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PROFESSOR: OK, so let me get started. So if you remember last class, I did the basic strategic investment theory and talked about how we think about firms trying to make long term investments that either deter rivals from entering or changing the nature of competition in a way that's going to make them more profitable if they go ahead and give up and accommodate that the rivals come in.

And the basic insights there are, to deter entry, it's fairly simple. You just want to do whatever kinds of investments are going to hurt your rivals. And then when you're talking about accommodating entry, one of the insights was it really depends on whether you're playing games with strategic complements or substitutes. And in strategic complements games, generally investments that help your rivals are ones that are good strategically, and investments that hurt your rivals are bad. And then it's reversed if you're looking at Cournot wide games.

So today, I'm going to talk about empirical work on strategic investment. And why are we interested in this? There's the standard considerations that we want to understand. Do the models work well? Do firms do what we think?

There are other cases where strategic investment of the type described in those models could be violating antitrust laws. I gave a model of tying where tying could be used to deter entry. That would potentially be a monopolization violation.

So anyway, so yeah, trying to see, do these-- and are the incentives that these models say could be there to signal costs or do other things? Are those actually empirically important? And then if they are important, do the firms recognize and react to them?

So if we're thinking about, one, are these incentives important, the main thing to understand is this d a1 star / dk1 and da2 star / dk1. If you remember, when we're talking about the entry deterrence, whether you do more or less investment to deter entry was determined by a strategic effect. And that strategic effect looked like-- it was d pi 1-- sorry, d pi 2 / da1, da1 star / dk1.

Strategic entry deterrence was about k1 is a commitment that makes me change my second period action. And then when I change my second period action, how does it affect firm 2 and keep firm 2 out of the market? Accommodation, I went to the helping and hurting. But before that, I had the strategic effect was d pi 1 / da2, da2 star / dk1.

So strategic entry accommodation was about getting your rival to do something that-- using k1 as a change in the nature of competition in a way that get your rival to do something that you want to do. We pretty much always know what these are-- the signs of these, d pi 2 / da1. This is just like firms like their opponents to set higher prices, or firms like their opponents choose lower quantities. So then, the important strategic questions are, how big are these things that-- how much do the a's change with the investments?

So anyway, that's one thing people do. And then the other thing people do is we're trying to see, does the model with these investment-- entry deterring investments better explain what firms do than a model without those investment firms in there, and are firms recognizing those? Sometimes, we can think of this question of are firms recognizing and reacting to entry deterrence incentives by really thinking of it as just different strategic models. So as I said, everything I did on strategic investment was comparing the investment with an entry accommodation motive to the open loop equilibrium.

And the open loop equilibrium is the fully optimal choice of k in this model, where K is never observed. The incumbent chooses Kk The entrant chooses in or out. There's monopoly or duopoly, and only after the-- and never does the rival observe k.

So you can think of non-strategic investment as just strategic investment in that model where k is unobserved. And then you could add in two different strategic variants, one where if you observed k here, that's the fully strategic model where you think about entry accommodation and entry deterrence motives. And if you observe k here, that's the model where you only think about strategic entry accommodation, not deterrence, because you're not observing k until after the entry decision.

Anyway, so I'm going to talk about papers taking a few different approaches. First approach is just examine the effects of the investment directly. Just look at some investment, k. Look at some action, a, that occurs later, and observe whether da / dk is large, and what the sign of it is.

Second approach you see is to try to understand if firms are following their strategic incentives, what we could do is examine reduced form predictions that differ between the non-strategic and strategic models, and then see which one better explains the data. And then the third approach is to write down a model that you can structurally estimate and understand, does a structural model explain things better than, hopefully, some alternate structural model that doesn't have that term? And so I'll talk about papers with each approach.

So I'm going to start with Chevalier's paper, *Capital Structure and Product Market Competition.* So this is a paper about the supermarket industry, and it's motivated by work in corporate finance. So the corporate finance question that motivates this is, why do firms choose the capital structures that they do?

I think we're used-- well, I don't know. How many people here have taken a corporate finance course? Is the answer going to be 0? OK, so-- one. Good.

OK, anyway, so starting point for most theoretical corporate finance courses is you start with Miller- Modigliani. A lot of corporate finance is about how does a-- well, the basic structure that you certainly want to teach MBAs is, how do you set up your capital structure of your firm? How do you decide between raising money through debt, raising money through equity? How is a firm value affected by choosing a capital structure?

And so the starting point for this literature is what's called the Miller-Modigliani theorem. And the Miller-Modigliani theorem is a basic theorem talking about how in competitive markets with different states of the world, your capital structure is just completely irrelevant. And if you think about it, it's like, there's just some giant set of states of the world that may arise, and the firm earns some different amount of profits in every state.

And then you divide up the state contingent claims on the firms into a debt contract, or an equity contract-- like any contract, like equity, or debt, or whatever, pays off different amounts in different states of the world. And then Miller-Modigliani theorem is basically saying, look, if you think about it, if you're just deciding how much to have in different states of the world, whether you have some this combination of debt and equity or this combination, all you're doing is changing the debt contract or something, the equities were something, but the sum of the two is-- or the sum of all the claims you issue on the firm are still just issued to all of the value of the state contingent profits you're going to earn. So capital structure is just completely irrelevant.

So then obviously, after that first observation, you need theories for why firms do have debt, and do have equity, and why they decide to do it. And I wouldn't say this is the biggest class, but a substantial part of that literature does say, one reason why you could want capital structure could matter is because capital structure can affect the product market competition between the firms. And there's a big literature about debt, arguing how debt could affect real actions that firms take, and effects that can go in different directions.

So let's think about, thought experiment, a firm takes on a large amount of debt. And so because they've taken on a large amount of debt, they need a lot of cash flow to make the debt payments that they've taken on. What does that do?

Well, first, start with a standard oligopoly game. That's going to have no effect whatsoever. So I take it on debt. I want to make more money.

If it's a static game, every period I'm trying to make as much money as I can. So I'm still just going to choose the profit maximizing prices in every period. Debt would have no effect whatsoever.

To get debt to have an effect, though, you can think about dynamic models. So one class of model might be if you have a model where you have customer loyalty. You sell things to consumers at good prices. They get used to your product.

They like the taste of your mayonnaise. They like your frequent flyer miles. And then you build up this goodwill over time, but then goodwill is an asset that you can depreciate. Well, if you now need a lot of money in the short run to pay down your debt, you might start raising your prices, exploit all the customers who are temporarily captive to you, and exploit and burn up all the goodwill you've gotten. So that might be a case where you raise prices because you need to raise money in the short run.

