14.01SC Principles of Microeconomics, Fall 2011
Transcript – Lecture 17: Oligopoly II

PROFESSOR: OK, so what we're going to do today is continue our discussion of oligopoly which we started last time. I want to return to the example we were using last time to discuss the example of Cournot competition. We started last time by talking about general game theory and the prisoner's dilemma and the concept of Nash equilibrium. Then we turned to a specific example of a Cournot competition, the way we can specifically model two firms competing in a market.

And so if you recall the example from last time, we had demand curve of the form p equals 339 minus q where this is thousands of passengers per month. And we had a marginal cost of $147. And we have flat marginal cost, so average cost equals marginal cost equals 147, equals average cost. So flat marginal cost.

And what we said, so therefore if the firm was a monopolist, if American Airlines say was a monopolist, they would set marginal revenue equal to marginal cost which would be 339 minus 2q equals 147. And so the monopolist was going to set a quantity of 96. That was the monopolist quantity with the price. So the quantity of monopolist is 96 and the price of monopolist is $243. So that was the monopoly case.

Something you should be very facile with for tomorrow night is solving those kinds of monopoly problems. And then we said, OK, but what if, in fact, it recognizes that it's not a monopoly. There's another firm in the market. United is in the market as well.

Well in that case it has to consider its residual demand. So in that case we said the qa, its residual demand, for American was equal to the total market q minus the quantity absorbed by United, qu. And we showed last time what this leads to graphically. And so we re-handed out figure 16-3 just to review.

The notion was that each firm develops a best response curve. Each firm says, based on what the other firm's going to do, here is my best level of production. Here's my profit maximizing level of production.

And each firm having developed a curve, there's an equilibrium where those curves intersect because at that point both firms are happy. You've achieved your Nash equilibrium because at that point both firms are satisfied with the strategy they're playing given what the other firm's playing. So that point of intersection, both firms' best response are consistent with each other. And that's we developed last time graphically.

Intuitively, I think it follows from the same logic, the idea is we're playing this game and the game will only have a stable outcome if we're both satisfied with the outcome. If we're not both satisfied we'll continue to change our behavior and it won't be stable.

And so what I want to do now is talk about how we solve for this mathematically. So let's just think about the mathematics of solving for Cournot equilibrium. So what's the mathematics now? What's American Airlines's residual demand function?

Well their price, p_a, is equal to the total demand, 339, minus what they supply minus what United supplies. So the price in the market, they don't have separate prices, the price in the market is going to be 339 minus what each of them supplies.

So now American can't control q_u, American has to take that as an outside given factor. That's what they're responding to. So American says, I need to optimize this with respect to what I can control which is q_a.

So how does it do it? Well, it computes marginal revenue. Well marginal revenue is p times q_a. So that's $339q_a$ minus q_a squared minus $q_u q_a$. Just multiplying through. That's their revenue function.

So marginal revenue, differentiating with respect to q_a which is all they can control, is going to be 339 minus $2q_a$ minus q_u. That's going to be their residual marginal revenue function. And they're going to set this equal to marginal cost. So I'm going to set marginal revenue equal to marginal cost. So they're going to set this equal to 147 which is marginal cost. And solving. you get that q_a equals 96 minus $1/2q_u$. q_a equals 96 minus $1/2q_u$.

Once again reviewing, what we're doing is we're saying we set up their residual demand function. We compute what that implies in terms of revenues. We differentiate with respect to their control variable, q sub a, to get a marginal revenue function. You set that equal to marginal cost. And you solve for their best response curve.

Essentially you just solve mathematically for the curve you see here graphically. You go to the graph and you look at American's best response curve. That is exactly this line. When qu is 0, it intersects at 196. When qu is 192, qa is 0.

So you can see we've just mathematically developed where this best response curve comes from. We've just solved for that mathematically through the similar mathematics of monopoly profit maximization. In this case we're essentially saying, imagine you're a monopoly except for the stuff produced by the other guy. That's the way to think about it. Imagine you're a monopoly except for what the other guy does and you get this best response function.

