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PROFESSOR: Today we're going to continue discussing firm behavior. But today we're going to deviate from our fantasy land of 14.01 to come to the real world a little bit which is to talk a bit about whether firms actually maximize profits. The whole presumption of producer theory is just as we think with consumer theory, consumers maximize utility. Except producers maximize profits. That turns out to be an incredibly useful shorthand for lots of things. And it will turn out to be, as with any simplifying assumption, largely right and largely will help us draw a lot of interesting conclusions about firms and markets.

Nonetheless, it's clearly not right in reality for every firm. For example, we see lots of firms doing things which look pretty wasteful like big corporate jets or other things like that. More relevantly, huge pay for CEOs seems pretty wasteful.

So, for example, on 2004 the net income of Eli Lilly, the drug manufacturer, fell by 29%. Yet the CEO got a 41% raise to to \$12.5 million a year. Or even more so in the financial crisis, in 2009, Citigroup and Merrill each lost more than \$27 billion. It's a pretty bad year for the financial sector, you might think. And yet their CEO's pay in each company rose by more than 10% to about \$15 million. So in the worst year for the financial system since 1929, the CEO pay increased in these two companies.

So you might think that this sounds kind of off. How could we explain that? Well, there's two possible explanations. So one explanation is that things which look wasteful really aren't. That is that we pay CEOs a huge amount of money, but they're worth it.

So, for example, even at his ultimate salary of \$33 million per year, Michael Jordan was vastly underpaid. By any reasonable economic analysis of the value he added to the Chicago Bulls, it was well in excess of \$50 million. So even though he was paid \$33 million, Michael Jordan was underpaid.

Similarly, just because someone gets paid a lot of money, doesn't mean that they're overpaid. These CEOs are very talented people. They may be underpaid. Now this is an argument you

might have made with a somewhat straight face maybe 10 or 15 years ago. It's hard to make that with a straight face now. It's hard to believe that these CEOs of these companies aren't overpaid given their company performance and even the kind of facts we just talked about.

So a better explanation for things like excessive CEO pay is something which we call the agency problem. And that's what I want to emphasize in today's lecture. In reality, we think of a firm as something where there's a guy who's an owner. He hires some machines and some workers. They make stuff that he thought of, and you produce it, and some profit is made.

So the model we have in mind when we talked about the firms so far in this course is the model of what we might call a sole proprietorship or a partnership. It's a model where one individual, where there's basically a commonality. The key thing that we've discussed so far is a commonality of interest between the owners who own the company and the control of production. So the people who earn the money from the company also control the production.

So when you start your start-ups when you graduate, you will start them as a sole proprietorship or a partnership where you own the company, and you control what's done. You're there 18 hours a day making sure the guys are doing what they're supposed to do. And you're who gets the money if they succeed or lose the money if they fail. And that's the model we've had in mind as we've thought about corporations or firms so far in our class.

But, in fact, most production in the US doesn't happen that way. Most production in the US happens through the guise of corporations. Corporations are marked by a separation of ownership and control. What defines a corporation is a separation of ownership and control. The owners of corporations are the stockholders or what we call the equity holders, people who have invested money in the corporation.

So the owners of the corporation are its investors, its stockholders, its equity holders. All of you, most of you, probably somewhere-- if you're Jewish, it's in some Bar Mitzvah gift you got, if you're not, it's in some other gift you got-- probably have some equity ownership in something somewhere. OK. You maybe have a little bond which says you own five shares of GM that someone gave you, because they thought it'd be cute or whatever. That's now worthless, but maybe some other company.

We're equity holders. We invest in companies. But we don't make the production decision. The production decision is made by the firm's managers who are employees of the owners, the equity holders.

Now these managers may have some ownership. And we'll talk about that in a little bit. But, by and large, the primary ownership of the firm is done by people who do not control the everyday decisions of production. And it sort of makes sense it has to be that way. When a company's as big as Microsoft, you couldn't have me. Somewhere, I'm sure if you add up my various stock funds I own, I own 0.000000000001% of Microsoft. It'd be crazy to have me involved with a 0.000000000001% of the decision making. I don't know anything about anything that Microsoft does. It makes sense that there's a separation of ownership and control once companies get big enough.

