

Principle of Economics

Oligopoly

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In chapter fourteen we studied the output and pricing decisions by competitive firms and what happens at the industry level in perfect competition in chapter fifteen we looked at the exact opposite case when there's only one supplier in the industry there's no competition and the provider makes both of the decision about output and price in the marketplace.

In the next two chapters we will look at the cases in between when there is some amount of competition or interaction among companies.

In chapter sixteen, we look at oligopolistic markets which are the markets with a relatively small number of providers and because there is a relatively small number of providers, you can think that the providers are not anonymous each company observes how many other providers there are in the market and each company realizes the interdependence among the companies each company realizes that it can affect its competitors profitability and it's realizes that the price and quantity decisions by competitors affect might own profitability and we will say that generally there is a trade-off between a the decision to compete with competitors and cooperate with them.

So, to summarize the differences between different types of market that we could have so far we've discussed the extreme cases of monopoly and perfect competition.

We said that in with monopoly we had single firm with perfect competition we had many very small firms in the industry and we assumed that the product made in these industries as homogeneous.

in oligopoly we will continue assuming homogeneous product but we will look at the case when there is a small finite number of producers in chapter seventeen we will look at monopolistic competition the case when there is a larger number of firms maybe same number of firms as in perfectly competitive industries but the product produced by each firm is slightly differentiate.

Oligopolistic markets are characterized by relatively few sellers offering very similar product so here we are not focusing on product characteristics once again, companies are only choosing their output level or price but they recognize the

interdependency of their payoffs.

We will say that the companies would be best off if they cooperated with each other fully but we will say that the fully collusive solution is not sustainable because both companies have a faced tradeoffs between cooperation and competition and in the solution with perfect collusion both companies would have an incentive to deviate from the collusive agreement and cheat on it and compete with each other little bit more aggressively so we will say that depending on the model of competition and interaction between the companies the outcome will be somewhere between the fully collusive solution and perfectly competitive solution.

As a small digression, when there is a small number of competitors in the market we could model their interaction as a competition in prices or competition in quantities.

So one idea how competition between two firms could work is that companies choose their price if the companies were choosing the same price, they would split the market between themselves perhaps each of them would supply half of the market at that price.

But both companies know that if they cut their price just a little bit they could capture the entire market remember that the product is homogeneous under all of the assumptions that we placed on our model such as perfect information by consumers, as soon as one company cuts its price a little bit all consumers will flood to this producer and this company will supply the entire market and so we will say that model of competition when the competition is in prices both companies have the incentive to undercutting each other just a little bit to go from supplying half of the market to supplying the entire market.

The solution to that model of competition would be but the price would be competed all the way down to the level of marginal cost of production.

So if we model companies as competing in prices we would get the same solution as in perfect competition.

And the intuition here is that remember from chapter fifteen where we discussed the output affect and the price affect faced by the monopolist.

The monopolist was deciding how much to produce and what price and each time he changed quantity or price he faced both of the output affect of supplying additional consumers and the price affect of charging lower prices to existing consumers we can say that with the competition in prices or the 'Bertrand competition' the output affect dominates as soon as the company charges slightly lower price than its competitors, it gets to supply the entire market it's output increases significantly.

On the other hand the price reduction can be very small so we can ignore the small reduction in price that this company charges.

So because the output affect was so significant compare to price effect we get the result that prices would be competed down to marginal costs.

On the other hand we could model the interaction among companies as competition in the quantities so called 'Cournot competition' and in that situation companies choose how much to produce and when both companies choose their output level consumers look at the aggregate output produced and determine what the market price of this product will be.

In this case we will get the same result as in the monopolistic markets but there's both and output affect and the price of affect.

When the company decides to produce one more unit of output, on one hand it faces the output affect because the company can collect price one more time from the additional unit of output produced.

On the other hand there is a clear price affect because with an additional unit of output produced, price in the marketplace will fall clearly and companies realize and companies have to balance these output and price affects of there quantity choices.

We will illustrate this on the next few slides ok?
So let's look at an industry with demand curve.

With linear demand curve suppose that marginal costs of producing discommodity the marginal cost zero.

And..looking at this graph, I want you to already think about what would be the solution in different forms of the industry.

If we had a perfectly competitive market, then prices would be competed down to the level of marginal costs.

So this would be the market solution if we had a monopoly operating in this industry.

Then the monopolies would choose quantity where marginal revenue is equal to marginal cost.

We would say that the solution has this output level and this price level in the market and now the question is what happens in oligopolist markets and as I said that depends on the interaction between companies.

As I said that if the companies compete in prices we might believe prices would be competed down maybe almost to the level of marginal costs and this in that case oligopolistic output could be close to the perfectly competitive output or if we think that companies compete in output levels we will say that the market solution really could be anywhere between the monopoly outcome and the perfectly competitive outcome.