In dynamic collusion, you can get the opposite effect. I talked about in the Rotemberg Saloner model, if firms have a big incentive to deviate from the cartel agreement, then the full collusion is no longer sustainable. So in a dynamic model, you could have that we can no longer sustain this high collusive prices because we have the debt. We need to lower our prices to reduce our incentive DV on the cartel agreement. So this need for short run money could raise or lower prices.

Another effect we talked about with debt is high debt-- like if there's a-- for every extra dollar you borrow, lenders are going to demand a higher and higher interest rate for the next dollar because the threat of bankruptcy is larger. So high debt raises the cost of capital and makes it difficult for you to borrow more money for future expansion. And so if you think about, how would this work in a standard Cournot competition model, in a Cournot model, if you've committed to not expand, then your rivals are going to expand. Because if I commit to a low Q, my rivals are going to choose a higher Q as a best response.

So it could be that debt is a commitment that leads my rivals to expand more. There could be other models, though. I haven't talked about them yet. Like if you have-- there's some new market, there's some new growing city. One of two firms is going to open up a store in that new growing city.

Well, if you know-- like if you are afraid your rival is going to open before you, you may race and get in there before it's short run profitable, but just when the PDV is positive, to get in and beat your rival into the new market. If you know your rival is debt constrained, can't raise money, you can just wait later and enter later. So it might be that your rivals enter less if you're constrained by your debt load. Anyway, so I tend to think of these as many different stories in which taking on debt makes firms soft or makes firms tough, and therefore, would have an entry deterring or entry accommodating effect.

OK, so this is what Chevalier is interested in, is basically this question of what effect does debt have, using the supermarket industry as an opportunity to explore debt? And she takes advantage of, again, what's a natural experiment? Well, Judy claims that the basic story here, though, is it's this weird natural experiment in LBOs in which there's a family called the Haft family.

They had a drugstore chain, the Dart drugstore chain, and they sold the chain for-- you know, this is back in the 1990s. Businesses were worth less than they are now. They sold their drugstore chain for $160 million. And soon after, they decided that they wanted to get into the super-- now, having cashed out of the drugstore business, they wanted to get into the supermarket business. And they embarked on a series of attempts to buy some national supermarket chain using leveraged buyouts.

So people know what a leveraged buyout is? Leveraged buyout is, I want to buy something. I don't have nearly enough money to do it, but I just get people to lend me a tremendous amount of money. I take all the borrowed money, and I use the borrowed money to buy the business that I want to buy. And so the leverage refers to you're buying this business largely with someone else's money, but you're just taking on an awful lot of debt to buy the business.

Anyway, so first thing we know they did is they tried to buy-- they just started buying up all the stock in Safeway on the market. And then obviously, you start buying up stock, and you can buy up 5% of the stock of a publicly traded company before announcing your intentions. So they started buying up stock in Safeway. They then announced, we want to do an LBO and take over Safeway. Obviously, as soon as they announced that they were going to take over Safeway, the price of-- like often you buy out a firm at 50% premium over the current stock market price.

So they announce they're going to take over Safeway. Price of Safeway stock jumps. And then-- so in some sense, they've bought the stock here. They then announce they're buying it, and the stock jumps like that.

And then anyway, the Safeway management does not want to be bought out by the Haft family and lose their jobs. So the Safeway management decides, no, we also think Safeway is undervalued. We're going to buy Safeway out ourselves.

And so then what the Safeway management did is they borrowed several billion dollars, did an LBO to buy the drugstore instead of letting the Haft family-- sorry, buy Safeway-- the managers themselves bought the firm and took it private rather than letting the Haft family take it over. And then I think one thing that the Haft family noticed here was that they made an awful lot of money when the stock did this, and then after it did this, then the Safeway management took it over, and then had to pay them again to buy up all of the shares that they bought, and to give up their takeover attempt. And so they ended up making $150 million or something like that.

And then what we don't know is, like, did the Haft brothers say, wow, that was awesome. I just made $150 million and I didn't have to do anything, or did they really want a supermarket chain? But they basically at this point went from chain, to chain, to chain, to chain, to chain, and kept trying to buy them, and kept losing. And the management of all these different supermarkets did either LBOs or what are called leveraged recaps where they just borrowed money, and didn't take it private, but borrowed a lot of money and bought back a lot of the equity.

And so in this period of just three years, 19 of the 50 largest supermarket chains in the US did LBOs. And so Judy treats this as she's going to think of this as a relatively random choice. Just where did the Haft brothers go over, and over, and over again trying to buy them? And we get this natural experiment of 19 chains doing LBOs, 31 chains not doing LBOs. And so you can treat this as a random event.

And then the market level impact of the LBO wave varied a lot from city to city because most cities will have three or four large supermarket chains. And these are national chains. And so it could be there are some cities where all the LBO chains had almost the entire market. There are some cities where there was only one LBO chain, some cities where there were no LBO chains.

OK, so what's her dataset? It's a few different data sources. First, she's got annual information on the number of supermarkets in each chain, each of 85 MSAs. MSAs means cities. She has the demographics of the MSAs, and how that changed over the six-year period, and then she has whether every store that was there in 1985 became part of an LBO firm by 1988 or by 1991.

So she's going to be running a lot of city-level regressions. In the city-level regressions, the main explanatory variable is LBO share. So LBO share is just the share of stores in 1985 that became part of an LBO.

And so we're going to be comparing cities that had lots of firms doing LBOs and not many firms doing LBOs. And the main thing she's looking at is interest is the effect of the LBO on entry. And so she's going to look at both do the existing non-LBO firms expand and build more stores, like a Cournot-like model that we can't expand, therefore they start building more stores, and then she also looks at effects on entry by brand new firms come into this market, perhaps because they know that Safeway can no longer expand, or they expect Safeway to raise its prices, or something like that. So she's going to look at effects on expansions and on new entry.

So anyway, it becomes, compared to many papers we've looked at, fairly simple paper econometrically. It's just largely a lot of regressions, looking at how conditions in the market change when-- differ between the cities that have lots of LBOs and cities that don't have LBOs. So the first one here is there is some fairly weak evidence that number of early LBOs led to an increase in the total number of stores in the market.

So you can see that that's this coefficient here. So it's regressing like log of the number of stores on a market on a bunch of things. And then one of the things is the-- and this is log of stores as of 1991 on market characteristics. And this one here is the fraction of stores that had done LBOs between 1995 and 1998.

