14.01SC Principles of Microeconomics, Fall 2011
Transcript – Lecture 10: Competition I

PROFESSOR: All right. Let's get started. Today we are going to talk about competition. Just, once again, I want you guys to try to have in mind a flowchart of where the course is all going. Where does this fit in?

We talked last time about how firms decide on the cost minimizing way to produce a given level of output through the tangency of the isoquant and the isocost. And we talked about how if we were consumers, we'd be done then. Consumers just find the tangency and indifference curve in the budget constraint, and they're done.

But firms aren't done. Because the level of output, unlike the budget which is given to you as a consumer, the level of output is not given to the firm. They get to choose it. So with firms, we have to go one step further. We actually have to choose the level of output that we produce. We don't just choose the way to produce it but actually how much to produce. So, for consumers, it would be sort of like consumers choosing what their budget constraint is.

And the way we do that is we bring in-- since we now have a third variable, which is how much to produce-- we have to bring in a third equation. And that equation we bring in is essentially the market. Essentially, we say the market imposes conditions on the firm which helps them figure out how much to produce.

So we take all the stuff we did before. We then take that and put that in a market. And the market interacts with the firm. And from that market setting, the firm derives how much to produce.

So, basically, the level of production for a given firm, little q, will be derived from how firms behave in different market settings. And the market setting we're going to start with today is the classic starting point for economics which is the market setting of perfect competition. We're going to start talking about perfectly competitive markets, a benchmark of perfect competition.

With perfect competition, this is basically a case where many firms are selling goods to many consumers. We're then going to, in the next few lectures, talk about more realistic alternatives like monopoly which is not a game but rather a market structure. It is basically a case where one firm sells to many consumers. Or oligopoly, my favorite word in all of economics, not because I like the topic so much, I think it's a cool word. This is when several firms sell to a large market, which is probably the most realistic setting of all. And we're going to come to talk about those.

But, today, we're going to start with our benchmark of perfect competition. Now, what is perfect competition? I can give you a technical definition. Technically, perfect competition exists whenever firms are price takers on both the output and input markets. They're price takers on both the output and input markets.

So perfectly competitive firms are price takers. That is no action that they take can affect either the price at which they sell their goods or the price that they pay for their inputs. They're price takers. They're not price makers. No action they take affects either the price at which they sell their good. No action the individual firm takes affects either the price at which they sell their goods or the price they pay for their inputs.

Well, when will this be true? Go back to lecture one. Technically this would be true if a firm faced perfectly elastic demand for their goods, and if they had perfectly elastic supply of inputs. Under those conditions, firms will be perfectly competitive if they face perfectly elastic demand for their goods and perfectly elastic supply of inputs. OK.

So let's focus on the first of those which is perfectly elastic demand. Let's take a look at Figure 10-1. These should be little q's by the way. This isn't a market. This is a firm. These should be little q's.

So, basically, what you have here is that you have a firm facing a perfectly elastic demand. What that means is the firm's quantity is pegged by their supply curve. Or, in other words, the point is the firm cannot change the price one iota from that level P. So, in other words, if this is a supply shift, say the price of the firm's inputs go up, the firm doesn't get to charge any more for their goods. They just sell fewer goods.

So the supply shift from S1 to S2, the firm is going to be-- it should be little q1 to little q2. They're going to reduce the quantity they sell, but they cannot change the price. They face perfectly elastic demand.

So when does this make sense as a description of the world? Well, it makes sense as a description of the world under four conditions. So there's four conditions under which perfect competition will exist.

The first condition is identical products. In a perfectly competitive market, when the firms in that market sell identical products, now let's be clear. They don't have to literally be identical. They have to be perceived by consumers as identical. So when I say identical products, they don't have to literally be identical. But consumers have to consider them identical for purposes of their demand across firms.

So firms have to sell identical products for there to be perfect competition. Because if products aren't identical, then firms will be able to charge different prices from each other because they have something different to sell. So firms need to be identical.

Second of all, consumers have to have full information on all prices. Well, let me write down the next two conditions, because they're related. And the third is low transaction or shopping costs.

OK, these two are critical. Because the way perfect competition is going to work, its consumers are going to shop across firms selling identical goods. And they're going to buy from the cheapest one. And if there's any failure of either of these, the consumers might not know if you're the cheapest. And, therefore, you might be able to charge extra.

