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Antitrust Economics Workshop
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Panel 4: Structural Modeling and Antitrust Current and Future Applications

Moderator:
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Panelists:
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MR. KEYTE: We're going to get started on

the last economics panel of the day, sponsored by The Brattle Group. I take off my Fordham Competition Law Institute hat, and I now put on my Director of Global Development at The Brattle Group hat for this panel.

I'm excited about the panel because I've been somewhat exposed to this subject of structural modeling, but I think to many it is either not heard of or somewhat mysterious.

So my first question is — show of hands, not being bashful — how many of you believe you know what structural modeling is?

[Show of hands]

Okay, a couple of economists, and that's all we have. That's good. That's very good.

Well, you're going to find out something this afternoon because we have really an incredible panel of economists and practitioners.

First, two to my left, Dr. Ariel Pakes at Harvard, who is, for those in the know, coauthor with Steven Berry and James Levinsohn of a fundamental

paper in this area, the "BLP paper," which may be in some sense described or not.

Dr. Ali Yurukoglu out of Stanford at the far end also has a seminal paper, the Crawford and Yurukoglu paper involving de-bundling of media, for those in the know.

To my left, Art Burke at Davis Polk, who has actually litigated structural modeling, which was the first time, and it doesn't happen very often. Art also does merger work.

Ken Schwartz, my former partner at Skadden Arps, has to deal with all types of data, modeling, and what economists like to do at the Department of Justice (DOJ) and the Federal Trade Commission (FTC), and so has been exposed in various degrees to this kind of analysis.

I'm going to turn it over right away to Ariel and Ali — they can divide it up how they want — to first describe what structural modeling is and what do you need to do it, and then we'll hop into some

follow-up questions from that.

PROF. PAKES: Ali and I made slides. I didn't know quite what to do, so what I decided to do is —

[Slide] Structural modeling is a way of doing things. It's not any particular thing. What I decided I would do is go over one example and then compare it to what you would do on the same example if you weren't doing structural modeling and show you the advantages of doing structural modeling. The simple example is going to be a merger analysis.

[Slide] The big advantage of structural modeling is it gives you a consistent framework to do counterfactuals — or but-for modeling, if you like. What "consistent" means in this context is the conclusions follow directly from the assumptions. In the case I'm going to go over now, the assumptions and limitations have been studied.

The advantage of the conclusions following directly from the assumptions is you can actually

question one of the assumptions and we can see how it changes the result. Straightforwardly, hopefully.

Let me give you the classic example. How do we analyze price setting? I need three things to analyze price setting:

• I need a model that tells me the demand for a given product, given the prices and characteristics of all products that are being marketed. That's what we call a demand system.

• I need a model for the cost of producing those products. These are two things that have to be estimated. They are primitives.

• Third, I need an assumption on how prices are set, given the demand for these products and the cost for the products.

[Slide] The assumption derives from John Nash, who won the Nobel Prize for it. It is a rest point. What each firm is doing is it is choosing a price to maximize its profits given what every other firm is doing, and every firm is doing this.

Why do we look there for the rest point? It's because if a firm is doing the best it can given what everybody else is doing, there's no reason for it to change its actions. If there was a firm that wasn't doing the best it can given what everybody else was doing, so it wasn't in a Nash equilibrium, you would expect it to eventually change its price. The rest point assumption is a natural place to look for how prices would change.

If you were setting prices, the rest point actually is very intuitive. The way you get it is the following: You increase the price of a good by a dollar. For everybody who stays with your good and doesn't leave you get an extra dollar. For those who leave you lose the markup price minus marginal cost. When those two things equate, the equilibrium is there.

I keep on increasing my price as long as I get more from the people who stay than I lose from the people who leave. What do I lose from everybody who

leaves? The markup price minus marginal cost.

That's the characterization of equilibrium. If you get that, you've got a Nash equilibrium.

[Slide] I want to show you how we have done and why we use this. It's easy to check whether this notion of pricing equilibrium makes sense in a given market provided you have the demand system and the cost system.

Let me say the disadvantage of going this route is that it takes data and time. It's going to take more time and more data than the standard way of doing things, which I'll come back to in a second.

It's easy to check because if I do have a demand system — and that's where this BLP stuff comes in — the price should equal cost plus a markup. You're going to keep on increasing the price until this condition is met; and as long as you have marginal costs — you know price equals markup — the increment of people will equal the markup. The gain from the people who stay will equal just the markup,

and you can take the markup directly down from the demand system.