And what it's showing is that in the cities that have more LBO stores, more stores that did LBOs by 1998, you see more stores in the market in 2001. So you would think that's consistent with this story that LBOs soften price competition. Safeway after the LBO is going to raise its prices to try to eat up its customer loyalty and pay off its debts. Other firms are going to recognize that as that prices are going to be higher in that market. We could move in and enter there, or expand there.

So that was total stores in the market. So this is a question of when there are more LBO firms, do the non-LBO firms build more stores in the market? So this is coefficient here. If you at the number of stores built by non-LBO incumbents, when you have an early LBO, the non-LBO incumbents expand more. Again, it's not highly significant effect, but non-LBO incumbents expand more when there are a lot of early LBO firms in the market.

Third set of regressions is about de novo entry. So de novo entry is looking at do you see brand new chains that were never operating in this market before start to open in stores? And typically big national chains, they either have a lot of stores in a city or no stores in a city. Because if you're going to have stores in a city, you need warehouses and things like that. And then occasionally, the big chains will decide, OK, now we're moving into this metro area, and they'll build out there. Also at the time, you were getting Kmart and Walmart were expanding from just other things into groceries.

And so what they find on-- what she finds on de novo entry is, again, this coefficient here. The more early LBOs there are in a city, the more likely it is that we're going to see some new chain that wasn't in the city, or Kmart, or Walmart opening up new supermarkets there. So I guess, overall, these results are consistent with models in which LBOs make incumbents soft.

This could be-- what the soft is in terms of entry, it could be the LBO firms are raising prices, or it could be that the LBO firms are capacity constrained. And that leads the rivals to introduce more stores. Certainly, if it's the raising prices part, the raising prices one would be, that is-- you do want to be soft in price competition games. So if it's a commitment to raise your prices that gets your rivals to raise their prices, that's good.

This isn't to say that you do more-- this isn't to say that strategic effect of LBOs is what makes you do an LBO, but it is saying that it's one of the considerations in whether to take an LBO is-- one of the benefits the LBO would be providing is the committing to raise your price, which gets your rivals to raise their prices. And that would be one of the factors in the calculation. So in some sense, you would do more LBOs than you would in the open loop LBO equilibrium where the rivals didn't know that you were doing the LBO and it couldn't affect your pricing. Questions on that?

And then Judy also has a nice follow-up paper in the Journal of Finance which looks directly at pricing. So this one, again, it's a fairly-- she's gotten data from supermarket scanner data, and looking at supermarket scanner data to compare how the firms with undertaken LBOs priced compared to non-LBO firms. And what she finds is that by 1992, the firms that did LBOs have raised their prices by 2% to 3%.

In markets where there isn't some dominant firm that didn't do an LBO, then market level prices typically go up after the LBO. But in markets where you do have the dominant low debt firm, what we see is that actually, on average in the market prices, if the market level prices go down, it seems like sometimes the low debt firms are exploiting the LBO firms. And the LBO firms are committing to cut prices, and the LBO firms perhaps could be deciding this is an opportunity for us to keep our prices low. And we see some increased exits of LBO stores where the LBO stores find it difficult to compete with the non-LBO firms. Questions?

I mean, it's two nice papers that are very much of that first approach I said of just looking at the investment, seeing what the effect of the investment is. What does it do to firms?

OK, so then the second paper I wanted to talk about, this is a paper Sara and I wrote about entity deterrence in the pharmaceutical industries. So I guess basics of pharmaceuticals is, you invent a new drug. You patent the new drug. After you patent the drug, you do some number of years of clinical trials to prove that the drug is safe and effective. If you have enough, you present your evidence that drug is safe and effective to the FDA. They approve your drug for sale in the United States.

The clock has been ticking since you patented the drug on how long you will have patent protection over it. There are various more complicated rules about if it's taken you this long to get the drug approved, you can get extensions to your patent term. And there are also various ways you can get other extensions to your patent term. But all drugs will have some date at which-- they'll have some date at which the price drops.

Prices of many drugs are quite high. I think these days, most people have insurance. But because most people have insurance, many new drugs come out that treat high blood pressure, or cholesterol reduction, whatever, and they come out with prices of $1,000 a month, or $2,000 a month, or whatever.

And then obviously, you have insurance as a copay. But the firms are getting these very high $2,000 a month prices for new drugs. Now, sometimes people are looking at pricing things at $50,000 a month.

At some point, the patent expires. When the patent expires, there's something called an abbreviated new drug approval, ANDA. I think that's what it stands for.

Rivals can come in, show that they're producing a chemical compound that's equivalent to the chemical compound being produced by the branded drug manufacturer that was approved by the FDA. Earlier in US history, you had to again prove safety and effectiveness, and there was essentially no generic entry. Now, all you have to do is prove bioequivalence of your drug with the existing drug. Then you can come in and compete with the existing firm.

Typically, what happens is firms are going along charging their $1,000 a month price, and then know, generics enter. And generics just come in and-- there's some date the generic entry is allowed. And the generic just goes like that and prices at a small fraction of what the branded firm charges.

Strangely, the branded firm does not cut its price to match. Typically, what the branded firm does, if anything, is do this, and price even higher. Because now, all they're serving is the people who will not buy-- people who will not buy a bioequivalent drug, and so those people you might think are captive and are not going to leave no matter what you charge.

But in any case, if you look at the market shares of the branded drug, the market shares go like this. The branded drug has a market share of 1, and then it pretty quickly asymptotes to some very small number, like 10%. And then the generics go like this, and then they start to survey the whole market.

So what's nice about drugs as a place to study strategic investment is there's no entry possible until some date, and then there's some date on which entry is possible. And looking at the FDA data, you know the date at which the entry is possible. And so we get this opportunity where there's no entry, no entry possible, no entry possible. Suddenly entry is possible, and you can use that change in how firms behave around the time entry becomes possible to identify what firms might be doing to deter entry.

So anyway, our data sample in this paper, it's 63 branded drugs that lost patent protection at some point between 1986 and 1992. I think I said that already. So this paper is, as I said, the reduced form approach. We're trying to understand not what the incentives are. We think that in many cases, the economics is simple enough that we know what the incentives for pharmaceutical manufacturers are to do, and how they would deter entry.

The question is, are they reacting to those incentives to deter entry, and do we see them taking actions to try to keep generic drugs out of their markets? And the way we propose to do this is to identify a prediction that we think differs between the strategic model and the non-strategic model, and then test that prediction. So the prediction comes off two observations.