So perfectly elastic demand, once again we're getting to the microfoundation of something we discussed in the second lecture. We discussed perfectly elastic demand. Now we're talking about where that comes from. What conditions do you need?

Perfectly elastic demand is going to require that consumers know all the prices and can cautiously shop across all the options. Otherwise, firms might have some opportunity to charge different prices.

And finally-- and we'll come back to why this is important-- there needs to be free entry and exit of firms. This one I can't really give you intuition for yet. Just take my word for it. We'll come back to why that's important.

So, basically, what you want for an example of a perfectly competitive market, you want a market where producers are selling homogeneous goods in an easily informed, easily shocked arena. So I think the best example of a perfectly competitive market is those guys selling like shlocky touristy things around Port Authority in New York or in any large open air market.

Basically, in that area, these guys all sell the same crap. You can go from one to one quite easily. And it's quite easy to find out what the prices are. That's not perfectly easy, but it's quite easy to find out what the prices are. That is a condition for a perfectly competitive market. It's easy to shop, because they're all in the same area. Prices are pretty easy to observe, and the products are all, basically, identical. There are only so many little Statues of Liberty you can buy. So, basically, that's an example of a perfectly competitive market.

Now, in reality, no perfectly competitive market exists. There's never been a perfectly competitive market. But this is sort of as close as we can get. Questions about that?

Now that provides a good moment to pause and talk about Peter Diamond who just won the Nobel Prize in Economics. This is my MIT economics Peter Diamond, MIT Econ Peter Diamond shirt. Peter Diamond just won the Nobel Prize in Economics. Peter Diamond is the greatest economic theorist of his generation, sort of the heir of the Paul Samuelson, Bob Solow generation that founded this economics department and made it great. Peter Diamond was sort of the next generation that led this economics department forward and kept it great.

And Peter has made contributions throughout economic theory. He should have won the Nobel 10 times over. What they finally gave it to him on Monday for was for search theory. And search theory is essentially about what happens when markets don't work like these vendors around Port Authority in New York, when markets aren't perfectly competitive. Where, basically, you have markets where there is some mismatch and some search costs that sellers have to pay to find the right buyers, and buyers have to pay to find the right sellers.

So the best example here, and the example of which they really gave him the Nobel Prize, was the labor market. It was about search costs in the labor market. And what Peter Diamond and his fellow co-winners talked about was about how in the labor market, your firms have vacancies. They have jobs they want to fill.

Individuals have labor supply. They want to provide themselves to these jobs. And so there's unemployment. There's people out of jobs looking for jobs. But there's vacancies. There's jobs that are empty. And both exist at the same time. And how can that be?

In a perfectly competitive market, that couldn't be. You couldn't have both jobs looking for people and people looking for jobs. But what Diamond wrote down, and these other theorists developed in their models, is basically how you get these frictions in the labor market. Where since these jobs have specific characteristics employers are looking for, you can't quite match the vacancies to the unemployed workers.

There's a sorting process where some are easy to match. You can take the high school dropout and put him in McDonald's. That's easy. But the job which requires some computer skills, you have to find the right guy to take that.

And, basically, it's these frictions that lead to what we call the natural rate of unemployment in our economy, which is the notion that no economy would ever get down to 0 unemployment. That's impossible. And the reason is because there will always be some frictions and some mismatch. There will always be some inability of people to find the right people to fill their vacancies.

Now, we don't know what the natural rate is. When I was in grad school, we learned that the rate was 7%. In the 1990s, the natural rate seemed to fall to about 4%. That is we got to about a 4% unemployment rate. Now who the heck knows what the natural rate is anymore. And a big debate right now among economists in macro is how much of our 9.6% is an increase in the natural rate, which is something the government can't really fix very well, versus short-term demand reductions, which the government could fix by pumping more resources into the economy. And all that is informed, theoretically, by the work that Peter Diamond did.

Now, I hope what I just described sounded pretty obvious to you. And that's good, because that's what great theory does. Great theory ex-post sounds obvious. It's just ex-ante, before Peter Diamond did this,

people always said, well, we have these perfectly competitive markets. This is how they should function. And he's the guy who really taught us how real markets should function like this. And that's why he gets to go to Stockholm.