Now, since we set this problem up to be symmetric-- that is we said the marginal cost identical for both firms, and the market demand applies to both firms-- since we set this up to be symmetrical, then we know that we can also write a symmetrical best response function for United, which is q sub u equals 96 minus 1/2 q sub a. We can solve for this but there is a shortcut. If it's symmetrical problem they'll have symmetrical best response functions.

So we can just write the symmetrical best response function. And then we can find the equilibrium. Remember the steps I went through last time. Now we have n equations and n unknowns. We have two equations and two unknowns. We can just solve by plugging one into the other. And we get that qa star equals qu star equals 64. Which is in fact where these curves intersect. So that's how I found the intersection of these curves was solving mathematically for the optimal level of production given what the other guy's doing.

And the price, what's the price? Well the price is 339 minus q sub a minus q sub u. So it's 339 minus 128 or 211. So you end up with each firm producing 64,000 units a price of $211.

And this is the Cournot equilibrium. Because it's on both firms' best response function. Both firms are maximizing profits. And in maximizing profits they both have chosen the same point to produce and so you're done. They're happy. That's the Nash equilibrium. Yeah.

AUDIENCE: So in the last lecture was that game theory box. And this would be the lower right hand box, correct?

PROFESSOR: That's a very good point, yes. This is sort of like game theory but with a whole distribution. But in some sense it's like at each point you've reached that point. But I really wouldn't draw that parallel actually.

The parallel that's important from that is the equilibrium concept. The reason we choose the prisoner's dilemma instead of choosing the equilibrium concept-- and the equilibrium concept is, you're in equilibrium when each firm's dominant strategy yields an equilibrium outcome. Here we've just taken that intuition and solved mathematically for each firm's dominant strategy. And that yields an equilibrium outcome.

AUDIENCE: That top left box, there's no way-- we shouldn't think about that at all?

PROFESSOR: No, actually it's a great segue to what I'll talk about next which is a cooperative equilibrium. So what we've solved for is we solved for a non-cooperative equilibrium. Where they're not cooperating.

So it's like the prisoner's dilemma in the sense they end up in that lower corner. But in some sense I think that parallel, I'm not sure how much that helps other than thinking about the strategies and about thinking that that's non-cooperative. We want to turn to next what happens if they can cooperate.

But before I do so, two things. First of all, these problems do not have to be symmetric. I've just solved symmetric problem often, and you'll see symmetric problems, that makes the math easier. But they don't have to be. American and United can be different and you could solve the same math. And in fact Perloff goes through an example like that. Symmetry is not guaranteed in these problems, it's just a feature of the way I set this up.

So this question is a great segue to the next topic, which is what about cooperative equililbria. Can't American and United get together and form a cartel? Remember we talked in the prisoner's dilemma about how that would be the best outcome if the two persons could just trust each other.

Well here can't American and United just trust each other and form a cartel? And what they do here mathematically is pretty easy. They would just say, look, let's get together and pretend we're one firm. Then let's act as that one firm monopoly would and split the profits. It's the way a cartel could work. They could say let's get together, we'll produce as if we're a monopoly and let's split the profits.

Well what would happen if they did that? Well we know that the total monopoly production if they had been a monopoly is 96. So that's a big Q. The quantity for the market is 96 and the price if they're a monopoly is $243. So what they did is they said, look, we'll each do 48 flights, for a total of 96 and we'll charge $243 and we'll agree to do that.

But what would happen? Well their profits to each firm would be their 48 flights they do times the price they get minus the marginal cost. Marginal cost is average cost here. The price they get minus the marginal cost. That would mean per firm the profits would be $4,608. So each firm would make $4,608 in profits. Actually that's four million. This is in thousands, right. So $4,608,000.

Let's compare that to the profits they made as Cournot competitors. Once again comparing the upper box to the lower box, going back to the prisoner's dilemma. I think that is actually useful to think about.

Let's compare that to what happened when they were Cournot competitors. When they were Cournot they each took 64 flights. They each did more flights when they were competing, but they only got to charge $211 with that same marginal cost. So their profits as Cournot competitors were $4,096,000 each. So by monopolizing and splitting the market they raised their profits by 12.5%, by an eighth. Their profits went up by an eighth, by 12.5%, which is a major jump in profits by getting together and forming this cartel.