But the fact that there is a separation of ownership and control can lead to this agency problem and can lead to firms not maximizing profits. So, basically, the point is that managers care not just about the profits they make but also how happy their life is. And things which make their life happy may be things which aren't profit maximizing. The managers who are in charge of production may have their own agenda that deviates from profit maximization. And the problem is it may be hard to figure that out if you're the owner of the firm.

So the agency problem is the first example of a problem we'll talk about later in the semester of imperfect information. This is the first time we'll see imperfect information. We've assumed in our class so far, and we'll assume in our class going forward that there's perfect information the world, that everyone knows what stuff costs, that everyone can shop costlessly across providers, et cetera. But, in fact, the world is marked by imperfect information.

As an owner of Microsoft, as a trivial owner of Microsoft, I don't know for sure that every Microsoft employee is doing what's profit maximizing for the company. I can't. It's just impossible for me to own that. So that creates an agency problem. And the agency problem arises because it's in the employees' interest, perhaps, to do things which aren't profit maximizing.

So so as a simple example, imagine that you're an investor in the company that's a medium-sized company. And the head of that company is jealous because all of his friends at bigger companies have their own jets, and he's got to fly commercial. He says, I want my own jet, because I'm not cool enough. There's this great episode of the *Simpsons* where Burns goes to the billionaires club. And he's in the billionaires club. And then eventually his wealth drops so low he gets thrown into the millionaires club, and it's these yokels in the millionaires club. He's like, I want to be back in the billionaires club.

The point is managers of companies care about how they look and who they hang out with. And you've got this manager of a medium-sized company who wants his own private jet. But he knows that that's not profit maximizing. Because he knows that if he figures out his travel, and prices it out at competitive prices, it'll be cheaper to just travel commercial.

So what does he do? He puts together a glossy PowerPoint which he presents to you, the owner of the company, showing that financially it would be more prudent to own a jet than to fly commercial. What he doesn't point out and put into that PowerPoint is that in putting together the commercial prices he used, he chose the highest rates from flying from point A to point B, not the lowest rates.

Now, unless you're an expert on the cost of flying from point A to point B, you won't know that. You'll say, well, that's a pretty impressive presentation. Yes, you can show you've saved 20% by having your own plane. Go get it. But it turned out he didn't save 20%. He just cooked the numbers in a way to make his life nicer even if it wasn't profit maximizing. And that's an example of the kind of problem that arises with imperfect information.

And I could go through examples all the time. But I think you guys probably all understand what I'm talking about, which is there's lots of ways employees of companies might make their lives nicer that aren't profit maximizing.

Now, corporations have recognized this from time immemorial. And they've recognized that their owners are too diffuse to monitor this. So what corporations do is they have set up an intermediary between the owners and the producers called the board of directors. The board of directors is a set of individuals appointed by the owners that are supposed to actually pay attention to what's going on in production. The owners say, look, we can't afford to pay attention. But we're going to appoint you, the board of directors, and we're going to pay you quite a lot of money. A typical director on the Fortune 500 company will make \$100,000 plus a year. It's a part-time job. We appointed you to keep an eye on the tools of production.

The problem is the board of directors aren't that good at it either. Because it turns out to be really hard to figure out exactly what's going on. And this is made worse, because the members of the board of directors are often chosen by management of the company, by the people running the production, not by the owners. So they'll make selections of who's going to be on the board of directors. And they'll pack it with their friends who will be nice to them.

So, for example, Richard Grasso was the CEO of the New York Stock Exchange. He started out in the mail room, worked his way up. He became CEO of the New York Stock Exchange and retired with \$187 million severance package which was outrageous and totally unearned. But the board of directors were a bunch of his buddies who'd known him since he was a kid. And they said, he seems like a nice guy. Let's give him a bunch of money. And a lot of the board of directors, when actually grilled on it, didn't actually know he'd gotten that much. They were like, wow. We didn't realize his retirement package was that big.

So it turns out having the board of directors does not solve the agency problem. Because there's still too much of an information imperfection between the managers and the board of directors, not to mention the managers and the owners.