So that's very exciting for our economics department, very exciting for the profession. And it's just a great moment, really, in taking economics-- I saw it described very well in one article-- these last few Nobel Prizes are the beginning of recognizing that economics is not what we teach in this course anymore. You need what we teach in this course to go on in economics.

But probably the first couple dozen Nobel Prizes were for about what we teach in this course. And the last few have been about what you teach in the subsequent courses. And that's a real evolution of Freakonomics, to understand that we need to mature as a science and move beyond the basics that you learn in 14.01 and move beyond to these other things. So we're giving you the basics here. But the excitement happens elsewhere. So it's a very exciting time for our department and for the profession as a whole.

Now with that little diatribe aside, let's go back. So we have these. So now, having said all that, forget it. Forget Peter Diamond existed. We're now going back to perfect competition. And, once again, as I said in the first lecture-- and Peter would be the first guy to say it, this is how he taught me to do economic theory-- you've got to make simplifying assumptions if you want to get anywhere.

So we're going to make a simplifying assumption of perfect competition. We'll weaken that as we go along. But, for now, imagine it's perfect competition. And we have the situation of perfectly competitive firms.

Now a very important distinction to draw-- and that's why it's important to remember that these are little q's not big Q's-- is the distinction between firm demand and market demand, firm versus market. And this is something which is confusing. It confuses me at times. I may even get it wrong at times. I'll need you to correct me.

Even if a given firm faces perfectly elastic demand, it doesn't necessarily mean that market demand is perfectly elastic. That is the overall demand for little, fake Statues of Liberty around Port Authority in New York is not perfectly elastic. As the price goes up, fewer people will buy them. As the prices goes

down, more people will buy them. But for any given vendor selling them, it is perfectly elastic. Because there's always someplace next door you can go.

So it's very important to distinguish between the demand facing the firm being perfectly elastic and the demand facing the market not being perfectly elastic. And the way to think about this is to think about the concept of residual demand. We have a demand function for market D of p. We have a demand function for a market which is that as the price goes up demand goes down.

Now the demand function for a given firm, we'll call the residual demand D super r of p, is equal to what? It's equal to the demand for the market minus the supply that all other firms in the market provide, S super 0 of p, the supply that all other firms in the market provide. So the demand for my product as a firm is my residual demand. It's the market demand minus what other firms supply.

Well, if you differentiate this with respect to price, you'll see that dDr/dp equals dD/dp minus dS0/dp. This first one is the market demand curve. We know that's a negative number, because demand curves slope down. We're not assuming Giffen goods. We know that's a negative number. But this is a positive number. Supply curves slope up. The amount that other firms in the market will supply as the prices goes up is positive. Supply curves slope up.

So this is a negative number. But this is a positive number which means, by definition, this is a very negative number. The firm's residual demand responds more to price than the market's demand does. Because the firm's residual demand is after all the supply of other firms.

So we can rewrite this in terms of elasticities. So let's assume, for a second, that all firms are identical. Assume, for one second, that we're in a market where all firms are identical, that little q equals big Q over N. Assume that all firms are identical. And so, therefore, the amount produced by other firms, Q super 0 is (n - 1) x q. So, basically, the amount that's produced by other firms is (n - 1) x q.

So the last is demand facing a given firm, epsilon sub i is n times the elasticity of demand for the entire market minus (n - 1) times the elasticity of supply for the market. So, for example, let's say you've got a market with 100 firms in it. It's a big market but not outrageously big. We have plenty of markets with more firms than that. And let's say that the elasticity of demand for this market equals minus 1. So it's in between elastic and inelastic, not a crazy number. And the elasticity of supply is 1. Let's just say that's the example.

Then what you get is that for a given firm, if you used this formula, the elasticity of demand facing a given firm is minus 199. It's a huge negative number. So even though the market demand is modestly elastic, minus 1-- it's elastic but not crazy-- the demand facing the given firm is crazy elastic.

So, basically, the point is that even if a market does not have super elastic demand, a given firm can face very elastic demand. And that's what can lead to perfect competition. It's very important to keep those distinct. When we talk about demand, think about demand at the firm level versus demand at the market level. Demand at the market level, that's about substitutability with other goods and the things we've talked about deriving demand curves.