[Slide] Let me give you an example. This is a paper that just came out in the *American Economics Review* by Tom Wollmann. Somebody referred to the last paper of Tom Wollmann in the morning when I was here.

He had a separate demand system. We regressed the prices on the determinants of cost that he had in his data and the predicted markup that came from this separate demand system. Then we look at the fit of this equation: how well does it do?

The coefficient of the markup, which we take directly down, should be 1. That's what the theory says it should be. Then I'm going to look at how well we fit over time.

Let me just say, given the demand system at least, he didn't have measures of cost. Typically for economic research cost is proprietary. But if we're at the Department of Justice, they can sometimes requisition it, so you might be able to do better than

this.

[Slide] These are the estimates. I want you to look at two things. This is a published paper. We took the demand system from the published paper and did these regressions.

You get an R^2 of either 0.86 (if you don't put in time dummies) or 0.94. That's about as good a fit as any equation in the social sciences, period, never mind economics.

It's true that it's a cross-sectional relationship and there are big differences in the characteristics of these different products, but when you go over time, nothing is changing for a given product over time, same characteristic exactly over time. And the cost functions don't change, just wages is the only thing, and they don't change.

[Slide] So the only thing that's changing is the markup. How is the markup determined? It's determined from the demand system, and it's determined depending on who's competing with you. Therefore, the

things that are changing the markup over time are just the number of competitors and where they are, how close they are in characteristic space to your product.

When you do that, you still get 60 percent R^2, which again for the social sciences is incredibly high.

[Slide] Now let me go back to the merger analysis. I told you how these prices are set, and I showed you that it sort of works, at least in this one case. Actually, it works in many cases, which is the reason it has sort of taken over.

What happens after a merger? Say two products merge. Now I'm going to increase my price by a dollar. I get a dollar from everybody who stays. Some people leave. I lose the markup on those people, on my first group, but now some of them go to the other good. Is that clear?

Seeing some of them go to the other good, I don't lose so much. I get the markup on the other

good, and price keeps going up, and that's the reason prices are higher after the merger.

You can show just by writing down the thing that in this Nash equilibrium after the merger the amount the price goes up is a function of the diversion ratio, the fraction of the people who leave who go to your second good. That's all that is.

You take all those people who leave and look at how many are going to go to the second good (that's the diversion ratio) and then the markup on the second good, because if the markup on the second good is very high, you keep on increasing price because that's where you're getting it back.

If we have the demand system and the current prices, we can compute merged prices. Again, you have to have the demand system and you have to have the current prices — that's nontrivial — but once you get it, it's pretty easy.

[Slide] What would you compare this to that came before? There are two, really.

There is the Herfindahl-Hirschman Index (HHI), which is an index of concentration in the industry. What's wrong with the Herfindahl-Hirschman Index? You can derive this index exactly from a theory when all the goods are exactly the same. Different companies are putting different quantities on the market, maybe because they have different cost functions, but the goods are exactly the same.

Where the Herfindahl-Hirschman Index comes from is you're assuming that goods are either perfect substitutes, so if you increase the price a little bit everybody goes to the second good, or they're not substitutes at all. If they're perfect substitutes, they go in the denominator of the Herfindahl-Hirschman Index; if they're not, they don't count at all. Is that clear?

That's just never true. Goods actually are a partial substitute. There is a fraction of them (the diversion ratio) that is between zero and 1, and you can never get an accurate measure of market power

from this thing.

Moreover, it's going to end up leading you to unnecessary debates about what's in the denominator. Is the thing in the denominator or not? Really, it's just partially in the denominator at some level.

[Slide] That was what was wrong with the Herfindahl-Hirschman Index. I'm not the first one to know this.

The thing that came later was this Upward Price Pressure (UPP). What is Upward Price Pressure? It's just what I told you a second ago: it's a diversion ratio times the markup of the second good. That's all it is.

The reason that you've heard about it is sometimes it can be approximated without doing the whole demand system. Especially for producer goods, you can go ask producers, "What fraction would leave if you increased the price by $100 — or whatever — $1000, whatever it is?" You can get some idea of what

the diversion ratio is without estimating the whole demand system.

It's much harder for retail goods, by the way, because for retail goods you have to have a real sample of all the people who are going to choose. It has to be random. For producer goods you might know actually who are the people who consume this good.

It's an improvement over HHI because it takes into account what partial substitution really is.

The problem with it is it evaluates everything at premerger prices, so it takes the markup premerger and the fraction that would move premerger. Is that clear?

So, what's really happening with the merger is it's true that one will tend to go up by the markup times the diversion ratio to the second good, but the second good is also increasing its price. Is that clear?