Let's to solve this numerically we should look at the profits that companies can earn from any quantity choice ok? So in this table I computed the profits that each company would make if it produced a particular amount of output and if its

competitor produced at different level of output so..

on this graph each row corresponds to each row gives us the profits that company 1 and company 2 at earn if company 1 would produce thirty thirty five forty and so on units of output.

Each column gives us the profits when company2 produces thirty thirty five forty and so on units of output.

You can think that thirty units of output corresponds to the monopoly output.

Sixty units of the aggregate amount of output and with... if the companies could collude and agree on this level of aggregate output each of them would earn eighteen hundred dollars of profit.

If companies produced large amount of output such as sixty and sixty which would be the perfectly competitive output level.

Each company would earn zero profits because prices would fall to zero to the level of marginal costs and looking at these payoffs we can see that profits clearly change depending on how much each company produces and the way to understand this table is each company is looking at this schedule of profits and each company's choosing how much to produced based on how much its competitors producing.

So suppose that to is producing thirty units of output.

How much would company 1 choose to produce.

Company 1 would choose at its different profits and it would choose and it would realize that producing forty five units gives company 1 the greatest profit.

So if company to produce thirty units of output company 1 would choose to produce forty five units of output.

So now we have decided that company2 might choose to produce forty five units of output what will company 2 wants to do will still we would really want to produce thirty units of output or really want to do something else.

So, looking at this row here we would compare the profits that company 2 can make and we would find that either thirty five or forty units of output give the greatest profit.

So suppose that company2 chose to produce forty units of output.

Question is what company 1 still wants to produce forty five units of output.

Again company one would compare the profit that it can make and now it would choose now company 1 would decide that actually producing forty units of output gives it greater profit than producing forty five units of output.

And if the company one chose to produce forty units of output.

Let's check whether company 2 would still want to produce forty units of output.

Yes indeed we can find that when company one is producing forty units of output company 2 would produce also forty units of output.

So now we have found that if this is a possible market outcome each company would want to stay at this schedule of output levels neither company would want to move.

Okay? So we can say that this is one possible market equilibrium.

If company 2 believes that company 1 will produce forty units of output company 2 will also find it profit maximizing to produce forty units of output and vice versa.

We could also find that there are two other possible equilibria so in general without knowing about bargaining power between the two companies it's unclear whether this would be market outcome or this market outcome we can say that depending on company's beliefs and bargaining power we could end up either here here or here.

So looking back at the... at the market demand curve now we have determined that in a duopoly where companies compete in quantities..eighty units would be the aggregate output level so we would say that the market solution in this oligopolistic market would be to produce eighty units of output.

Total at this particular price level and one other way to think about this problem so if we want to illustrate this problem graphically, let's look at the market demand curve and think about each company's problem.

So company 2 is thinking how much to produce.

Company2 observes how much company 1 is producing so suppose company 1 is producing this output level and given this output level by company 1, company 2 is thinking that it has a residual demand that looks like this.

After this many consumers are served by company 1 company 2 can choose how much to charge and how much to supply to the other consumers in the market right? After subtracting, these consumers from the aggregate market demand company2 choosing its quantity and price for the remaining consumers.

We can say that company 2 is acting as a monopoly on this residual..in this residual market.

So we could find company 2's marginal revenue curve on this residual demand and to maximize profits.

We would realize that company 2 once to produce where marginal revenue is equal to marginal cost of production and we would say that given company once output level company 2's profit maximizing response would be to produce this output level

here.

And once we saw for company 2's optimal response we would go back and evaluate whether company 1 output level was indeed profit maximizing given that company 2 wants to produce this output level how much would company 1 want to produce.

We would look at we would perform the same analysis where company 2 supplies particular portion of the total market company 1 has a residual market with the residual marginal revenue curve and company 1 is choosing its profit maximizing output level and we would go through this analysis studying each company's choice of quantity in turn until company 2's optimal response until we get the output levels of the two companies as optimal responses to each other's quantity choices.

So in the solution we would find that company 1's output is a best response to company 2's output and company 2's output is a best response to company 1's output.

That's really what this table summarizes numerically, ok.

Now, let's compare the possible solutions in different market structures.

So far we said that in duopoly with competition and quantities either of these three outcomes is a possible depending on firm's beliefs and firm's bargaining power.

We said that in monopoly this would be market outcome and in perfect competition this would be the market outcome.

Notice that monopoly outcome gives greater profits, gives greater aggregate profits than the oligopoly outcome.

So if here you should think that if the oligopolists talk to each other if they could limit their output levels to thirty units of output profits of each company would increase from sixteen hundred to eighteen hundred but the question is "is this solution possible?" Notice that if company 2 produced thirty units of output as we discussed already company 1 would not find the profit maximizing to stay with this output level it would choose forty five units of output rather than thirty.