When we derive demand curves, we're not deriving firm demand curves. We're deriving market demand curves. And so the demand curve was a function of elasticities and substitutability across goods. The firm demand curve is a function of all that but also how many firms are in the market. If there are a lot of firms in the market, it's going to be very elastic in a perfectly competitive market. Questions about that? It's an important distinction to keep in mind.

Now, with that as background, let's now come to profit maximization which is what this is all about. Remember I said we assume that every decision consumers make is driven by utility maximization. Every decision producers make is driven by profit maximization. So let's talk about profit maximization in the short run. How do firms maximize profits in the short run?

Now, the first question we have to ask is what is profits? Well, that seems pretty straightforward. I defined those already. I said, the profits were equal to revenue minus costs. Profits are equal to revenue minus costs.

Well, the trick is that there's two different types of people who measure costs. Revenue is revenue. It's just, basically, the money you make. And anybody can measure that. But there's two different ways of measuring costs. There's accounting costs, and there's economic costs. And these are different concepts.

Accounting costs are cash flow costs what you actually pay. So your accounting costs are what you actually pay. So if you buy something for x dollars, that's your accounting costs. The economic costs are

about opportunity costs, which is not about what you lay out in cash, but what you could have done with that cash. It's not just about what you lay out, but what you could have done with that cash.

So to give you an example, let's just do a simple example. Imagine that you graduate. You're going to graduate. I don't mean that. You're going to graduate. Imagine that after you graduate, you decide you're going to start a website design firm on the side. You're going to do this while you decide what to do with the rest your life. You're trying to figure out where to go to grad school or whatever. You'll start a website design firm. That seems easy.

Basically, how does the website design firm work? Basically, you work full-time, and you hire some slave programmer who works for you. He does all of the grunt work. And let's say that you have to pay him $40,000 a year. So it's going to be you working full-time plus some slave programmer you're going to pay $40,000 a year.

And let's say that you have a computer that's like six months old, a year old. It's still in pretty good shape. It's not brand new, but it's still in pretty good shape. And you just let the slave programmer use that. So you don't have to buy a new one.

So you've got the programmer, you're paying him $40,000. You're letting him use your computer. You buy some new computer you're working on. So you do your work, and he does work. You put it together. At the end of the year, you tally up all the receipts you've had from your website design, and you've made $60,000.

So you sit back and say, well, that's pretty good. I put in $40,000. I paid $40,000. I brought home $60,000. That's $20,000 in profit. That's not a bad profit. If we think about profit margins, we'll often think about profit relative to revenue. Well that's $20,000 of profit on $60,000 of revenue. It's a 33% profit margin. Most companies would kill for that. So you say, that's not bad. I made a 33% profit margin.

But what opportunity costs did this calculation miss? So if you were an accountant, you'd stop there. That's why accountants don't make as much as economists. Because we're better. If you're an accountant, you'd stop there. But if you were an economist, what do you recognize? What did this calculation miss? What opportunity costs were involved in running this firm that the cash flow calculation didn't capture? Yeah?

AUDIENCE: If you plot your grunt worker and your computer, you might have been able to do more work, because the computer might be more efficient.

PROFESSOR: Yeah. OK. That's sort of a different issue. That's sort of about the fact that you might not have produced as efficiently as possible. I'm not asking that question. I'm asking, given the numbers I gave you, why did I misstate your economic profit? Yeah, in the back.

AUDIENCE: You could have gotten another job that paid more.

PROFESSOR: I could have gotten another job that paid more. Here's another thing about it. I just spent an entire freaking year, and I made $20,000. You're hoping you do better than that with an MIT degree. At least your parents are hoping you do better than that with an MIT degree.

So, basically, the first source of opportunity cost that this has missed is the value of your time. That doesn't show up as an accounting cost. But it's a real opportunity cost, because you could have had another job.

So let's say you could have gone out and made $60,000 a year. You could have easily found a job making $60,000 as an MIT graduate. Well, then that's a cost of running this website. By spending the year setting this up, you forgo-- I don't know what the past tense of forgo is-- forgoed? $60,000 in income you could've earned. You've forgone $60,000 you could have earned. That's a real cost. It's not an accounting cost. It didn't show up on anybody's books. But it's an opportunity cost. What else? Yeah.

AUDIENCE: Also the $40,000 that you gave the program, you could have invested it somewhere else. And it could be growing.