That will feed back into the first good. If

you just do the diversion ratio on the first good, it's not a Nash equilibrium for the second good. It was a Nash equilibrium before — it was doing the best it could — and now you've changed the second good's price, so it's not a Nash equilibrium anymore. Therefore, you have to solve for it jointly. That's what's called the diversion ratio.

The UK Competition and Markets Authority (CMA) has started to look at that. It's still partial because it holds other competitors constant, just the two goods it does together, but again it's a step in the right direction.

[Slide] I'm going to give it to Ali now. You can go from this to much more complicated things, but Ali will start that. Maybe I'll come back.

Another one of the things that have just started to be used, and actually we're using it in stuff, is vertical markets. Ali can talk to you about that in bundling.

MR. KEYTE: Ariel, let me ask you one

question, though, before you –

PROF. PAKES: One more word and then you can ask.

Let me just say that the other thing that is pretty easy to do if you have a demand system is product repositioning, which is something that has been ignored largely in court cases, and I can show you industries where I know it's of vital importance. People can reposition products faster than they can move prices in several industries.

MR. KEYTE: That was going to be my question. Most people who have done at least merger work are familiar with UPP and its tendency to be static and not account for supply responses from other competitors, new entrants. How do you model that?

PROF. PAKES: Let me just say there are partial models for all of that. I want to give it to Ali so he can tell you about vertical stuff. I think Ali might tell you something about entry also.

The more you get into it, the harder it is

and the more assumptions you're going to have to make. When making assumptions, at least you know what you're assuming when you get an answer. So, it's not necessarily bad, but it does take more time and it does require more assumptions.

We can do entry. I'm doing it right now actually.

PROF. YURUKOGLU: Good afternoon. Thank you to the organizers for inviting me. I also prepared some slides.

I'm going to take a step back. I was asked to talk a little bit about the ingredients that go into a structural model.

[Slide] I just want to give a high-level overview of those ingredients, basically three steps: a specification, a model estimation, and then a simulation. I'll discuss what's good about doing things this way and what are the pitfalls.

I have a running example of thinking about the question of: What would happen if the government

regulated unbundling of cable television, which is a paper I wrote with Greg Crawford several years ago.

[Slide] These empirical economic models — that's what I like to call them more than the term "structural"; I think structural is hard to understand, and people react weirdly to it, so these are really just empirical economic models.

There are three steps:

• The first step is you have to specify a theoretical model of consumer and firm behavior. As Ariel alluded to, this can be very general. You can have many different effects. It gets harder the more effects you add. The most well-trodden path is merger simulation, where basically there are consumers like us buying stuff from firms that sell directly to them and the set of products is fixed.

I'm not going to get into the details of most of this stuff. This specification ends up being a system of mathematical equations with lots of Greek letters. Ariel worked out a lot of this stuff in his

career and did a lot of important work.

At the end of the day you get a map — it's on the computer — where you plug in inputs like: How much do consumers like this product? How much does this product cost to make? You get outputs like prices and market shares.

• The next step is to estimate the parameters of those models. For different parameters you'll get back different answers for what prices ought to be and market shares ought to be in the market.

• The estimation step is to discipline the model by choosing the parameters so that the predictions of the model match what we've seen previously in the data. We're calibrating the parameters of the model so that we're predicting what has happened in the past, and that gives us the confidence to then take that model and those parameters and simulate alternative scenarios by changing the rules of the model. For example, you can

take a firm out or you can merge two firms, and those parameters will give you a prediction for what should happen now.

[Slide] I'll talk a little bit more about this, but at a high level the benefit is being able to explicitly use economic theory and state your assumptions. Furthermore, it allows you to combine related data sets, data sets from different areas of the market that regression analysis or UPP analysis might not be easy to combine.

The downside is that these are very computationally intensive, and they have many assumptions. That combination means it's hard to test the robustness of those assumptions. Sometimes it's just very costly to try all the different combinations of assumptions, and you're open to the criticism that, "Well, if you change this assumption, this might not work, but you didn't have enough time or resources to try that and see what would happen."

[Slide] Here's the example of cable

bundling. Think circa 2005 — so before Netflix, Amazon, all that stuff — there were movements to mandate unbundling of channels, actually coming from Republicans in Congress for a variety of reasons, and there was an antitrust case.

The thing is we've never actually seen unbundling happen — in every country the TV providers bundle — let alone in many comparable environments, where you could do sort of a regression analysis and see what a bundled world would look like compared to an unbundled world.

How do we evaluate such a policy using economics and data? It seems like something an economist ought to be able to say something about. It's not a crazy question.