So what do we do? What do we do with this agency problem? Well, this was known for a lot of years. And about 25 years ago, the thinking was, look, the way to solve this problem is we need to align the incentives of the managers and the owners. If we're going to solve this problem, we need to get the managers, the producers, to actually care about maximizing profits enough that they'll do that even if it makes their life a little uncomfortable.

And how do we do that? We turn the managers into owners. We give the managers, the producers, an ownership stake in the company. We say look, your income is going to be directly derived from the profitability of this company. So now you'll have a direct incentive to do what's profit maximizing even if it makes your life a little uncomfortable. Even if it means flying commercial, you recognize if I have my own jet, then I'm going to suffer. So you align the incentives.

So we want to give them an ownership stake in the company. Well, how do you do that? How do you give managers an ownership stake? Well, there's two ways you can do it. One way is you can directly give them stock. So you can directly say, look, instead of paying you in cash, we are going to pay you in company stock. So your fortunes will directly be tied to the performance of this company if you pay them in stock.

Or, alternatively, you can do something which turns out to be cheaper. You can give them stock options. It turns out to be cheaper, at least, in principle. We can give them stock options. So let's talk about what a stock option is. And some of you may deal with these along the way.

A stock is a piece of paper which says you own 0.00001% of the company. A stock option is simply a piece of paper which says we are granting you the right to buy the stock at some

price. Typically, it's today's price. We're not giving you a share of the company. You have a piece of paper which says if the value of stock today is \$100, you have a piece of paper which says no matter where the stock ends up, you can always buy it for \$100.

Why is that valuable? Well, that's valuable because let's say you give a CEO of a company a million options at \$100 each when the price of the stock is \$100. Well, if the price of the stock rises to \$150, that CEO can then take his million options, say, I want to buy the shares for 100, which I'm allowed to by these pieces of paper, and I'll turn around and sell them for \$150. I've just made \$50 million.

So a stock option is valuable if the stock goes up. But it's worthless if the stock goes down. So it's kind of the ultimate incentive, if you think about it. Because what it says to the CEO is, look, we're going to incent you to do better. And you make a lot of money by doing better. But if you do worse, you're not going to get anything.

And as myself as the owner it seems great, because it's cheaper. Because if the stock goes up, I share some with the guy. But I don't care. I'm happy. The stock goes up. If it goes down, I don't have to give him anything. And, in fact, giving someone a stock option costs, effectively, about half as much as giving them stock.

So if I say today's stock price, if I instead of giving you a share of stock, I give you an option to buy a share of stock at today's price, the value to that, what it costs me in the market is about half of what it costs when I actually give you the share of stock. So it seems like the best deal. You get all the incentives for them to raise the price, but it costs you half as much.

And, in fact, there's been tremendous growth in use of stock and stock options. So if you look at Figure 12-1, now, this sort of changes. Before 1992, there's only two categories. And after '92, there's three. So before '92, we just have to divide into salary and bonus versus options. So you see there was essentially no options in '84.

This is the mean CEO pay. So the typical CEO in 1984 made \$500,000, and it was all cash, all salary and bonus. By 1992, they made about \$1 million, and a decent share of it started to be stock options.

Now, starting after '92, we actually break into three categories which is salary, bonus, and options. But that doesn't really matter. The main thing is to pay attention to the option share, which you see grew astronomically. And so by its peak, in about 2002, first of all, the typical

CEO was making \$3.5 million. Second of all, the majority of that was in stock options.

In fact, if you look at salary and bonus, it didn't grow that much over time. If you look at 1992 versus 2002, over that decade, salary and bonus barely grew, but options went through the roof.

So there's a huge increase in use of these. And the motivation is pretty basic economic intuition. What we're going to do is this is a cheap way to align the incentives of owners and managers. And that was why they took off. And everyone thought it was great. And people like Michael Jensen at Harvard Business School made fortunes off having suggested this, et cetera. It was like we solved the problem.

And, remember, we did pretty damn well in the 1990s. And a lot of it, people attributed it to exactly what's in this graph. That by finally figuring out how to align the incentives of producers and owners, we'd figured out a way to change the economy. And people thought we sort of entered this new economic era of massive productivity.