PROFESSOR: You could have invested the $40,000. You gave him the $40,000. You paid it. It's gone. If you put it in the bank, you could've earned interest on that money. That's an opportunity cost. And we'll come back and talk about capital markets and interest later. But that's opportunity cost. What else? There's one more.

AUDIENCE: You could have sold the computer.

PROFESSOR: I could have sold the computer. I gave it to him, and he used it for free. But if I could have sold that for $1,000, that's an opportunity cost as well.

So, in fact, if I could have worked for $60,000. On the $40,000, I could have made $2,000 of interest. And I could have sold the computer for $1,000. Then, actually, my opportunity costs were $63,000 plus the $40,000 I paid the guy. So, actually, the entire cost of the operation was $103,000. So I actually lost more than $40,000 running my little website business.

So opportunity costs represent the fact that you could have done other things with your resources. It's not just the fact that your cash flow said positive $20,000. Your economic flow said minus $43,000. Because while you're plus $20,000, you were minus $60,000 that you could have earned. Now you're down to minus $40,000. You're minus $2,000 that you could have earned in interest on the money you paid the programmer. Now you're down to minus $42,000. And you're down another minus $1,000 you could have made by selling that computer. So you're at minus $43,000. So you actually lost money.

So when we talk about profit, we want to think about economic profit, not accounting profit. Now, I'm not going to make that distinction much now. But I want you to keep that in mind as you go out and think about starting your business or think about whether firms are profitable, remember we use an economic concept which accounts for opportunity cost, not just an accounting concept which follows the dollars. Question about that?

OK. Now, armed with this, we now say, OK, how does a firm maximize profits? Well, that's easy. We say that profits is a function of quantity produced. Revenues is a function of quantity produced minus cost as a function of quantity produced.

Remember, what was our goal when we laid out the start of this lecture? It was to figure out what little q a firm chooses. Well, what little q a firm chooses is dictated by maximizing this equation. So a firm will choose little q such that dR/dq equals dC/dq. That's the profit maximizing equation. A firm will choose its quantity such that dR/dq equals dC/dq or, to put it in economic terms, where marginal revenue equals marginal costs. The firm will choose to produce a quantity q where its marginal revenue, which is

the revenue made from selling the next unit, equals it's marginal cost, which is the cost incurred by making the next unit.

Well, in a competitive market, we know what dR/dq is. Because remember in a competitive market, dR/dq is given to the firm by the market. In a competitive market, dR/dq, or marginal revenue, equals the price. The price is given to the firm. It comes from God in the competitive market. We'll talk later about where it comes from. But, for now, let's consider it God.

They're price takers. They just get some price handed to them. So in a competitive market, we know what marginal revenue is, it is price.

So what this says is that in a competitive market, the profit maximizing equation is price equals marginal cost. Memorize it, put it under your pillow. In a competitive market, price equals marginal cost is the profit maximizing condition. You will produce until the marginal cost of producing the next unit is equal to the price you can sell that unit for in the market.

So, to see that further, let's look at an example. Let's go to the next figure, Figure 10-2a. For the next few examples, I'm going to use a particular cost function. The cost function I'm going to use to make this all concrete is C equals 10 plus 0.5q squared. That's the cost function I'm going to use.

So armed with that cost function, let's say the price in the market is 6. Let's say the price in the market 6. I just pulled that out of my hat. It's a market for whatever. We're just doing an example.

Now, what we have on this graph, we have a cost curve and a revenue curve. The cost curve literally graphs that function. So, in other words, if you produce two units, then your cost is 10 plus half of 2 squared or 12. If you produce 2 units, your costs are 12, and so on. You've got this cost curve.

You've also got a revenue curve. Well, the revenue curve is just 6 times the number of units produced. Because the price per unit is 6. So it's just a straight line with a slope of 6. So each unit you produce, you make 6.

Now, what you'll see here is that for this cost curve, what's marginal cost? Well, if we differentiate this, we see that marginal cost equals q. I made this an easy example. If you differentiate that, you'll see that marginal cost equals q. That is just differentiate this cost equation. Marginal cost equals q.