First observation is that strategic entry deterrence models often predict that the relationship between investment and market size is going to be non monotonic. The idea is that if you're Eli Lilly and your patent on Prozac is expiring, or if you're Pfizer and your patent on Lipitor is expiring, there's nothing you can do to stop entry from occurring. Because Lipitor is bringing in billions of dollars a year in profits.

It costs almost nothing to make. As soon as the patent on Lipitor expires, there's going to be a ton of generic atorvastatin firms. There's nothing that Pfizer could do about that.

Most drugs in the data-- we think of drugs as having these high prices and incredibly high revenues. If you actually look at the full cross section of FDA approved drugs with expiring patents, most of them don't do anything. Firms get drugs. They get the drugs approved.

But then the drug gets approved, but it's not as good as some other drug in the market. Or it was the best drug when it was first patented, but then some new drug has come in and supplanted it. So many, many drugs, basically, to first order approximation, nobody takes.

And if you have a drug that nobody takes, there's never going to be any generic entry because the generic firm is not going to come into a market that already has no patients when it's got pharmaceutical reps pushing it. And so our thought on the paper is that these entry deterrence incentives really are something that exist just in intermediate sized markets, and markets that are big enough so that generic firms would want to bother, but small enough that it's plausible that you could keep the generic firms out by taking some set of strategic actions. And so there's this potential non-monotonic effect of there will be some action.

And in small markets, you don't do this action. And in big markets, you do this action. And then in really big markets, you don't do the action again.

And then the other observation is that non-strategic models-- so if I'm putting here market size on this, and investment on this axis, the other observation is that non-strategic models like the model ignoring that entry deterrence incentives often predict that the relationship between market size and investment is going to be monotone. We talk in the paper about there being basically two effects that determine whether we should see more or less investments in big markets. One is the direct effect, and it's just, is a marginal investment return larger in a big market than it is in a small market?

And many investments like TV commercials, like you may be aware that there's just-- if you watch TV, there's zillions of these annoying commercials that go on for a minute talking about all the conditions that someone might have, and all the side effects of this drug, and buy Xeljanz or whatever at the end of the commercial. Obviously, commercials like that are only going to be feasible for conditions that a lot of people have. If there's some condition that's very rare in the population, you can't buy a national TV commercial advertising your drug. If there's a condition that many people have, you can buy the commercial. So we'd call that the direct effect of investment returns. The more people who have the condition, the more you're going to invest in over-the-air TV advertising.

A second effect-- do I have second effect here?-- strategic effect. The second strategic effect is, are the returns to this investment bigger in a monopoly market, or in a duopoly market? Because the bigger is the market, the more likely you are to end up with competition. And so you're going to have to think about, is this an investment that I'm making more valuable when there's competition, or more value when there's no competition?

So if those two effects go in the same way-- this is something you want to invest more in big markets than small markets, and this thing you want to invest more in oligopoly markets than in monopoly markets-- then we're going to see a monotone relationship between market size and the investment. And so if you have investments like that, we think those two effects go in the same way, we would expect it to be monotone if there wasn't the entry deterrence motive. But with the entry deterrence motive, we could look for a non-monotone pattern. I think I have several more slides on this. I'll see how many of them I do.

So here would be an example of a simple numerical model I can solve that has this property, monotone effect without entry deterrence motives, and a non-monotone with the entry deterrence motives. So here, think about a cross section of markets, and the markets are identical other than the number of people, zi, who-- you can think of this as the market for a particular drug, and zi is the number of people who would be served by the drug. Assume that each market has a continuum of types with theta distributed uniformly on 0 and 1.

Assume that this advertising has this technology where A is my per-consumer spending on the advertising. And if I spend A per consumer on the advertising, then consumers are going to get utility theta times root 2A minus p1 if they buy the branded drug, 1/2 theta root 2A minus p if they buy the generic drug, my rival, and 0 if they buy neither good.

So a motivation for this technology would be some drugs treat diseases that are typically managed by specialists. The way you market drugs that are sold to specialists, rather than putting on TV commercials, you just send sales reps to the specialists. So if this is a not very common disease, you have the top 25 specialists in this disease in the Boston area. You send a sales rep to visit every one of them. You tell them one on one about the drug and all the newest data on its effectiveness, and you try to get them to prescribe it.

So we're modeling that as the more you spend on advertising, the higher utility people will have for buying your drug. But because the doctors you're talking to will know that the generic is also much the same in this model, I'm going to assume that people get utility-- when you raise people's willingness to pay for your drug, you also raise their willingness to pay for the generic drug. What happens in this model-- give me a second. It's right here or not. Nope, OK.

Anyway, what happens in this model I will explain it a little more later. If there's no strategic entry deterrence motive, this is a model where you would do less investing the larger is the market. And you're going to do less investing the larger is the market because the larger is the market, the more likely it is that the generic competitor is going to end up entering.

If the generic competitor ends up entering, it's as if the gain you're getting is 1/2 theta root 2A instead of theta root 2A. Because it's only the marginal way that increases your value relative to the competitor that matters. So the bigger is the market, the more likely generics are going to enter and profit. And so therefore, advertising is monotone decreasing in the market size. In some sense, this is what you would do if you knew entry was never going to occur, and this is what you would do if you knew entry was going to occur with probability 1.

But if you look at the strategic entry in this model, the strategic entry will be like this. It'll have this non-monotone pattern where it departs from the strategic one, dips way down, and then comes back up. What's this dip?

The dip is I'm trying to keep my market small enough so that the generics don't come in and compete with me. So what I do is I do less advertising. With less advertising, I have lower sales. Lower sales, less likely there's a generic competitor. And so what I'm doing in some sense is I'm keeping the market small so that I can get monopoly profits in the small market instead of getting oligopoly profits in a bigger market.

And at some point, I give up. Here, I start increasing my advertising again because I realize that generics are going to come in no matter what. So I might as well be splitting the best possible market with the generic competitor rather than trying to keep it small enough to keep the generics out.

Anyway, so the example above, I was comparing investment in two different models. The upper line that I drew for you, that was the line for this no entry deterrence motive model where the potential entrant only observes the advertising level A after it's come into the market or not. And then the other line was the standard strategic entry deterrence model where I choose A, they observe A, and they can stay out.