So we can summarize that even if the two companies collude and agreed to produce a small output level each company will have an incentive to cheat on the collusive agreement and produce more.

This is the kind of interaction that's game theory studies.

Game theory is a subfield of microeconomics.

That looks at the decisions of companies and people in strategic situations.

Whenever there are tradeoffs to be made between cooperating and competing with each other.

Game theory can be used to study the optimal decision making, using very simple model.

We would say that the solution to game theoretic situation is that nash equilibrium and the nash equilibrium is defined as the outcome when each decision-maker chooses the best strategy for himself.

Given the best strategies chosen by its competitors.

The simplest kind of game theoretic situation is so called prisoner's dilemma.

The example goes like this..the police catches two prisoners and holds them into different cells in the prison and each prisoner has an option to remain silent or to confess all the crimes and because police has limited information on the two prisoners' crimes if both prisoners remain silent the police cannot get hold them in the prison for too long.

Suppose that the police will be able to hold them in prison only for one year because there's a limited evidence on the crimes committed by the prisoners.

On the other hand, if both prisoners confess the police can hold both of them in prison longer because it has more evidence on the crimes and to induce prisoners to confess the police can offer prisoners some incentives such as if only one prisoner confesses so if we go from remaining silent if only clyde confesses and bonnie remain silent the police could promise to clyde that the police will release clyde that clyde will not have to serve any sentence in the present.

So notice that in this simple situation we have four possible outcomes.

We know the payoffs to each player to each prisoner and looking at these numbers.

It looks like remaining silent for both prisoners would be the best outcome.

In all other outcomes you both prisoners have to serve high sentences or what this one prisoner has to serve high sentence in prison.

So but what happens in the situation.

Notice that let's think about this strategy of clydes.

Now what clyde does clearly depends on what bonnie has chosen and the payoffs to clyde also depend on what bonnie has chosen.

Suppose that bonnie remain silent what would clyde decide to do what he decides to remain silent or to confess.

We can say that..we can see that by remaining silent, clyde would go to prison for one year by confessing he'll get zero years of prison so his...it's optimizing for him to

confess now what would clyde do if bonnie confesses.

Again looking at the payoff from remaining silent to the payoff of confessing we see that it's optimal for clyde to confess.

So we can summarize that it doesn't matter if bonnie confesses or remain silent.

It's always optimal for clyde to confess.

We would say that the dominant strategy for clyde is to confess and because the table asymmetric.

We would get the same conclusion for bonnie regardless whether clyde confesses or remain silent it's optimizing for bonnie to confess.

Eight years is less than twenty years..zero years is less than one year.

So we just figure it out that the dominant strategy for both players is to confess.

So surprisingly even though this solution is clearly better for both prisoners than this solution through this interaction of tradeoffs to cooperate and to compete with each other.

Both prisoners decide to compete and confess.

The textbook goes through several examples when this framework of prisoner's dilemma can be used we can see that oligopolistic competition can be studied using the framework of prisoner's dilemma.

Nuclear threats can be studied using this framework.

An extraction of natural resources and decision to drill for oil can be used....

Can be studied in the same framework and the surprising result we get is that the efficient or the welfare maximizing outcome is not the equilibrium ..outcome in those situations.

Now one criticism of these games could be that they always assume that the game is displayed one time only and we might ask what happens if the game is repeated over several time periods.

Suppose we might hope that if the game is repeated sufficiently many times, three times or ten times or one hundred times.

Maybe both prisoners would realize that sustaining the efficient outcome is beneficial to both of them.

And through repeated interaction we could get the efficient outcome rather than the competitive outcome.

Again kinds of surprisingly we can derive that if the players interact in a finite number of time periods, we will get the same result as in a one-time game.

Suppose that bonnie and clyde interact and three time periods.

Let's think of their decision making in the last time period in the last in the third time period when there is no future interaction among them, bonnie and clyde will think whether to confess whether to remain silent and because they're not facing any further interaction in the future they will remain the same decision as in a one-shot game.

So in the last period of the repeated game they will choose the same strategy as in a one-time game.

Now in the second time period so one time period before that they'll realize that in the next time period they will not cooperate with each other and because there is no beneficial future cooperation between the players even in the second time period they will decide not to cooperate with each other.

Again they will decide their dominant strategy his to confess and not cooperate with each other.

So because there was no possible cooperation after the third time period because of the..there was no likelihood of cooperation in the third time period there was no cooperation in the second time period.

Finally because there is no likelihood of cooperation in the second or third time period even in the first time period the players will choose not to cooperate with each other.

So surprisingly even if we have many time periods in which the players cooperate even one hundred time periods if we solve the game from the last period to the first time period who find that there is no cooperation.

Only if there's a positive chance of cooperating in the future can we get cooperative outcome between the players.