So what that says is that the profit maximizing point is going to be to set marginal cost equal to price. So that says set q equal with 6. And you're done. That's how much the firm should produce. The firm should produce six units, because it's marginal cost function is q. It's a linear function. The price is six. That's a horizontal line. So they only intersect in one point where quantity equals 6.

Now, what you notice in this graph is that this happens to be the point where the gap between the revenue curve and the cost curve is largest. These are not marginal curves. This is revenue and cost. But notice that at 6 that's exactly where the revenue curve and the cost curve have the largest gap between them.

I think a more intuitive way to see this is to flip to Figure 10-2b. This shows the marginal profit that you make on every unit you sell. So, in other words, if you sell fewer than 2 units, you lose money. Why? Because if you sell 1 unit, your costs are 10 plus 10.5. If you sell 1 unit, your costs are 10.5. Your revenues are 6. You lose money. You lose 4.5.

If you sell 2 units, you make 0. Your costs are 12, your revenues are 12. You make 0. If you sell 3 units, your costs are 14.5, 10 plus half of 9. Your revenues are 18. So you make money.

So each unit, you can calculate how much you're making on that next unit. On the 3rd unit, you made money. 4th unit, you make even more money. 5th unit, even more. 6th unit, you make the most money you can make.

In the 6th unit, your costs are 10 plus half of 36, or 18, so 28. Your costs are 28. Your revenues are 36. So you make a profit of 8. You make a profit of 8 on that 6th unit.

Think of yourself as climbing this hill. In economics, optimization is a hill climbing exercise. Think of yourself as climbing up this hill and asking yourself, should I make the next unit? Does the hill keep going up? Yes, it keeps going up. Make that next unit.

Then you get to the top. And now you say, well, should I make the 7th unit? Well if I make a 7th unit, my costs are 10 plus half of 49, so 34.5. My revenues are 42. So my profits are only 7.5. I make less profit on that 7th unit. So I shouldn't make it.

Now, you might say, wait a second. Why wouldn't you make it? You still make profits. Why wouldn't you go ahead and make all units all the way down to 10? You still make profits on those units. And the answer is because of opportunity cost. The answer is that yes, you make profits. But given where your marginal cost curve is, you could do better by that point going and producing other goods. That's why I care about accounting costs versus opportunity costs.

Accounting costs says look, you're going to make money until you go to 10 units. But opportunity cost says, no. At that point, the opportunity cost has gotten high enough that you could do better devoting your resources elsewhere. And that's why you want to stop at the point where you're at the top of the hill, where the price equals the marginal cost.

So what are the profits you make at the top of this hill? Well, if you go to the next diagram, we can see what the profits you make are. So this next diagram, Figure 10-3, illustrates this example. So what we have here is an example with cost curves for this cost function, once again, 10 plus 0.5q squared. Average costs is that line in the middle there. That's the average costs. You have an average variable cost that's a line, that's linear, an average variable cost that has a slope of one.

You have an average fixed cost that's everywhere declining, because your fixed costs of 10 is everywhere declining. As you produce more and more, your fixed costs are declining. And, as I said, you have a marginal cost of q. So your marginal cost of 1 unit is 1. Your marginal cost of 2 units is 2, et cetera. So this draws out the cost curves that correspond to that cost function. You see them drawn out here.

Now, we also, on this diagram, have a demand curve. The demand curve is perfectly elastic facing this firm. It's a perfectly competitive market. And that perfectly elastic demand curve is horizontal at price equals 6. So what does the firm do? It chooses to produce where marginal cost equals price. When it produces where marginal cost equals price, then what profits does it make?

On each unit, it makes a difference of the profits between the price and average cost. Now it's an important distinction. We went over this in lecture and section. But let me go through it again. Marginal cost is the cost of the next unit. Average cost is the average cost of all the units you've made.

So if I make 6 units, what profit do I make? Well, on that 6th unit, I make a profit of 1 and 1/8 or 1 and 1/4. I make profits of 1 and 1/4 on that 6th unit.

But I make those profits on all 8 units I sell. So what that means is, in total, I'm going to make a profit of 8. The area of this rectangle is eight.

Here's the key. You cannot choose a production level that produces a bigger rectangle than this. So if you produce 7, your rectangle will be longer. But the gap between price and average cost will be smaller. So your total rectangle size would fall.