And so our argument was that the relationship between market size-- determining market size in the investment, A, was going to be monotone on the bottom model and non-monotone in the model on the top. So anyway, the paper tries to explain why is it that we're going to see these monotone patterns versus non-monotone patterns? How do we think about-- the strategic entry deterrence model, you have a profit function pi 1 of A.

And I guess I didn't say here, you know, in all of Tirole's models, Tirole always has the entry cost, E being known. And the entry cost, E, being known means if I want to keep the entrant out, I have to distort this far. And going this far keeps them out, or going less than that doesn't keep them out. In empirical work, we're always going to be making the entry cost, E, random and have it unpredictable to the incumbent exactly what's going to keep the entrant out or not.

So if I think about what's my profit if I choose investment A, I don't know the entry cost. So assume that the entry cost, E, has some distribution, F. So F of pi 2 duopoly of A is the probability that my rival's entry cost draw is low enough that the rival comes in and competes with me, in which case I will get the duopoly profits that you get after investment A. The other case is when the entry cost is high. If the entry cost is high, which happens with 1 minus F of pi 2D star of A, then I'm going to get to be a monopolist and get this profit level. And then I have a cost of doing the advertising.

The model on the bottom of my board was different in that the entrant only observed A after making its entry decision. So again, this is a shorthand for your not thinking about the effect of A on the entrant. So if the entrant wasn't observing A, what advertising would you do? There, the entry decision doesn't depend on A. The entry deterrent depends on A star-- what the incumbent expects you to-- what the potential entrant expects you to invest.

So you want to think about writing your profit as a function of two things-- the actual advertising that you do, and the equilibrium level of advertising. And here, the firm enters if its entry cost is less than what duopoly profits would be at the equilibrium level of advertising. But then, the actual profits received depend on the true level of advertising.

Again, entry depends on the equilibrium level of advertising. Monopoly profit depends on the true advertising. Cost of it depends on the true advertising. So when I think about the first order conditions for this profit maximization problem versus this one, the two first order conditions are going to differ because of the fact that here, there's a derivative with respect to A in this term, and here, changing A doesn't affect this term. So that's what makes the two problems different.

What is the extra term? So they have the same first order conditions. Except if you think about what's the effect that comes from differentiating this with respect to A, it's that it's the derivative of this with respect to A times this plus the derivative of this with respect to A times that. That's the new term.

So the extra entry deterrence term is-- and this is intuitive-- how much does A affect the duopoly profits that the firm is going to get times the probability that that effect on profits is going to affect 2's entry decision. And it's going to affect 2's entry decision if and only if his entry cost is identical to the profits, or within D pi of the profits. And then if you do effect entry, the extra profit that you get is the difference between the monopoly profit and the duopoly profit.

And this term-- [INAUDIBLE] says that? No. OK, yeah. This term is where the non-monotonicity comes from, because this term is multiplied by the likelihood that a small decrease in an entrant's profits is going to be pivotal to their entry decision. And so this is what creates the non-monotonicity.

You know, this we think of as a big number between monopoly and duopoly profits. This is just whatever effect your advertising has on the rival. But the thing that makes it non-monotone is, is that change in your rival's profit is going to be pivotal to whether they enter or not? And that's going to be non-monotone.

And then the second effect, I said this earlier in the paper, there are these two reasons why investment normally changes in market size. It changes for this direct effect which I define here. So there's this direct effect, which is just its direct effect on pi 2.

And then there's the competition effect. So the competition effect is, do you want to do more in a duopoly or a monopoly? And the direct effect is, do you want to do more in a big market, or a small market?

And so in some sense, the theorem says that there are, in that model, exactly two reasons why you're changing investment as market size increases. One is because of the direct effect, and the other is because the competition effect. If those two go in the same direction, then the investment would be monotone. And we can think about whether we expect investment to be monotone by just thinking about what are direct and competition effects of an investment.

And what I'd done in this model is clearly, the fact that the advertising raised the value for the generic is what gave it a negative competition effect. If my rival is going to be benefiting from that and raising-- I'm getting a smaller value in a duopoly, I eliminated the direct effect by saying A is a per-consumer spending on advertising. And so it's a per-consumer spending for a per-consumer benefit, so there's no direct effect, big versus small, if you're thinking of this as per-consumer spending.

And that technology where you're visiting doctors, and the number of doctors you have to visit is proportional number of patients, it's plausible that the per-consumer cost and the per-consumer benefit are the same. So I've just basically eliminated direct effect. And so once you eliminate direct effects, it's going to be monotone increasing or monotone decreasing depending on whether the competition effect is positive or negative.

Anyway, paper does other stuff. So let me go to empirical application here. There are 63 branded drugs in our data sample. All the branded drugs lost patent protection at some point between 1986 and 1992. And so we're going to think about how does the behavior of incumbents compare between big and small markets?

So we're going to put-- generally, you're going to make up graphs where we have market size on the x-axis. What market size means for us is revenue some number of years prior to patent expiration. The thought is that if you're going to be doing something with your drug to deter entry, that comes closer to the entry date.

And so we're going to look a few years back from the entry date and say, how big was the market? That's our possibly exogenous measure of market size. And then we're going to look at for potential strategic investments.

One is detail advertising. So detail advertising is-- strangely enough, data on this exists-- the expenditures by pharmaceutical firms sending sales representatives to doctors offices to tell them about their drugs. And we have data on that at the drug level.

Second strategic investment we have is journal advertising. This is-- one thing you do with drugs is advertise them in medical journals that are sold to doctors. And so we know, for each drug in our sample, how much money they were spending advertising them to physicians.

Third strategic investment we look at is presentation proliferation. Something that people have discussed firms doing to deter entry is, if you go into your doctor with a prescription for-- you go into the pharmacy and have a prescription for a 50-milligram tablet of some medicine, and then they don't have a 50 milligram tablet, they have a 100 milligram tablet. Sometimes, they can give you the 100 milligram tablets, and give you a little pill cutter thing that cuts the pills in half. And you can turn one pill into two, and take half of the 100 milligram pill, but sometimes you can't.

And certainly, if they've given you a prescription for an ointment that contains this drug, and they don't have the ointment, they only have the oral, the pharmacist can't sell you the generic ointment when you're supposed to be taking the pill. They can't sell you the gel cap if you're supposed to be taking the pill, or the liquid if you're supposed to be taking the pill, or whatever. And so something you've heard that pharmaceutical firms might do to deter entry is start producing the drug in a zillion different varieties to, in some sense, raise the cost of the entrance to come in and compete with you. So if, instead of having one standard pill, I have a whole bunch-- I have a regular pill, and a time release pill, and a gel cap, and a something or other-- I can have many different-- if the generic only came in and only produced the most popular presentation of the drug, it would only be competing for a small part of the market. And that could make it more difficult to enter.