Well people, as we know now, were wrong. Things slowed down in the 2000s and then now have completely crashed. And why were they wrong? Well, they're wrong because what makes economics fun is unintended consequences. And these stock options had two kinds of unintended consequences.

The first unintended consequence is that they lead to excessive gambling. And what I mean by that is that once your stock option is out of the money, once, if you've got it for 100, you're below 100. You don't care how low it goes. If you're at 99 or 20, you don't care. All we care about is being 100 versus above. What that means is as an owner, as a manager, you'll take excessive risks to go into the positive territory. Even if there's a huge risk you'll get nailed on the downside.

Contrast to guys working for a company that's currently worth \$100. One is given stock, and one is given stock options at \$100. Imagine they're both going to leave the company in one year. Because there's dynamics with the long run issues. Let's put that aside. They're both going to leave in one year.

One today is given a share of stock, and one today is given an option to buy at \$100. And then they're given the choice of a risky investment. Someone comes to them and says, have I got a deal for you. I've got an investment that has a 10% chance it will double the value of your

company and a 90% chance the value of your company will fall by 20%. So there's a 10% chance of a 100% return and a 90% chance of a 20% decline in your company's value.

Now, what is the profit maximizing thing to do in this situation? Well, to do that, we have to consider the concept of what delivers the company the highest expected value. Expected value is a concept we'll use-- and we'll come back to this later when we talk about uncertainty-- it's a concept we use to measure how you value things when there's uncertainty.

So the expected value of a gamble is the probability that you win times the value if you win plus the probability that you lose times the value if you lose. That's the expected value of a gamble. And the profit maximizing thing to do would be to take gambles of expected values of greater than zero. The expected value is the summation of the value of that gamble.

This gamble has an expected value of 0.1 times 100-- 100% return and a 10% chance-- plus 0.9 times negative 20-- a 90% of losing 20-- or an expected value of minus 8%. That is if you take this gamble, and you took it an infinite number of times, you would end up losing 8% on average. Any one time might work out. But by the law of large numbers, if we took this enough times, you'd lose 8% on average.

So you will lower the value of your company. You will reduce profits by taking this gamble. Your company is worse off if you take this gamble. Well, what would the person who got the \$100 in stocks do? They won't take the gamble. Because their \$100 in stock will be worth, on average, 8% less if they take this gamble. So I'm not taking the gamble. This is stupid.

But now let's look at the guy who got the option. His gamble is a little bit different. Because he doesn't care whether the value of the company is 99 or 80. He just cares about how much it goes above 100. So what is his calculation? Well, his calculation is he has a 10% chance of making 100% and a 90% chance of what? Zero, ending up with zero. He can't lose. He has a 90% chance of zero.

So what is his calculation? Well, he uses the positive 10% gamble. He makes money on this gamble, because head he wins, tails he walks away. The guy who owns the stock loses if it's tails with this weighted coin that only hits heads 10% of the time.

This guy only wins. So he says, sure. Any gamble which has a huge upside, I'm going to take. Because I get all the upside, and I don't bear the downside.

So what this does is it leads to excessive gambling, excessive risk taking. And that's exactly

what we saw in economy, was companies gambling on things which sounded very good, managers gambling on things which sounded very good, some of which worked out very well and some of which didn't. And that's the first problem we have with the use of stock options. And questions about that? Yeah.

AUDIENCE: What about using a package of options like a number of stock options [INAUDIBLE PHRASE] package of stock options [INAUDIBLE PHRASE].

PROFESSOR: Certainly there are more sophisticated ways you can do that. I mean, there's certainly more sophisticated ways you can do that. But that's a great segue to the second problem with these. The second problem is who decided the structure of the stock options? The managers.

So the managers had executive compensation committees that designed the stock options the managers got. So the second problem was there was just outright cheating. So what you just described would be a great structure which would incentivize them maximally, but it would not make them the most money.

So the second problem we had was outright cheating. So there's a wonderful investigation by the *Wall Street Journal* that investigated a whole list of stock option arrangements. And what they found was companies would frequently do what's called backdating stock options.