Just as the two prisoners were better off not ratting each other out, they were both better off not ratting each other out. These guys are both better off getting together and forming a cartel and splitting the profits, same logic. So why don't we see these cartels everywhere? Why do we have American and United, why don't they just do this?

Well that's for two reasons. Two reasons why we don't see these cartels everywhere. The first reason, so why not cartels? The first reason why we don't see cartels is there's a fundamental instability.

Cooperative equilibria are fundamentally unstable because any one party has an incentive to cheat. Any one party in a cartel can make money by cheating because they stick the other firms in the cartel.

So let's just talk about this for a second. Imagine what would happen if American decided to cheat. Imagine they had this cartel, it's running along, they're each making their $4,608,000 per month profit. They're all very happy. Now imagine American says, wait a second, what if on the sly I increase my number flights from 48 to 50? What if I just did that and did it in a way which wasn't immediately transparent to United?

So American takes its q sub a which was cranking along as 48 and it raised it to 50. Well what happens? Well if they do that the total quantity in the market instead of being 96 rises to 98. And if it rises to 98 that means the price is going to fall, right?

This is not a price discriminating monopolist, this is a one price monopolist. So if they want to sell 98 flights, the price is going to have to fall. So the price is going to fall to $241 from the current level of $243.

Well you might say, gee American just shot itself in the foot. Its just lowered the price by selling more flights. But look what happens to American's profits. American's profits are now 50 times 241 minus 147 which equals $4,700,000 which is higher than it was making ib a cartel. American just increased its profits to more than they were making when they cartelized splitting the profits.

And what's happened to United? So this is profits for American. United's still doing 48 flights but the price has now fallen to $241. So United's profits fall to $4512. United's profits fall. American's profits go up. So basically American has stuck it to United by cheating. It's raised its profits at the expense of United.

And why is that? What's the intuition? Well it goes back to our monopoly intuition. Because when one firm cheats in a cartel it gets all the benefit of the extra quantity, but only feels part of the poisoning effect.

Remember when a monopolist increases its quantity. It's got these two effects. It sells more but poisons its previous sales. Well here when American sells two more flights, it sells more, it's got all that effect

like a monopolist would, but the poisoning effect is shared with United. They don't feel as much pain from that price going down because they're sharing that pain with United. They get all of the benefit from quantity going up and only part of the pain for price coming down. And that's why it makes sense to cheat.

A monopolist would never cheat itself. It'd make no sense for the monopolist suddenly to go from 96 to 98 and say, ha I've cheated myself because it would feel the entire pain of the poisoning effect. But American doesn't. That's shared with United. So it actually makes sense to cheat because they get all the benefit of the more quantity and only part of the cost of the lower price. And that's intuitively what's going on. Questions about that?

Well knowing this, clearly United says, wait a second, if we form a cartel American will cheat. So I'm going to cheat first and the whole thing falls apart. And we get back to the repeated game intuition we talked about in our game theory lecture. Where if they can commit to never cheat, if they can commit to punish each other if they cheat, you might be able to make this work in a repeated game, but only if the repeated game never ends. So if there's either not a repeated game, or it's a repeated game with an end, then there's going to be incentive for someone to cheat. Once there's an incentive for someone to cheat, the whole thing falls apart. And that's why cartels are fundamentally unstable.

Now there's a second reason why we don't see cartels which economists would always put second. We always put the economic stuff first and the legal stuff second. The second is they're illegal, but we think that's less important as economists because we think folks are often smart enough to figure their way around laws.

Technically these are illegal. In fact, in the late 1800s cartels were very common in the US. They were called the trusts. There were trusts in sugar, railroads, other areas. This is how these robber barons made all their money-- the Rockefellers and the Vanderbilts and stuff-- was by building monopolies. That's what made their money. And then in the early 20th century Congress passed what was called anti-trust laws which explicitly forbid the creation of cartels or these kind of trusts. So technically they're illegal.

In fact, there are lots of ways, and Perloff talks about this in his book, there are lots of ways that firms can implicitly cartelize. There are ways that firms can say, look we'll get together not under the government's auspices and we'll agree that you raise your price and I'll do it two weeks later and look like we're not a cartel. I'm just following you, but in fact we've agreed to do it. So there is some implicit

cartelization and basically that's why there's an anti-trust division exists that's quite large. The Department of Justice is basically to prosecute exactly those cases when firms try to do that.