And then the final thing that we do is just prices. And again, I discussed some of these issues about the entry deterrence-- the entry deterrence through signaling costs, or signaling something about demand, or something where you set low prices to try to deter entry. And so we're going to look at these investments and how the investments look when you graph them against market size. And do they look monotone? Do they look non-monotone?

And what we're going to particularly do is focus on four drugs that are in that intermediate range where entry is uncertain. Is that where we see a distortion in the direction that you would expect the distortion? And what distortions would you expect?

If I'm trying to deter entry, I'm going to do less detail advertising because I'm trying to keep the market small. I'm going to do less journal advertising because I'm trying to keep the market small. I'm going to do more presentation proliferation and introduce more versions of my drug, and I'm going to set lower prices. And I'm going to look for are they non-monotone with those deviations from monotonicity in the range where it's plausible that you could keep rivals out?

And we're going to look at this in two different ways. One, just in the pure cross section, advertising versus market size, is advertising non-monotone in revenue? But sometimes, these things are just super steeply increasing depending on how you describe the variables, because just bigger markets-- like TV advertising, this would never work because TV advertising, the bigger the market is, the more you spend.

So the other thing we do is look at how are firms changing advertising in the year the patent's expiring relative to what they were doing two years before the patent expires? And so you can think of it as it's like we're using AT minus 2 as the control level of the investment, and think about how are they changing investments? And is the change in investment non-monotone in that kind of pattern?

And what are some of the findings? And again, we're very conservative in this paper in looking for general tests of non-monotonicity, non-parametrically, rather than just putting in quadratic functions. And so nothing's all that significant. But there are a few places where it looks like we find these non-monotonicities.

The first is in the detail in journal advertising. When you just graph them versus the market size, it looks like the detail advertising-- these are just the means-- the detail advertising is relatively low for the second quintile drugs relative to the other drugs.

And the journal advertising is relatively low for the second quintile drugs relative to the other drugs. So it looks like there's this cross-sectional pattern in the detail in journal advertising where in these second quintile drugs where the entry is uncertain, there is lower levels of advertising. But marginally significant once you test it non-parametrically.

And then the other thing we look for is how are things changing as patent expiration approaches? And here, we get some marginally significant results on the presentation proliferation and on the journal advertising. The journal advertising is going in the wrong direction, but the presentation Herfindahl, there's some evidence of the presentation proliferation also going up for these second quintile drugs. This looks like they're introducing new versions of the second quintile drugs as the patent is expiring that they hadn't introduced years before when they were monopolist.

Questions? Comments? No? OK.

So the third paper, this one I'm going to do super quickly. Goolsbee-Syverson is-- it's another reduced form prediction paper looking at some prediction that would hold for strategic models versus non-strategic models. The prediction that they explore is, how do firms change prices when they become threatened by Southwest's entry even though Southwest has not entered?

And so what's really nice about this application is, imagine you have a market-- so we have a market that Southwest is not currently serving, like flying from Boston to Nashville. And there are no flights on Southwest from Boston to Nashville. And the current carriers serving Boston to Nashville are completely unscared of Southwest entering and competing with them because Southwest doesn't have any operations in Nashville.

They have no gates there. They have no aircraft there. They have no employees there. If Southwest doesn't have any employees in Nashville, it's unlikely they're going to just start a Boston to Nashville flight.

But suppose Southwest does operate out of Boston. Suppose Southwest were to announce, we're moving into Nashville, and we're initially going to fly Nashville to Miami, Nashville to Dallas, Nashville to Las Vegas, Nashville to LA. Well, then, if you're the carriers on the Boston to Nashville route, you become scared that Southwest, now that they have operations in both Boston and Nashville, are they going to start serving the Boston to Nashville market?

But the nice feature that Goolsbee and Syverson note is that Southwest both announces that they're coming to Nashville five months before they come to Nashville, and when they announce we're going to come to Nashville with these routes, so you know they're not serving Boston to Nashville. And so what Goolsbee and Syverson say is, let's imagine that firms are trying to keep-- that once this happens, suddenly United Airlines has an incentive to try to keep Southwest out of the Boston Nashville market. What might they do?

They're looking at, again, this limit pricing thought of they could start limit pricing and cut their prices on the Boston to Nashville route to signal to Southwest that they have low cost and tell Southwest, you should stay out of Boston Nashville. And the nice thing about it is you can look at, do they do this five months before Southwest is even operating Nashville to Miami? So you've got this long period before anything has actually changed in the airline market where it's just the threat of entry has changed. And we look at with that threat of entry changing, does United start changing its pricing, and changing price in a way that looks like it's limit pricing or something to keep entry out?

Anyway, the interesting results in the paper are that this does seem to go on. So as they said, Southwest typically announces it's coming into an end point airport like five months before it does. And if you look at-- so in this case, Southwest has announced that it's coming in at time T0. And what you find is that eight months before, you don't pick up anything. But then seven, six, five months before, you pick up the airlines having lowered their prices by 7%. It goes up to 10%.

And then by the time Southwest is almost in Nashville, United's prices end up 13% lower than they were before the entry occurred. And again, this is entry not competing directly on the route. This is just threat of entry causes this 13% decline in prices. And prices are then even lower after Southwest gets to Nashville, and then lower still if Southwest actually comes in and starts competing with United on Boston to Nashville. But what they're finding is that there are these price declines well before anything has actually changed in the markets other than the future entry possibility.

So I think it's a striking finding. It's not perfectly clean as a reduced form prediction of they must be behaving strategically because this is a model that would have a competition effect. If United knows that Southwest is coming into the market, then it knows that it's going to be in a duopoly instead of a monopoly in the future. It, therefore, might want to behave in a way that's good for it in a duopoly relative to what's good for it in a monopoly.

Now, my first thought would be, actually, that one could even go in the other way. And it could be they want to raise their prices because of the competition effect. Because if they've been trying to build customer loyalty over the years, and build frequent flyer miles, and get people to spend a lot of money, it could be that, again, you just start eat your loyalty.

It's like, OK, people have good feelings about us. Good feelings are going to be worthless to us. Let's just go ahead and make all the money we want-- $2,000 to fly to Nashville. We'll take all our goodwill. We'll burn it in the next six months, and then be done with it.