What they'd say is, look, the value of the company just went up from \$100 to \$15 last week. We're going to give you an option at \$100. And let's pretend it was issued before the company value went up. We've just given you money. You haven't done anything to earn that. We've just given you money.

And the *Wall Street Journal* found incredible evidence of backdating stock options. So they had one CEO. They Yeah, I'm sorry.

AUDIENCE: Is the company paying the money? I thought it was like the market who gives it.

PROFESSOR: The owners are paying the money, the owners.

AUDIENCE: People who are buying the stock are exercising the option to.

PROFESSOR: No. But here's the thing. When I gave it to you, then, basically, I gave you something of value. I have to pay for that thing of value. Now, ultimately, the transaction happens in the market. But, basically, in other words, I give you this option to buy the stock at \$100. This is an

important point that I wasn't clear enough on. I give you an option to buy a stock at \$100. The stock is now worth \$150. That means that stock I could have had at \$150 as an owner. And it's worth \$150. But by letting you take it at \$100, I let you keep the extra \$50 instead of me getting it. I have a share of stock which [INAUDIBLE] \$150. I've given that to you. I've, essentially, transferred to you \$150.

AUDIENCE: So when companies [INAUDIBLE PHRASE].

PROFESSOR: They'll keep some amount of shares. The owners, they will sell stock and they'll do offerings. But the owners own the majority of the stock. That's what makes them the owners. Maybe that's the right way to put it.

AUDIENCE: [INAUDIBLE PHRASE].

PROFESSOR: No. Well, in principle, the board of directors approves stock. They don't decide. An executive management committee decides. The executive management committee consists of all the golf buddies of the CEO. They decide. The board of directors is supposed to make sure nothing untoward happens. The board of directors, they're just a bunch of retired former executives who are also golf buddies of the manager. So they don't really get it right.

So there's outright cheating. So, for instance, one CEO, he got six stock options. Each one happened to be issued, happened to be issued the day before-- at least on paper-- was issued the day before a huge increase in the stock price. Now, the CEO said he was just lucky. But the *Wall Street Journal* did a simulation and calculated that there's a 1 in 1 billion chance he could've been that lucky. That, in fact, what clearly happened was he got the stock options later, and they were backdated to make it seem like he got them before the price went up.

But that's not the best example. The best example is Cablevision. They granted and backdated options to their vice chairman from 1997 to 2002. So from 1997 to 2002, they gave them options and they kept backdating them to make them look good.

The only problem was that he died in 1999. So, basically, they were just giving money away to this guy's heirs. Clearly they weren't incentivizing his performance. As the quote said, trying to incentivize a corpse suggests they were not complying with the spirit of shareholder approved stock option plans. They were just giving money to his heirs, because they felt bad for him, because they weren't keeping their yacht up or whatever.

So, basically, this is an example of a kind of cheating. Of course, then you can go further, and

there's outright fraud. The backdating is sort of cheating. You can go even further. I don't know what determines fraud versus cheating.

You can just do what Enron did. What Enron did is the executives there just lied about how much money they were making. They just went public with figures that were wrong. The stock price went up. They cashed in their options and quit. And as long as you don't get caught, that's a great deal. And if you do get caught, well, they fine you for 1/3 of what you made. So who cares?

So basically it was outright fraud. And this was a lot of what happened. A lot of the wealth that we thought was created in the 1990s in the stock market was really just false wealth created by people saying their company's were worth more than they actually were. Yeah.

AUDIENCE: Who decides the salary [INAUDIBLE PHRASE].

PROFESSOR: No. I mean, once again, it varies by company to company. But, basically, the dividend payout would be something that a different set of managers would decide, once again, subject to approval of the owners.

But, once again, the point is that the owners of a company, of a big company, are just a diffuse set of people who don't know what they're doing. The managers know exactly what they're doing. The board of directors is in between and is half clueless, half knows what it's doing. And that's what leads to the agency problem.

What's so interesting about this example is it sort of points out, like in many things in economics, why we're called the dismal science. There is no right answer here. On the one hand, if you don't incentivize your owners, then they might not do what's profit maximizing. On the other hand, if they incentivize your owners, they might do cheating to maximize their profits as opposed to the company's profits.