Now in fact, however, the government has a bit of blood on its hands in this respect, because sometimes the government actually promotes cartels even though it might not mean to do so. And the best example was the 1981 voluntary export restraint policy, the Reagan administration.

1981 was the worst recession before this one. Actually unemployment was higher than this one. This is a very bad recession, but actually unemployment was higher in 1981. It was well over 10%.

And a big place where unemployment was high was in the manufacturing sector, particularly auto manufacturing. We were getting killed by Japan. Basically this was the first wave of Japan really producing much better cars than the US. And US car manufacturers were suffering enormously as a result.

So basically the Reagan administration was trying to figure out what to do about this. One thing you could do, and we'll talk about in international trade in a few lectures, you could impose a quota and you could actually say to Japanese producers, you can't sell in America.

But Reagan was a Republican. And Republicans are for free trade. And he really couldn't do that politically. Plus economists have often said that's a bad idea. And we'll talk about why that's a bad idea.

What Reagan did instead was said to the Japanese auto manufacturers, look, I'm a charismatic guy. I'm Ronald Reagan. Why don't we get together in a room and I'll convince you to just export less to America. Let's have a voluntary export restraint agreement.

Where I'm not going to put on a quota, because that would be bad, I'm going to actually suggest to you, I'm going to make you an offer you can't refuse that you just export less to the US. It was basically a back door way of imposing a quota without looking as politically bad as actually imposing one. And in fact, Japanese automakers agreed to this and reduced their sales of cars in the US.

Now why would they agree to this? Now there's two explanations. One is they could have thought if they didn't then a quota was coming. They could have said, look, this is kind of an olive branch before they lower the hammer. That's a really bad set of metaphors, but you get the idea. That basically look, if we don't do this, then he's going to impose a quota.

The other is they could have said, thank you Ronald Reagan, you've just formed a cartel for us. We can't stop from competing against each other. We can't stop cheating. We'd like to form a cartel but we can't. But you've told us we have to cartelize because you've limited how much we can sell.

You've essentially said, look you can't sell more than this. You have to agree to sell more than that. You've essentially allowed us a framework where we can get together and implicitly cartelize in a way where it's hard to cheat because then we'd be violating the agreement with America. So basically what Reagan gave the Japanese was a cartel enforcing device.

What American and United need is some way where American and United can monitor each other to make sure they don't cheat. That's what Reagan gave the Japanese. Said, I'm going to report on how many cars are selling in the US and you're going to agree to limit it to this. And they're like, great, that gives us the tool we need to enforce the cartel we wanted in the first place. Thank you very much. They made a ton of money. American consumers lost out. And I'll talk more about international trade on why that happens.

But the bottom line is, this end up being just like a quota. The bad thing about quotas and things like this is that essentially they raise prices and hurt American consumers. And in this case they were bad for American consumers and very good for Japanese producers. We essentially increased profits for Japanese producers which they used to develop better cars and then came in later and killed us in the car market anyway. So it was dynamically a pretty terrible policy. So that's the legal issues around cartels.

Now what I want to do now is step back for a second and say, we've now talked about three different kinds of market forms. We've talked about perfect competition. We've talked about monopoly. And we've talked about oligopoly. In particular, non-cooperative oligopoly which is a more interesting case since within cartels it's going to be hard to sustain. Non cooperative oligopoly. We've talked about three.

How do these compare? So let's just do ourselves a little chart. Let's consider the three cases. We've got monopoly, oligopoly, and perfect competition, three cases. Let's ask how they compare on quantity and on profits per firm. Quantity produced in the market and profits per firm. And let's do it for this American, United example.

Well we know the monopoly case, we told you that in the monopoly case 96 units get produced in the market. And the profits per firm are $4,608,000. In the oligopoly case that's the Cournot case, in the Cournot oligopoly case we said the total amount in the market was 64 per firm or 128,000. And the profits per firm were lower. They were $4,096,000 per firm.

Now what about in perfect competition? What's the quantity that's going to be sold, what's the price going to be in perfect competition? We haven't done perfect competition. You can tell me. You can just do that intuitively. What's going to happen in this market if there's perfect competition what's this price going to be? Somebody raise their hand and tell me. Yeah in the back.