But it could also go the other way if, by keeping prices low, today people are loyal to United, and don't ever try Southwest, and find out what it's like to fly without having a reserved seat. And maybe you want to build up the customer loyalty and not get them to try-- get them so they don't feel like they're not angry and wanting to try Southwest. But anyway, and then a second problem is that the pre-entry stuff, I think, is really nice. The post-entry estimates, there's always this concern that while Southwest is not flying Boston to-- they eliminate markets where Southwest is flying-- where Southwest announces Nashville to Boston, they also would eliminate if Southwest announces Nashville to Miami, and then they already fly Miami to Boston. But they don't eliminate it if you can go from Nashville to Chicago, and from Chicago to Washington, and then from Washington to Boston on Southwest.

Those markets, they don't eliminate. People who fly Southwest sometimes do things like that. So it could be there is actually some mismeasured real competition there that causes from people taking these multi-leg Southwest journeys to compete with the Boston Nashville flights that United has. Any questions?

So the thing I wanted to finish off today is talk about, I think, a very nice recent paper by Sweeting, Roberts, and Gedge on dynamic limit pricing in the airline industry. And this is very much, again, I think I say over and over again, you don't have to be really original to succeed in economics. You can just take a good paper and do it better.

And so what Sweeting, and Roberts, and Gedge are doing is looking at pricing by incumbents when Southwest is threatening entry, and trying to understand, does the limit pricing story really hang together to explain what we see in the pricing in the months before Southwest enters a market? So what they do is they start out, they discuss a theoretical model in which the limit pricing would make sense. They do a test of reduced form predictions of that model versus a non-strategic model, and then they do a structural estimation. Are the magnitudes here are sufficient to explain those 13% price drops that Goolsbee Syverson reported?

So anyway, what's their model? So it's a multi-period Milgrom-Roberts limit pricing through signaling your cost model. So the incumbent has some marginal cost of carrying passengers, CIT, and it follows some Markov process on an interval, C lower bar, C upper bar. And we're going to assume it's a highly persistent Markov process, like an AR1 process with a coefficient close to 1.

So costs are following an AR1 process on this interval. So at every point in time, you're always uncertain about what United's cost is because it's always different, and it's evolving. Southwest has a fixed entry cost KT, and it's drawn i.i.d. from some density in every period. And so there can be periods when it's good for Southwest to enter and bad for Southwest to enter. They're going to be more likely to enter when their costs are low.

And so at each time, T, the incumbent chooses some price. It earns some profit. Southwest observes a price they charge, but doesn't observe the profit or the cost. And then Southwest learns what its cost draw is for entry costs, and then it decides to enter or not.

And if it enters, there's duopoly competition with now commonly observed costs in all future periods. And firms just play the static Nash equilibrium of all future periods. If Southwest doesn't enter, then they just wait, and they can enter again next period if they get a good cost draw.

So notice that Southwest, even if a market is profitable, may want to wait some number of periods to come in to wait for a good cost draw. And obviously, they're going to be more likely to come in if they think that the incumbent's cost is high. This is a model where the incumbent's cost is bouncing around on some interval, C lower bar C upper bar, and Southwest just has some other different costs, which I think we think of as down here.

So we think of Southwest as being a lower cost carrier than United. So it's such that if United's cost is down here, Southwest is going to say, our cost advantage isn't big enough to pay all the fixed costs of buying the gates and hiring the employees. If United's cost is up here, Southwest is going to want to come in and compete with them.

And this Markov process, like Milgrom and Roberts was this one time, you price low to signal your low cost, and then they learn your cost, and then they enter or not. Here, there's just this perpetual incentive to always signal your cost because there's always a new innovation to your cost. And that creates this incentive to continually limit price, limit price, limit price to always make them think your cost is low.

So the first thing they do in the paper is-- it's a non-monotonicity test, and it's motivated by the limit pricing model. The model predicts that limit pricing is going to be most important in markets that have an intermediate entry probability. If you have a market where there is a very low entry probability, then you're not going to bother limit pricing.

If there's a market where there's a very high-- so the service from Boston to Billings, Montana, there's no way Southwest is going to start flying Boston to Billings, Montana. It's just not something of the kind of market they serve. There, you don't need to limit price.

If they've just entered Las Vegas and they're not serving it yet, you know sooner or later, there's going to be a Boston to Las Vegas flight on Southwest. There's nothing you can do to stop that, so you don't try to limit price there. But maybe Boston to Nashville is an intermediate sized market where you could try to make that one unattractive.

And so what they're going to say is, do incumbents drop their prices most in markets with an intermediate entry probability? And so this is pretty simple, again, econometric exercise. They just have a first stage regression where they regress the probability of Southwest entry on market size, concentration of whether the endpoints have dominant carriers or not, how it fits with Southwest's network, other explanatory variables. So they have a first stage regression trying to understand where it is that Southwest enters.

And then the second stage, so PM hat is the predicted entry probability. And so what they're looking for is this-- I think this sounds for Southwest post entry. They're looking at is price being reduced after entry in markets where there's an intermediate entry probability which you would get from the beta 1 being negative and the beta 2 being positive? It would be saying that dips down and has low prices in those intermediate sized markets. And so they just estimate this entry probability based on market characteristics, and then they look at how the prices change related to that.

And pretty clean results that those 13% price declines are relatively larger in the intermediate entry probability markets. So what you get is-- and they give many different versions of this, but the simplest one is just log of price. You regress-- This is the change in log price after entry, and you see that its interaction with the probability of entry is a negative coefficient on the probability of entry, a positive coefficient on the probability of entry squared. So it's as if that effect is something that goes down like that and then goes up like that.

Another thing they do, just on the quantity side instead of on the price side, is look at how full are the airplanes. Are they sending off full or empty airplanes? And again, this one, as you would expect, it goes the opposite way.

So this is the price. If you look at how full the airplanes are, that one goes up and then down so that it's your more filling up the planes in the intermediate sized markets, which presumably you fill up the planes by charging lower prices. And all the others seem to go same way. But the story seems to be that, yes, it is the intermediate sized markets where you're unsure if they're going to enter, where the price declines are biggest.

And then the final thing they try to do is a structural analysis. So what they're trying to do is take that Markov model they wrote down, calibrate that model, and see whether that model explains what it has. So in particular, what they're often trying to do here is trying to not use the data in the threat period, calibrate the model using data from either the pre-period before Southwest announced, or after the Southwest entry, and then show that we can calibrate this model. And that model actually does predict price declines close to the actual price declines.