And that's why you need complicated structures, the type that was suggested in the back. And that's why, for example, they find that companies with much more concentrated ownership, the ones that Warren Buffett owns 20% of, they do a much better job in their CEO compensation than the ones where it's just a bunch of people owning a tiny, tiny percent. So that's exactly the kind of difficulty you face in setting up executive compensation.

Now, this was a real departure from the kind of things we talked about, just one example.

Partly what we want to do in this course, I want to teach you about basic economics. I partly want to excite you about what else you can go on and do in economics.

What I've just done in the last half hour is a microcosm of the field of corporate finance. There's an entire field in economics called corporate finance. We teach it in course 15. And it's a terrific course. 15.401 and 15.402 are the introductory courses. And if you find this stuff exciting, as I'm sensing some of you are, that's a great place to take what we're learning in this course and go on and actually dive in.

Realize that half the stuff I've told you, I'm talking out of my ass. I don't really know for sure. But those guys do in course 15. And you can really get into these agency relationships and understand our corporations work and how you set up these kinds of compensation arrangements. So this is kind of just a very exciting area.

Now, we're going to go back after this and assume corporations maximize profits again. And, once again, as with any assumption we make, by and large, it's right. And by and large it will deliver the kind of important knowledge that we need to know about how firms function. But it's important to remember that these kinds of things are behind it.

What we do in this course is teach you the basics. Then you go on in these other electives and actually learn about this kind of more interesting tweaks and what we do here. And other questions about this before I move on? OK.

Now we're going to stop with that topic, and we're going to move to sort of an in between topic. That is, we've been talking about firms and firm profit maximization. And we talked about how that depends on the structure of the market and perfect competition. Starting in two lectures, we're going to start talking about alternative market structures like monopoly and oligopoly.

But in order to talk about them, we need to introduce a new concept we haven't used before. And that's what we'll do the rest of this lecture and next lecture. We need to move from positive economics to normative economics, from positive economics to normative.

Positive analysis is the study of the way things are. So positive analysis is explaining why do firms produce this many widgets? Why do they hire this many workers? Why did I buy this many CDs? That's a positive analysis, trying to explain the way things are. That's what we've done, by and large, so far.

Normative analysis is the analysis of the way things should be. Is it good that I bought that

many CDs? Is it good that the company made that much profits? Would be better if we have a minimum wage or don't have a minimum wage? Normative analysis is the analysis of the way things should be as opposed to the way they are.

So, for example, we showed in the last lecture that in the long run, with free entry and exit, all firms are driven to zero profit, and the supply curve is horizontal. Well, is that a good thing? We don't know. We just said it happened. I described why it happened. But I didn't tell you if it was a good thing or a bad thing.

Zero profits, I make a lot of money off the profits that the companies I own make. I don't know if I want to work with zero profits. I've got a lot of stock and stuff. And I'm making money because these companies make profits. I don't think I'd be that happy to work with zero profits.

How do we think about whether that's a good world or a bad world? How do we think about whether we like these outcomes or don't like them? These are the tools of normative economics or what we will refer to as welfare economics.

Now, let me be clear here. The term welfare, as you might have heard it, often refers to money you give to low income populations. And we'll talk about that kind of welfare later in the semester. Here, when I say welfare, I mean well-being. Welfare is the term economists use as the measure of well-being.

We need to start talking about welfare economics, measuring the impact of economic outcomes on well-being, not just studying what happens when firms maximize profits or consumers maximize utility, but measuring how we feel about it, measuring whether it's good or bad, and measuring whether some outcomes might be preferred to others. Because if we don't do that, we can't ever talk about the role of the government in the economy. Until you start talking about welfare, you can't talk about whether we should have government interventions or not. You can only talk about what happens, not whether it should happen.

Now, the problem of welfare economics is that it's a lot harder because of something I mentioned when we talked about utility. Utility is an ordinal concept, not a cardinal concept. Utility is an ordinal concept, not a cardinal concept. That is, utils are meaningless.

We use utility functions to decide whether you prefer package A or package B. But the actual amount of utils you get, unlike profits, is sort of a meaningless concept. It's just sort of an index.