The largest rectangle is produced at a production level of 6. That's the most efficient use of your resources is when you produce at a point where marginal cost equals price. Because when you produce at marginal cost equals price, that causes the maximum gap between price and average cost.

Flip back for a second to the first figure. Not the first figure, I'm sorry, 10-2. This relates back to 10-2. As I noted, the largest difference between your revenue and your cost curve was that 6 units. That's where the gap is large between revenue and cost. That's where you produce.

Now we flip forward again to Figure 10-3. You see that corresponds to the point of the largest gap between price and average cost, I'm sorry, the largest of the points on the marginal cost curve between price and average cost. So if you produce on the marginal cost curve, if you produce 7 units, then you're going to have a smaller gap between price and average cost. And, therefore, even though you produced 1 more unit and are making profit on it, your total profits will fall.

The key point is that yes, climbing back down that hill I still make money. But I make less and less money. And that, as a result, that rectangle is being reduced as I climb down that hill. That rectangle is maximized at the top of that hill. That's the point at which I make the most money.

So that's why we say profit maximization occurs at the point where price equals marginal cost. Because that is the point of greatest gap between revenues and costs. Where price equals marginal cost is one of the greatest gaps between revenues and costs. That's the profit maximizing point where that rectangle is largest. And you can demonstrate for yourself, and you should, that at any other production level, that rectangle will be smaller. Questions about that? Yeah.

AUDIENCE: What do you do if you have a linear cost function. So that means marginal cost is a constant. Then how do you determine the line?

PROFESSOR: You don't. It's an indeterminacy. That's right. I'll try to avoid giving you problems like that. Basically you get a corner solution. In a perfectly competitive market, you'd get an indeterminate solution. In a nonperfectly competitive market, you will have a determinant solution. But in a perfectly competitive market with a linear marginal cost, you'd have an indeterminate solution. Either you produce 0 or infinity. So you'd have an indeterminate solution.

Now, just a further drill this in, imagine, for a second, there was a cost shock to the firm. Imagine there was a cost shock to the firm. Imagine that there's a tax on the firm where the firm has to pay a tax of an amount t. Let's say t is $1. The firm has to pay a tax of $1 on every unit they produce.

Well, what is their new cost curve? Somebody tell me what the new cost curve is. If you have a tax of $1 on every unit you produce, someone tell me the equation for the cost curve. I didn't write it down here, did I? No. OK, what's the equation for the cost curve. Yeah.

AUDIENCE: Just add plus tq to the top thing.

PROFESSOR: Exactly C equals 10 plus 0.5q squared plus tq. Because for every unit you produce q you pay a tax t. And since t is $1, it would just be plus q. If t is $1, it would just be plus q. So the cost function has now shifted.

So what we see is that it has shifted average cost and marginal cost both upwards. Average cost has shifted upwards by that amount. And average cost has shifted upwards. And marginal cost has shifted upwards by precisely $1. It's just a linear shift of marginal cost. Because marginal cost is now q plus 1. If you differentiate this with respect to q assuming t is 1-- t is now $1-- if you differentiate this with respect

to q, marginal cost is q plus 1. So your marginal cost curve has shifted up by $1 or by t, in this case, in the more general case.

Well, what does that do to the first production decision. Well, now it doesn't change their maximization formula. They still want to set marginal cost equal to price. So now they say, set q plus 1 equal to price. Well, the price is 6. So it says set q equal to 5. Now the profit maximizing level is 5 units. The profit maximizing level is 5 units.

What this is saying is because the tax increases your marginal cost, you are now producing less. And what we can see now, if we flip to Figure 10-4, we can see what that's done to your profits. Your profits have now fallen to the dotted rectangle, the much smaller dotted rectangle. Your profits used to be that entire slashed rectangle plus the dots. Now your profits are just where the price exceeds average cost which is just that smaller dotted rectangle. Your profits have fallen dramatically. So by imposing a tax on this firm, we've dramatically reduced their profits.

Now, this is the economics behind why taxes can lower production. Now, you might say, wait a second. In reality, if we tax a firm, the don't have to lower their profits. They just pass it on and charge consumers higher prices but not in a competitive market. In a competitive market, they can't do that.

If you tax a firm in a competitive market, it comes out of their profits. Because they face a perfectly elastic demand, so they can't raise the price. All they can do is just say, well, the price is the same. My marginal cost has gone up. I'm going to produce less, and I'm going to make less profit. And that's life. So a tax in a market like this is just going to lower the firm's profits, and it's going to lower their level of production from 6 to 5.