So it's an exercise of saying, we're going to take this model. We're going to calibrate it using the data that we have not from that strategic investment period, and then say, what does it predict should happen in the strategic investment period? And yes, it does seem to predict the data pretty well.

And then once they have it, they also use it to discuss some welfare questions because it's going to be a model that you get back consumer utility and prices out of it. You can estimate deadweight losses, and see how they change, and talk about the welfare effects of this limit pricing.

So how is this done? So they restrict themselves to 109 markets. So these are 109 city pair markets, and they're all doing-- to get as close as possible to this monopoly case, they're doing 109 markets where there's one carrier that has a dominant share before Southwest comes in.

Many markets, there are multiple carriers serving them. But if you pick smaller city pair markets, a lot of them that have one carrier doing most of the traffic. So you can think of it as there's a monopolist, and then the monopolist might be competing with Southwest.

What they assume is that demand is a nested logit model where you have the outside good of not flying in one nest, and then Southwest versus United in the inside nest. And then they estimate that model using data from before there's any threat, and using data from after Southwest has entered. And then you're just observing the competition between the other airline and Southwest.

And where do they get the IVs to do this? In the pre-period, It's fairly easy. In the pre-period, they're getting the IV for your price from fuel prices. When fuel prices go up, airlines raise prices. When fuel prices go down, airlines lower prices.

Looking at how demand changes with fuel prices, they estimate substitution between the inside good and the outside good. And then for the price competition between Southwest and United, they're not as great endpoints, but it's like, using United's endpoint shares, and where United has bigger shares at the endpoints, they're going to tend to set higher prices. That's going to change the relative prices of Southwest and United.

Then the marginal cost, going back to what Tobias lectures, if you first estimate the demand elasticities, and then you assume that firms are pricing optimally, you can back out what the marginal costs are. So they do that kind of approach where they first estimate the demand elasticities. Then given the demand elasticities, assume price firms are pricing at the static optimum. They back out what the costs are.

And then once they get a cost period by period, they just run regressions on them to estimate AR1 coefficients and find if they're serially correlated. And then for entry costs, they just take a subset of the data using 20% of the markets, and they just say what distribution of entry costs-- given the demand estimates that we have and the profit function we've estimated for Southwest, what entry costs would rationalize the observed level of entry and the observed correlation between entry and market size? And they estimate the entry cost distributions to match that to the data. So that's where the primitives come from.

What do they look like? OK, so here's what they look like. The demand estimates find that these goods are close substitutes. After entry, the average own price elasticity for incumbents is minus 2.9. So you're still going to get 30% markups over marginal cost, but demand is fairly elastic after people start competing with Southwest.

The marginal cost estimates suggest that the traditional carriers are much more expensive, much higher costs of operation than Southwest does. The marginal costs are averaging 258-- the backed out marginal cost average 258 for the incumbents, and 168 for Southwest. So it looks like Southwest has a big cost advantage, which reflected comes out in the data of you see Southwest just pricing much lower than their traditional rivals. And when you do the serial correlation of the costs, it looks like costs are very highly serially correlated over time.

And now on the calibrated entry costs, they just say that we can match the-- this graph here is putting two things in the paper. On the x-axis they've gotten the-- x-axis is the predicted entry probability from a regression of entry on market characteristics. The y-axis is the predicted entry cost that comes out of the theoretical model with the entry cost they've calibrated to make the two curves as close to each other as possible. And they notice that they can make these two curves look very, very close by picking an appropriate entry cost distribution. So it's both measuring the-- you have to match both the level of entry and the correlation between entry and market size, but it looks like they're able to do that.

So two things they then do with the calibrated model. One is, does this model-- is the limit pricing story explaining how much limit pricing is going on in the data? So panel B here is the data. How much are incumbents reducing price as a function of the probability that entry will occur within the first four periods?

And here, I guess you can see the data in theirs must apparently be not quite as large a price reduction as-- maybe it's fine if these are things. It's like, we're getting in these intermediate size markets. We're getting 13% or 14% price reductions.

In these markets with very low entry probabilities, we're getting like 4% price reductions. And then in very big-- in markets where there's almost sure entry, although there are very few such markets, they're getting price increases. So that's what the data look like.

And then this is what the model predicts. The model predicts that in very small markets you would have very, very tiny price cuts-- just a couple percent. In the intermediate sized markets, you would have 17% price cuts. And then as we go to this extreme, we're getting 9% price cuts.

So again, it's not like the model is exactly fitting the data, but the model is-- it's the model that they've estimated not using the pricing data from the period when the threat of entry occurred. And this is what the model predicts will happen in that threat period. And this is what did happen in the threat period, and they argue that it seems like quantitatively, the model is doing a pretty good job of explaining how much limit pricing there is. And so we'll say, they think the limit pricing is explaining why this is-- the signaling is explaining-- could be explaining-- let me say, signaling is of the right magnitude to explain why this is happening.

And then the second thing they do is talk about what are the welfare effects. And I guess, not surprisingly, limit pricing is really good here compared to a model with known incumbent costs. Because those limit pricing models are like this-- if you think about relative to complete information, firms are pricing a lot lower, and they're not affecting the entry much.

And so you know by pricing lower, there's a substantial increase in consumer surplus from the limit pricing. There's a loss in incumbent profits from the limit pricing, but essentially, we're eliminating the deadweight loss. And so by limiting the deadweight loss, we're making things much better.

And the only place where they argue that this doesn't happen is in the very large markets where there's much limit pricing going on. There, there's not really much of a welfare gain because the incumbents don't really do much limit pricing. But in general, the limit pricing just lowers prices. You have these consumer preferences where that reduces deadweight loss. This limit pricing is a socially beneficial thing.

OK, questions? No? OK.

So I just want to say, very nice structural paper on entry deterrence. Stephen Ryan has a very nice paper. I'm leaving it for [14.]273 because it uses a lot of methodology that's covered in [14.]273.

But the basic thing of Stephen's paper is looking at when you raise environmental regulations, one of the costs the environmental regulations, is they make entry more difficult. But then the incumbents don't have to strategically deter entry anymore, so you can get much higher pricing as an additional cost of environmental regulation. Anyway, that's covered well in [14.]273.

So next week, again, might shift gears. Next week, I'm going to talk about bounded rationality. Not 100% sure what I'm going do with those two lectures. I may mix them up somewhat. But anyway, next week, I'll be doing something talking about bounded rationality.