AUDIENCE: [INAUDIBLE]

PROFESSOR: 147, because price equals marginal cost in perfect competition. So quantity would be 339 minus 147 or 192. There will be 192 units sold. And what will profits be? Zero. Zero profits in perfect competition. With a flat marginal cost there will be zero profits with perfect competition.

So we can now compare this and we could say, an oligopoly case leads to less output and more profits than does perfect competition. And a monopoly case leads to even less output and even more profits than does oligopoly. And basically how do we think about welfare in this case. Well to think about welfare you'd have to actually draw the diagrams to compute producer and consumer surplus.

What I could draw and show you is basically social welfare is highest in the perfect competition case, lowest in the monopoly case, and we talked a couple times about the deadweight loss of monopoly. This is not a price discriminating monopolist remember. This is a one price monopolist so there's deadweight loss.

And it turns out if you write down the graph that it's in between the oligopoly case. Oligopolies cause some deadweight loss, it's worse than perfect competition but better then monopoly in terms of total welfare. And in fact, the bottom line is, we can actually pretty much tell what happens to welfare.

A shortcut for thinking about welfare is to look at quantity. Because remember what social welfare is about, what causes deadweight loss, is trades that aren't made. Under perfect competition every trade that has a positive social surpluses is made. So the closer the quantity produced comes to the perfect competition level, the smaller will be the deadweight loss, roughly speaking.

So it isn't always true, and you can find bizarre deviations, but a good rule of thumb is that welfare, the distortion of perfect competition will be proportional to how much quantity falls relative to perfect competition. If quantity falls a lot relative to perfect competition, that's going to be a big loss in welfare. If quantity is falling just a little, it's going to be a small loss in welfare. And that goes back to that deadweight loss triangle. About the fact that it's smallest right around the perfect combination equilibrium and gets bigger as you move further away.

So basically perfect combination is the best, monopoly is the worst, oligopoly would be somewhere in between. This leads to the question. I think you might look at this chart and ask yourself is well, gee, does this sort of say that the number of firms determines welfare? You've got one firm, two firms, infinite firms so can we make a more general statement about the role the number of firms.

And it turns out the Cournot model we can. Basically in the Cournot model, the more firms there are, the closer you get to perfect competition. In the Cournot model as n increases you approach perfect competition. And in particular, and the book does the math in this, you don't need to know the math, it's more the intuition. But the book shows that the markup in a market, price minus marginal cost over price, in a Cournot market is equal to 1 over n times the elasticity of demand. That is that we've said before that markup was inversely proportional to elasticity of demand.

I might have used a different letter, I might have used nu for that elasticity. But this is elasticity of demand. I forget what letter I used last time. Same elasticity I've been using. So basically, we said before we had this equation, right? We said markup was inversely proportional to elasticity demand. The more inelastic was the good, the higher market power the monopolist had.

Well here we now divide by n. So the point is, that for a given elasticity of demand the more firms that are competing in the oligopolistic setting, the closer and closer you're going to get to a zero mark-up with a Cournot equilibrium. So it's just this intuition you see from this table.

This is one firm. Then oligopoly can imagine a number of branches. This is oligopoly with two firms. You should be able to show yourself. If there were three firms, which you can solve, that's three equations and three unknowns.

It's the same math we just did. It's high school math. You can do this if you just put in three firms, do three equations and three unknowns, you get an even higher quantity and so on. So as the number of firms goes up you're going to move that quantity up towards the perfect competition level and profits will fall towards the zero that we get from perfect competition.

And this is consistent with our rough notion. We talked about extremes, about perfect competition being lots of firms, the monopoly being one firm. But this confirms the rough intuition of the more firms, the more competition. That's a good solid intuition.

Now this raises the interesting question about should we ever allow the number of firms in a market to shrink. Should we ever allow the number of firms in the market to shrink? What we call that is we call that a merger. You've all heard of mergers. When two companies merge to form one company.

Well by the logic I just told you that's going to be bad. I just said that the more firms you have, the higher welfare. The more you get towards perfect competition. And yet mergers happen all the time. The government does not stop them. The government typically investigates them if they're big mergers, the government would typically investigate them. But by and large they often let them go through.