So what we do to do welfare economics is we turn from utils to dollars. We measure welfare in dollars which is easy on the corporate side. That's profits. How do we do it on the consumer side? We do it through the concept that we call compensating variation, which is one of these things where economists use fancy terms for something which isn't that hard to understand. But you need to know the fancy terms, because that's kind of how we teach, compensating variation.

That is instead of asking, how sad are you about outcome x, we ask, how many dollars would it take? Instead of asking, how sad would you be to not have a CD, we ask, how much would you pay to avoid being in that situation? So instead of asking, how sad are you that you end up with this car instead of that car, we don't want to measure the utils of driving a Hyundai versus a Lexus. We can't measure those.

What we can ask, is how much more will you pay to get the Lexus than the Hyundai? And that's \$1 measure of your utils. That's a compensating variation. How much do you have to be compensated?

So, in other words, instead of asking you how sad are you that you couldn't get tickets to a Lady Gaga concert-- maybe that's not a good example because no one's sad about that. But let's say you were. Let's say I am because my daughter wants to see her. How sad are you? I ask, instead, how much would you pay to get the tickets to the Lady Gaga concert? That's a measure of how sad you were you couldn't get them. Because you'll pay an amount to compensate yourself for the sadness of not getting them. So it's a way of turning utils into dollars.

And that leads to the concept that we'll refer to throughout the semester. That leads to the concept of consumer surplus. Consumer surplus measures the benefit that a consumer gets from consuming a good above and beyond what they paid for the good. So it's the benefit of consumption beyond the price. So your consumer surplus-- surplus means extra-- is how much you enjoy consuming something above and beyond what you had to pay for it. In other words, the idea is if you have to pay exactly as much as you'd enjoy the good, there's no consumer surplus.

So let's do an example. So consider my demand to buy a Lady Gaga CD. I've got to update my examples. You guys don't buy CDs anymore. How many of you have bought a CD in the last year? Wow. OK, let me ask another question, just one for the record. Just because I have

to decide how hard a time to give my 16-year-old son. How many of you typically pay when you buy a song? Wow. OK. Let me ask another one. How many of you typically don't pay when you buy a song. Well, when you get a song, when you download a song, you know what I mean, when you download a song. So the majority of you don't pay when you download a song. Interesting. OK.

I'll update this next year. But, for now, we're still 10 years ago. Consider my demand for Lady Gaga CDs. I'm trying to decide whether to buy the marginal CD. And let's say that it's worth \$15 to me. I'd be willing to pay \$15 for the Lady Gaga CD. And let's say the price is \$15. In that case, there's no surplus to me. There's nothing extra. I've paid what I was willing to pay.

So that's a case of a zero consumer surplus. The consumer surplus is how much extra I got from consuming it. I've got no extra. It was worth \$15. I paid \$15, no surplus.

Now let's say that the price was \$10. Then I've got a surplus. I've got \$5 in surplus. I was willing to pay \$15. It makes me \$5 happier to have this Lady Gaga CD. But I only had to pay \$10 for it. So I've derived some surplus.

Well, how do we know what people's willingness to pay for a good is? The demand curve. That's the definition of the demand curve. The demand curve measures your willingness to pay.

So let's go to the second figure. Think about the demand curve for CDs. There's some demand curve for CDs. What this measures is the utility maximizing choice. Every point in this demand curve represents my utility maximizing choice at that price.

This is backwards. That should be a \$15 on the y-axis and a \$5 on the x-axis, Sorry, guys. It should be \$15 on the y-axis and a-- no. Wait, hold on one second. Time out. At \$5, I get no consumer surplus. Yeah, this graph is kind of messed up. Let me draw a new one here.

So you've got my demand curve for CDs. You've got the quantity and the price. And I've got some utility function that delivers this demand curve. And let's say the way this works, this demand curve for CDs, let's say the way this works is that I am willing to buy 1 CD. I'm willing to buy if the price is \$20, I'm willing to buy 1 CD. So at a price of \$20, I'm willing to buy 1 CD. So if I get that 1 CD at \$20, then basically that's my willingness to pay. It equals a price, so there's no consumer surplus. Really imagine it's right next to that y-axis.