In noncompetitive markets, different things can happen. We'll talk about that. But in a competitive market, this is what happens with the tax. You basically set the new marginal cost equal to price, and you get that they produce 5 units instead of 6 at a lower profit level. Yeah?

AUDIENCE: Would that be a good cause for entering the market--

PROFESSOR: You're right. That's an excellent point that I should have pointed out. What do I mean by short run? What I mean by short run is remember, labor is variable. Capital is fixed. What do I mean in

this context? Think about the short run as being the period over time over which firms cannot enter and exit.

When we talk about competitive markets in the short run, we talked about short run being the time in which capital is fixed. Now we're going to add another condition. We're going to say the short run is the period of time in which there's no firm entry or exit. That's the short run.

We'll come back and talk about what entry and exit does. And that's going to have some funky effects. We'll talk about that next time. But what we mean by short run here is no firm entry and exit. Whichever firms are in the market at the beginning of the short run people are in the market at the end of the short run period. Yeah.

AUDIENCE: But in your conditions, you had like free and fluid entry and exit of firms.

PROFESSOR: Right, exactly. And that's why I said, don't pay attention to that yet. In some sense, those are the conditions of perfect competition. I didn't say if that was short run or long run. Those are the full long run set of conditions. That's why I said we're going to ignore four for now and just focus on the first three. In the short run, only the first three are relevant. Because in the short run there's no firm entry or exit. In the long run, which we'll talk about next time, that fourth one will be relevant.

Good question. That's a good point. Thank you for pointing that out. Other questions or comments?

One other thing I want to cover before we stop which relates to the long run, is that in the long run, this is sort of the transition, the bridge to talking about the long run. We also have to decide, ultimately, whether or not we want to shut the firm down. So, in other words, we want to set price equal to marginal cost. That's one condition.

But, actually, short run profit maximization has a second condition. Short run profit maximization has two conditions. The first is to set price equal to marginal cost. The second condition of short run profit maximization is to check whether the firm wants to shut down.

Why would a firm want to shut down? It might want to shut down if it actually loses money by continuing to produce. And that's because firms may lose money but not shut down. Firms may lose money but not shut down. Or firms may lose so much money they shut down. And we need to consider that.

Let's get rid of the tax. Let's go back to the marginal cost with the tax. Imagine the price in this market suddenly fell from 6 to 3. The price of the market is now $3 per unit you sell. Well what would the firm's profits be? Well, if the price fell to 3, the firm would choose to produce 3 units. You would still have this condition, marginal cost equals price. Price is 3, and marginal cost is q. So q is 3. You still produce 3 units.

If you produce 3 units, its costs are 10 plus 4.5 which is 14.5. At a price of 3, it makes 9. So its profits are negative 5.5. It would lose money from this production.

Remember marginal cost equals price. That doesn't vary with what the price is or anything. This is a maximizing condition. If a price changed, it's not like you change which equation you follow. You always follow this equation. The efficient production level is always marginal cost equals price regardless of what the price is. So if the price is 3, the efficient thing to do would be to produce 3 units and lose money.

Now, you might say, well, then that's stupid. If that goes negative, wouldn't they just shut down? And the answer, is in the short run, no. And the reason you wouldn't shut down in the short run is what I talked about last time which is about the notion of sunk costs.

In the short run, the fixed costs that you paid to produce are sunk. They're unchangeable in the short run. In the long run, they're changeable. You can just leave.

But in the short run, you've invested fixed costs of 10 in being in this market. You've paid a fixed cost of 10 to produce in this market. Given you're in this market, and you've paid 10 to produce, you will not exit unless you lose more than $10.

You will not shut down unless you lose more than $10. You will not shut down unless you're losing so much money that you can't cover your fixed costs. Because you've paid those fixed cost. In the short

run, they're sunk. So unless you're actually losing more than your fixed costs, you will not shut down your firm.

OK. This is actually pretty confusing, and we're out of time. So what I'm going to do is we'll pick it up on Monday exactly at this point. And I'll go through some more of the intuition for this. And that will be our segue for talking long run profit maximization which we'll talk about on Monday.

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