Why is that? Why should the government not stop all mergers? And in particular, if anyone for extra credit, can anyone tell me what concept we covered which would explain why it might make sense to allow firms to merge. Yeah.

AUDIENCE: The economy of scale.

PROFESSOR: Economies of scale, exactly. That's the term I was looking for. It could be that you have two firms that are producing inefficiently relative to having combined production. So you've got one plant that produces the left shoes and one plant that produces the right shoes. And that's not a good example because they wouldn't really compete with each other. But you know the point.

The point let's say you've got two firms competing with each other and they're both running a plant at half capacity. There's two separate plants running half capacity, much more efficient to have them merge and have one plant run at full capacity.

And yes, if they merged they would then be a monopolist, but it's possible the cost efficiencies could be so high a monopolist with lower marginal cost might be better than oligopolist with higher marginal cost. This is kind of like the patent example I did last lecture or the lecture before. Where I talked about how a patent could be a good thing or a bad thing. It depends on how much demand increases due to the patent. It's the same notion here.

The tradeoff is on the one hand you get marginal cost down by allowing a merger, on the other hand you reduce the number of firms in the market by allowing a merger. And there's that tradeoff. You're going to raise each firm's mark-up ability but by lowering marginal cost you might actually in essence, might in the end lower the price.

And that's exactly what the Department of Justice does every day. And this is what is the hundreds of economists that work for the Department of Justice do, they have quite an interesting job. They have to go ahead and evaluate these mergers. People want to merge and they have to say, well which effect is going to be larger.

How do we decide whether the savings from economies of scale exceed the cost and increase market power? And that's just an incredibly hard thing to do. That turns out to be an incredibly hard thing to do. And part of the reason it's hard is exactly comes back to what I talked about when I talked about regulating monopolies. Because the data is controlled by the market participants. And so you can have necessarily good data on what it's going to do.

So a great example is hospitals. Over the last 20 years there's been enormous mergers in the hospital sector. Even here in Boston we've seen huge mergers of things like the Beth Israel and Deaconess hospitals merge. Other hospitals merged.

These mergers were big and had to go before regulators. And the hospitals rightly argue, look, there's huge economies of scale in hospital production. Partly because hospitals are rarely full. They have to have excess capacity in case somebody comes in injured. They have to have an extra bed around. They don't want people sleeping in the halls.

As a result, in a situation where you're rarely full, where you're constantly under capacity, there could be huge economies of scale from combining and using your combined space more effectively. So pretty compelling argument. And for that reason, pretty plausible. Most hospital mergers were allowed through. Very few hospital mergers were rejected.

Well what happened? It turns out the hospitals just lied. They kept exactly the same production process they had before the merger and just raised prices. So in fact, Beth Israel and Deaconess each kept their building just like they had before the merger. They just charged more. Essentially they just cartelized. But the government let it go through.

And what we've done, essentially, is we're fooled by the theory of these economies of scale, when in fact there was nothing to force the companies to necessarily do much to realize them. We just allowed them to have market power. So basically this is an incredibly tricky and difficult issue in deciding whether to allow mergers or not is basically evaluating whether in practice you'll see the economies of scale that justify the increased market power. And that's why the Department of Justice has a hard job. Questions about that?

One other point I want to make here is about the size the market is, I've talked about how mathematically the size of the market will lead to more competition. There's also another reason, which is the bigger the market, the harder to enforce a cartel. If there's two players in the market and one cheats, the other one has the first one whacked or something.

You know what's going on, you can keep an eye on each other, you know who's to blame. When there's lots of players in the market it becomes-- so let's say there was 10 airlines flying, it becomes hard to figure out who's cheating.

Or more still, imagine the most important cartel in the world which is OPEC. The Organization of Petroleum Exporting Countries. This is an organization of 20 plus countries who control the world's oil supply.

But there's no good way of tracking who's selling what oil. We just know the total amount of oil sold out there. So if a country like Venezuela run by some nutty guy decides to cheat and throw a bunch of oil on the market, it's hard for the other members of OPEC to actually view that.

