Microeconomics: Theory & Applications
Prof. Deep Mukherjee
Department of Economics Sciences
Indian Institute of Technology, Kanpur

Lecture – 50
Model for Cartel Behaviour

Hello, welcome back to the lecture series on Microeconomics. So, we have finished our discussion on Cournot and Stackelberg duopoly models, which are basically examples of non-collusive oligopoly models. Now, we are going to end our discussion on oligopoly market models by discussing another type of model, which is called collusive oligopoly. Now, what do we mean by collusive oligopoly?

Previously, if you note that in the case of Cournot model, the firms were unaware of each other's output decision, and they used to take others output decision as given, and used to set their own market quantity. In the case of Stackelberg model, the leader firm used to set the quantity or market supply first in the market and the follower firm has to follow. So, basically in these two types of model, there is rivalry between the duopolist firms to capture the market share, and to attain a higher level of profit.

But, what if they shake hands, if they become friends, and if they want to work together, then they will become basically a monopoly power. Because, if there are only two firms, and if they kind of go for joint profit maximization, then there is only one firm, so that kind of situation is called a collusive oligopoly model, where basically the rival firms meet and then they strike an agreement, so that they take output decisions, which are good for all of them. So, basically under the collusive oligopoly model firms enter into a pack, and then they decide on each individual firm's output level in such a way that the aggregate output level maximizes their joint profit.

So, now we are going to look at one example from real life, where this type of model is applicable. Most of us are aware of this organization called OPEC. So, those who are not for them, let me tell you the full form of the organizations name. So, it is known as the organization of petroleum exporting countries. So, this organization is a major cartel of crude oil producing countries. So, now they have 15 countries as members, and this organization was founded in 1960. And since then they had a huge say in the crude world crude oil market, and they use they influence the market price of crude oil heavily. So,

how does this kind of organization work, we really do not have a very good answer for that but of course, we can try to model their behaviour. And so here in this lecture, we present one such simple model to explain the behaviour of collusive oligopoly or sometimes known as cartel.

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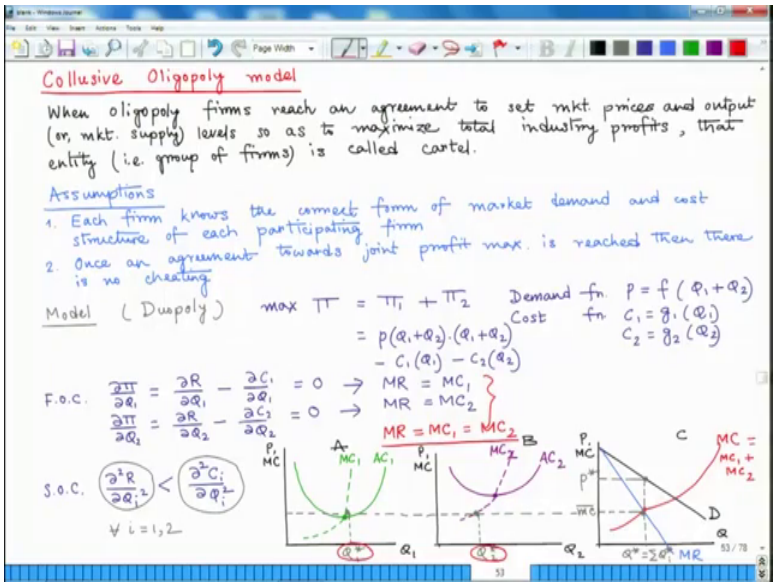

So, we start with the definition of cartel, when ok. So, now before we start with the model for a cartel, let us make some assumptions, which are very critical. So, let us start with some assumptions behind these types of models ok. So, the first assumption should be that each firm knows the correct form of market demand, and cost structure of each participating firm right ok. And then we have to also assume that once a an agreement towards joint profit maximization is reached, then there is no cheating. Cheating makes a cartel unstable, and we will see that there is every incentive for cheating in this model ok.

So, now let us get into the model part ok. So, here also we are going to assume that we have only two competitors in the market. So, it is basically a duopoly model, the only difference from the previous models is this here. They want to cooperate with each other, and they want to basically take joint decision to maximize joint profit ok.

So, now the model would be like maximization of joint profit, which is basically the sum total of individual profits of my firms 1 and 2 right ok. Now, the demand function is given. So, now I can write the demand function, of course the inverse demand function

as P equals some function of Q 1 plus Q 2 the individual output levels ok. Now, we also assume that the cost functions are different. So, for firm 1 we have some cost function, which is given by some function g 1 of Q 1. And for firm 2, it is given as g 2 as a function of Q 2 right ok.

So, now we are in a position to write down the next step for our profit function. So, basically we can write price as a function of Q 1 plus Q 2 times the total supply in the market by these two firms, and of course we need to subtract the costs. So, basically this will become C 1 of Q 1 minus C 2 of Q 2 right ok. So, this is what we start with.

So, now we have to derive the first order conditions ok. So, now we are going to find out the first order conditions of this profit maximization problem. So, we would like to take this derivatives, and this will become we need to set that to 0. And that basically leads to MR equal to MC 1 right ok. Then, of course the next derivative follows, and we have MR equals to MC 2 ok.

So, these two are basically my first order conditions. So, combing these two, I can write one single first order condition for joint profit maximization, and that is this. So, basically what do we mean by this, we mean that the cartels marginal revenue shall be equal to the individual firms or participating firms marginal costs for optimal quantity level ok.

So, now it is time to have a look at the second order condition. Now, the second order condition is given by del square R by del Q i square less than del square C i divided by del Q square i. So, here i takes two values right. So, this is also similar to what we have seen earlier. So, rate of change in marginal revenue, which is basically given by this expression shall be less than the rate of change in the marginal cost. So, basically that means that the marginal cost curve of the firm shall cut the marginal revenue curve from below ok.

