoly market is obviously, cartel which is of our interest. So, in the subsequent lectures what we will be doing we will be studying the cartel and the dominant firm price leadership model.

So, first we will be starting the market structure of the dominant firm price leadership model and then we will apply to OPEC oil cartel. We will in another lecture we will be discussing the OPEC oil cartel and then we will also study what are the conditions for a successful cartel and we will be comparing the OPEC oil cartel with the copper cartel which is known as CPEC.

So, we will be comparing OPEC and CPEC, why OPEC has been there for a long time. See what we have discussed in the module where we studied whether OPEC is a cartel or not, we studied the observation from the literature, we also dealt with empirical data. Now, whether OPEC is a very successful cartel or not that is subject to lot of debates, but one thing we cannot deny is the existence of OPEC for such a long time whereas, in other markets the cartels are very short lived.

So, that is why we will be comparing the existence of OPEC for such a long time means OPEC's ability to control the market price from 1970s to till date and we will compare it with the other market structure and see what are the conditions for a successful cartel because OPEC till now can be taken as an example of a successful cartel which has been there for a very long time that we cannot deny.

We cannot deny the existence of OPEC in controlling the world oil price for a very long time and OPEC's limited ambition can also be one of the reasons. So, we will be studying all these in the subsequent lectures.

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References

1. Microeconomics by Jeffrey Perloff, Pearson Education; Seventh edition, 2019.
2. Microeconomics by Robert Pindyck, and Daniel Rubinfeld, Pearson, 8th Edition, 2017

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So, the reference for this part is the standard Microeconomics book that we have been following thoroughly for our course that is Pindyck, and Rubinfeld and Perloff. But you can also study other type of books related to Microeconomics or Industrial Organization those who want more in depth analysis. So, you can also study advanced books like The Book of Oz Shy ok.

So, thank you very much we look forward to meet you in the next lecture.