Now let's the price falls to \$15. Sorry. That's a 1. That's the 1. That's a 20. At a price of \$20, I'm willing to buy 1. At a price of \$15, I'm willing to buy 5. I'm willing to buy 5 CDs.

Now, what is my consumer surplus? Well, let's ask. For the first CD, I got no consumer surplus. But for the second, I was willing to pay. When the price was \$20, I got no consumer surplus. Now let's say the price is \$15. So what was I willing to pay for the first CD? \$20. So what's my consumer surplus on the first CD? 5. So on that first CD, I got a consumer surplus of 5.

The second CD, I was willing to pay less because I've got diminishing marginal utility. But I was still willing to pay more than \$15. So I've got some surplus there. Third CD here, et cetera. But on the fifth CD, I derive no surplus, because I was willing to pay \$15 for that fifth CD, and I paid \$15 for that fifth CD.

What that means is that all of this is my consumer surplus. Because on every unit, because I paid a fixed price of \$15, and for my fifth CD, that delivered no surplus, that was indifferent. But in my first through fourth CDs, that made me very happy. Because I was willing to pay more than \$15 for those.

So my consumer surplus is the amount by which I derive utility above what I was willing to pay, above the price-- I'm sorry-- the amount that I was willing to pay about the price. The amount I'm willing to pay is every point on this curve. So anything I buy that I was willing to pay more for the price for, I derived surplus on. So this becomes my consumer surplus.

So, basically, consumer surplus is the area under the demand curve above the price. So, graphically, consumer surplus is going to be the area under the demand curve above the price. Intuitively, why is that? Intuitively, what's going on is that every unit above the price under the demand curve are units which I valued higher than the price. So I get surplus on them. OK. Question? Yeah.

AUDIENCE: If you're [UNINTELLIGIBLE] this, would you start at zero?

PROFESSOR: Yeah. Really, in some sense, you'd want to start at zero. It's really the integral of this whole area. The problem is it's discrete. I should have a stepwise curve here. I made it discrete. But, really, it's the integral of this area. Yeah.

AUDIENCE: [INAUDIBLE PHRASE]. upward sloping demand curve?

PROFESSOR: I'm sorry.

AUDIENCE: With an upward sloping demand curve.

PROFESSOR: With an upward sloping demand curve, well, as I said, we don't believe in Giffen goods. We think they are a fantasy. So with an upward sloping demand curve, how would that work?

So an upward sloping demand curve, then that would say that if the price is here, then you'd have an infinite consumer surplus. It wouldn't be well-defined. It wouldn't be well-defined. So I don't know how you'd do that. That's why we don't like upward sloping demand curves. Yeah. Question? No?

OK. So, basically, what you end up with is this consumer surplus concept which, basically, as pointed out mathematically, is the integral of this area. But we're not going to make you integrate. It's basically this triangle which is basically all the units above the price, all the units for which you're willing to pay more than the price. And you get consumer surplus on every unit you buy up to the point where your willingness to pay equals the price.

And that's our normative measure of welfare. That's our normative measure of how happy you are. And the key that drives this is diminishing marginal utility. That's why we don't like upward sloping demand curves. What drives this is diminishing marginal utility. It's that with each additional unit I'm willing to pay less and less for. So I'm going to get less and less surplus off each additional unit I buy.

And that's going to be the key thing. The key intuition that you guys have to remember is that the last unit that I'm willing to buy at that price, by definition, I get no surplus on, or I get a \$0.001 of surplus on. Because if I've got a lot of surplus, I'd buy 1 more.

So, by definition, the marginal unit is the one where surplus is driven to 0. And units before that are the ones with positive surplus. And that's why an important intuition to have is the amount of surplus you're going to get from a purchase is going to be about how far away from the price point you are. Those first units are going to give you more surplus. And that's going to dwindle as you get to the actual last unit you buy at that price. Any questions about that?

OK. Let me stop there. We will come back next time, and we're going to spend the whole lecture talking about welfare economics, we'll introduce producer surplus, and talk about how we then think about whether changes are good or bad.