So, now let us going to have a look at a diagram to find out the solution to this problem; So, now I move on to a graphical analysis to find the solution in this cartel model. So, I will have three panels of diagram. So, in panel A, I have the necessary curves for my firm 1 or duopolist 1. Now, in panel B I have the curves, which are required for analysis for firm 2. And in panel C, I have the aggregate picture ok. So, I start with firm 1. So, it is output is measured along the horizontal axis, and here in the vertical axis. I measure

the price and the marginal cost of production. So, same here for firm 2, and here we have the total production right, and here also we have this P comma C fine.

So, now we are going to first draw the cost curves for firm 1 or duopolist 1. So, of course, it will have some average cost of production, which is given by AC 1. And corresponding to that the firm will also have the marginal cost of production curve MC, which will pass through the minimum point of average cost these things are known from my theory of cost, I hope you remember. And this is my marginal cost curve ok.

Now, we are going to have the curve for firm 2. Now, here note that we do not have to assume that they have the same cost structure. So, In fact let me assume that my firm 2 is a high cost producer. So, it is average cost curve AC 2 lies totally above the average cost curve of firm one. But, for this firm also we will have a marginal cost curve, which passes through the minimum point of the average cost curve right call this MC 2 ok.

So, now how to solve the puzzle, how much output to be produced in this market for that basically we have to follow a trick ok. So, before we go to panel C, and start discussing how the optimal level of output to be produced in this case. I would not say optimal, I would say equilibrium level of output to be produced in the market. We have to see, how these firms are going to decide to produce.

So, here in this market there are two firms' right and each of them has marginal cost curves. Now, we have seen in the competitive industry analysis that if we have two firms with two different marginal cost curves or even identical marginal cost curve, we have to aggregate this marginal cost curves to find out the industry supply or the aggregate supply curve right. So, basically that part of marginal cost curve, which lies above the average variable cost curve is basically a particular firm's supply function. And this supply functions have to be horizontally added.

So, basically for a particular price level or marginal cost level, we have to first find out how many units of output firm q is going to supply. And at that same marginal cost or price how many units of the product firm 2 is willing to supply, we need to add them. And that sum total gives us the industry supply for that particular marginal cost number or price. So, we are going to adopt the same strategy here to find the industry supply.

So, now let us sum these two marginal cost curves. So, as this marginal cost curves have different slopes and different intercept, there will be a kink somewhere. And it will basically give rise to some kind of marginal cost curve like this; here note that there is a kink point ok. It is due to the difference in slope and intercept of the individual marginal cost curves. So, this is basically my total marginal cost, which is basically the horizontal sum of marginal cost 1 and marginal cost 2 individual marginal cost curves ok.

So, now the only thing that is left here to is to impose the demand function of the market. So, basically now we can superimpose the market demand curve, the assumption is that the cartel knows the market demand function. So, this is given by D. So, if that is known to the cartel, now note that the cartel will now behave as a monopoly right, because there is no second person in the market to supply ok.

So, if that is the case, then the monopolist cartel can derive the marginal revenue function in this case right. And that is given by this blue line and at the intersection of the marginal cost curve and the marginal revenue curve the cartels equilibrium is determined, so somewhere here ok. The rate point the kink point and the grey point, which is basically the cartels equilibrium point seem to be same, but actually it is not this is just by fluke because of hand drawn diagram. So, please do not be under illusion that the cartels equilibrium will always lie at the kink point of the aggregate marginal cost curve it is not.

So, here we get you start the total market supply, which is basically the sum total of individual supplies right. And we know what to do, now as we have done in the case of a pure monopoly model. We have to move up from this point to the aggregate demand function for the commodity, and we know that we have to now move to the aggregate demand function for finding the price that this cartel is going to set in the market right. So, this is the point corresponding point, this is the point on the demand function corresponding to the optimal or profit maximizing output quantity level. So, at this price the, this is the price that the cartel will set in the market for its product ok.

So, now let us study, how many units will be produced and supplied by this participating duopolist firms right. So, we have to now equate this common marginal cost, which equates, which gets equated to the marginal revenue. And we can call this as some marginal cost part, which is basically the common marginal cost. Now, note that here this

MR equal to MC is found, and this firm 2 produces Q star 2 level of output. And here at this point their MR equal to MC 1 condition is satisfied for the participating firm 1. So, the duopolist produces and supplies Q star 1 units of output to the market.

And if you sum them, you will get Q star the market output. Now, note that here as the firm 2 has a cost disadvantage or we can say that our firm 1 has a cost advantage, because it works with the lower level of average cost and marginal cost of production. So, here we can say that if the marginal cost curve always lies below, then the other participating firm, then the firm which has that kind of cost advantage will necessarily produce and supply more output in equilibrium in this cartel model. So, here we can see that this Q 1 star output level is basically higher than Q 2 star output level ok.

So, we are done with our discussion on joint profit maximization monopoly model, and this is more like a multi-plant monopolist. So, basically here comes a monopoly and here comes a monopolist firm, which has a different plants. So, each of these participating duopolist will now become different plants in this cartel model and together they go for joint profit maximization. So, one can also read this model as a multi-plant monopolist model.

So, with this discussion on cartels, we conclude our discussion on imperfect competition market models. In the next lecture, we are going to go through these types of models and their solutions through numerical exercises for better understanding. So far we have done all these modelling through general functional firms, there we are going to assume explicit functional firms, so that it will be easier for you to understand, how to solve these types of models if simple functional firms are given.