OPEC's efficiency has varied over time. At times OPEC has not done such a good job of controlling the supply of oil in the world, at other times it has. But basically the more players, the harder it becomes.

And as a good example, which is the cartel to produce mercury was an existing cartel. Italy and Spain essentially had controlled the market to sell mercury. They had a very well functioning cartel. Other countries entered and the cartel broke down. So we can see this. And this becomes a big issue in thinking about the benefits of enforcing competition. And becomes a big issue in government policy.

Here's another government policy issue which you may followed lately which is the rare earths issue. You guys all know as scientists better than I, the importance of rare earths, but these are materials which are very important for putting in cell phone batteries and other things. These are important new materials for the modern economy.

The US used to be the dominant producer of rare earths and then China turned out were able to produce it much more efficiently, so we just let China take it. So now 97% of the world's rare earths are produced in China.

China's now started saying things like, Japan we're mad at you, we're not selling you rare earths, which is a huge, huge problem. And basically we've allowed China to essentially monopolize this market.

Now we tend to think in economics it's a bad idea for the government to subsidize businesses. The government should just let the economy work and decide what works. But this may be a case where the government wants to say, no, we are going to actually subsidize rare earths production in America, to make sure on national security grounds we have enough in case China decides to shut us off. And that's exactly the kind of issue the government has to face in terms of trying to decide whether or not to try to

actively get in there and promote competition versus just letting the market work. Questions about that?

Now I want to talk about one last thing before we stop, which is the fact that Cournot competition is not the only model of competition out there. In fact it might not even be the first one that comes to mind. In fact, if I said to you, imagine two firms competing to sell something, the first thing to come to your mind would probably not be best response functions. If you say, well they just compete over the price. And if there was really tough competition the price would just come down. And the limit, if they're incredibly good competitors, the price would have to come down close to marginal cost. Well that is a different model of competition that we call Bertrand or price competition.

Cournot competition is competition over quantities. You get together and decide how much quantity to produce given what the other guy is producing and then the market gives you the price. Bertrand competition is the flip of that, which is firms set their price and they produce whatever the market demands at that price. Once again, Cournot competition is firms set their quantity and then they set the price reading it off a demand curve. Bertrand competition is totally different. They say, we're just going to compete over price and we'll just produce whatever quantity you want at that price. We don't really even care what demand is. We're just going to compete over price.

And the idea is that you have some marginal cost that firms will never go below in the long run. And the question is how much will they compete down to that marginal cost. In practice, what's crazy about Bertrand competition is it's possible with two firms you can get to the perfectly competitive outcome, with only two firms. Because those two firms are competitive enough in setting the price, they can fight it all the way down to the marginal cost.

That is if I ever try set it to marginal cost plus $1, you'll come in and set it to marginal cost plus $0.99, because you can still make money. Now I'll come and set it to marginal cost plus $0.98, because I can still make money. And we'll compete it all the way down until we both are charging marginal cost plus a penny. And if anyone tries to sell a higher price they can't sell the product because people will only buy the lower priced good.

So you could have a world with Bertrand competition where essentially firms compete over price. And where unlike this case, oh I just covered it up, unlike our comparison where with two firms there's still lots of profits to be made. In Bertrand competition it's possible that two firms are enough, just two firms are enough to get us to perfect competition.

You don't need n firms. Two firms are enough. And in some sense, if we thought about it, that's probably the first model we have in mind if we thought about firms competing is they compete over where to set the price. And that's essentially what the Bertrand model is.

So two questions about that. The first is, well jeez, which model do we use? How do we know whether it's Bertrand competition or Cournot competition? How do we know which model to use? We've got a market with two firms in it, you tell us the models are going to give very different answers, how do we know which one to use? And the answer is, basically we don't know which one to use for sure. We can talk about the conditions under which quantity competition is more likely and under which price competition is more likely.

Basically quantity competition is going to be more likely when there's lags in the production process. So that you can't flexibly say, here's my price, I'll produce as much as I want. If an airline said, I'm charging this, I'll fly as many guys as I want, you can't do that. You only have so many planes. Airlines can't just set a price and then meet whatever demand comes out. Airlines have to actually sent a quantity. They have to say there's this many flights we can do.

So when there's lags in the production process it's going to be hard to do pure price competition. It's going to be more like quantity competition. That's going to be like airlines or cars.

On the other hand, take selling cereal at a supermarket. The supermarket if it runs out of cereal the next day it can get a whole bunch more. The supermarket can almost instantaneously replenish any supply it's out of.

So there, you're more likely to see same price competition between say cereals in the supermarket. People can just compare very easily. And if one's cheaper they'll just buy it up and if it runs out the supermarket will just reload the next day with that cereal. Essentially it's pretty easy to meet quantity. So this is not a very clean distinction.

But the bottom line is quantity competition is going to be more likely when it's a hard good to produce on demand. And price competition more likely when it's an easy good to do that. That's how you're

going to think about which kind of competition makes the most sense in which context. That's point one.

Point two, and the last point I want to make. What can firms do to avoid Bertrand competition. Let's say, for example, you're a cereal producer. You're in a Bertrand market. Well this is a shitty market to be in. I just said two firms can drive your profits to zero. What do you do? What do cereal producers do? Yeah.

AUDIENCE: Differentiate.

PROFESSOR: They product differentiate. So the way to beat Bertrand competition is through product differentiation. Once your products are different, then you can price above marginal cost. Then they're not perfect substitutes anymore and you can price above marginal cost.

Have you ever asked yourself why the hell there's so many kinds of cereal. I mean have you been to the supermarket? It's crazy. Why are there so many kinds of toothpaste and shampoo. It's all the same crap.

Why? Because it's product differentiation. It's to avoid Bertrand competition. Because once you can differentiate, you get market power. Differentiation provides market power.

In the book, this is too detailed for the course, but in the book Perloff talks about this as monopolistic competition. Which is sort of an odd oxymoron, right? Monopolistic competition. But these are models of differentiated products where essentially you can say, look I'm different enough that essentially I can charge a higher price than my competitor.

This comes back the concept of contestable markets we talked about. The idea is that, look, if you're different you can charge a little bit higher price. Once it's too high people are going to switch back to the other food. But if you make it different enough, people will pay something.

The most famous example is Apple Cinnamon Cheerios. Cheerios have been around forever. And what happened was people bought Cheerios, it was very popular. But then supermarkets started producing

generic Cheerios. And Cheerios are like pretty freaking easy to produce. And it turned out they were identical. And supermarkets charged like half as much for the generic Cheerios.

And Kellogg's, no Kellogg's? Not Kellogg's, the other one. General Mills. General Mills was all like, any of you guys from Minnesota? Mall of America has this cool General Mills thing in Minnesota, I remember it.

So General Mills said, well gee, we're getting killed here. These generic Cheerios are going to wipe out our profits. So they invented the Apple Cinnamon Cheerios. And this was a product differentiation where basically they could still charge a high price for Apple Cinnamon Cheerios because it was different enough from the generic cheerios the supermarket was making. And they could patent them.

They could say, hey, we've got a different thing we can patent our secret Apple Cinnamon formula. So supermarkets now just can't copy us. So for a while we get price greater than the marginal cost. Or even if supermarkets can copy them, they at least get for a while price above marginal cost until supermarkets catch on and make the product.

So product differentiation is the way that firms fight Bertrand price competition. So is this bad? Once again we don't know. It depends how much you like Apple Cinnamon Cheerios. Just like patents, it depends on whether the new good they invented delivers sufficient extra consumer surplus that it's worth the fact that they can market prices on it.

In fact, one of the most famous studies in this field was done by my colleague Jerry Hausman, who actually measured the demand curve for Apple Cinnamon Cheerios and the cost of producing Apple Cinnamon Cheerios and found that the introduction of Apple Cinnamon Cheerios raised consumer welfare by $67 million a year. That even though the prices were high because of product differentiation, people were so happy with this wonderful new taste, it shifted demand out so much that actually consumer welfare went up. Even though this was a tool introduced by the companies to avoid price competition, which should make consumers better off.

So it's all about these trade-offs between how much does it make consumers better off versus how much more market power does it give the producers. And product differentiation is another example of that.

Why don't we stop there and we'll come back. Good luck tomorrow night and we'll come back on Wednesday and move on to factor markets.

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