[Slide] This is how we do it. We build a model of the industry. We bring in data on that industry — basically how much time do people spend watching various channels, how much money do they spend for products, what packages do they buy — and

then we combine that with economic theory to get this machinery to simulate unbundling. We can actually get an answer this way.

That answer comes with all the assumptions that go into the model, but you can discuss those assumptions, you can debate those assumptions, and actually get an answer.

MR. KEYTE: Ali, let me ask you one question in the middle of that. What if you can't replicate when you start the actual world? How much are you allowed, in a sense, within the profession, the industry, to assume certain things away to get it to solve, to get it to replicate before you import the change?

PROF. YURUKOGLU: There are multiple levels to that question.

Imagine you had all the data you could ever want. In that hypothetical world, if you can't replicate the previous world, then I think you're not good enough at modeling to be engaging in this

exercise.

There's another world where you made your discovery or request for a bunch of data, and you get a bunch of data that's not very good, and you're stuck. Then you start making assumptions, and I think we should allow for not matching every possible feature of the world.

MR. KEYTE: We'll talk to the lawyers here about some of the *Daubert* issues that are raised by that.

PROF. YURUKOGLU: I don't want to dominate the whole discussion, but let me just quickly run through.

[Slide] In the cable bundling specification, here's what the model has to tell you in words.

You have to say, "Who are the agents?" The agents are the entities in the model. You have consumers like us who buy TV; you have the cable and satellite distributors; and you have the content makers. That's one way to cut off an industry from

the rest of the world. Those are your players.

You have to ask, "What are those agents allowed to do?" Consumers can choose what package to buy, what channels to watch, how much time to watch each channel. The cable and satellite firms can choose what prices to charge and what channels to include, what packages to offer. The content makers can, for example, negotiate prices with cable and satellite distributors.

There are some actions that they take in the real world that I've left out here because it's a model, like content makers deciding how good or how many programs to make.

Then you have to ask: What happens? What are their payoffs? What is their benefit of taking certain actions when other agents take other actions? Consumers want to entertain themselves and not spend too much money, and firms usually just want to make money.

Finally — and Ariel talked a bunch about

this — you need some equilibrium notion that pins down what actions are going to be taken by each of the agents.

[Slide] The next step is the estimation step, which James asked about. In the cable case, you input tastes for channels, like how much do people like different channels. You can have heterogeneous agents, where some agents like ESPN, some like The Food Network, some like a little bit of ESPN, some like a little bit of The Food Network. When you put in those parameters, you get back what prices and choices should be according to the model, and you just rerun the model over and over at different levels of those parameters until you're matching what you see in the data.

If you tried to put in parameters where people really love The Weather Channel, then your model would say, "Well, The Weather Channel's price should be really high." But when you look at the data, The Weather Channel's price is not very high, so

your model is going to say people don't like The Weather Channel that much.

That's the discipline.

[Slide] In the bundling example we match things like the market shares for each package in each local market, the prices charged by the cable and satellite operators, how much time was being watched on each channel, the spread or the variance in time being watched on each channel — some people watch an hour of ESPN a day; some people watch ten minutes — and so on.

We did that for about five years of data. Again, there are lots of details that Ariel worked out for how to do it that we don't have time to cover.

[Slide] Then you get all that and then you run your simulation. This is your but-for world. You have your model, you have your parameters, and you just change something in the mathematical system to mimic what you want to examine.

The key additional assumption here is that

the parameters are invariant to the change that you're considering. If you want to consider unbundling, the assumption is that if we were to force unbundling, people's tastes wouldn't change; people wouldn't all of a sudden like more ESPN or like more The Weather Channel. That's the invariance assumption.

[Slide] What we did here is we said in the context of the computer simulation: "Okay, cable providers, satellite providers, you can't offer packages; you have to offer a price for each channel."

[Slide] Then we just ran the whole equilibrium and got back an answer. You end up with tables like these. One of the benefits of this is that you can talk about very specific outcomes for different types of agents.

But, just focusing on the bottom, this is what we estimate under bundling, that 88 percent of the country was subscribing to cable. Back then they were paying about $30 — this is year 2000 dollars — and we had measures for consumer surplus and industry

profits.

Then we do the counterfactual simulation. We did two counterfactual simulations. This one I'll talk about later.

This is a counterfactual simulation forcing bundling but holding all the prices of the content fixed. They set a price. Comcast has to offer à la carte pricing, but the price between Comcast and ESPN is fixed in the input rates. There we predict that consumers would be way better off if you were to ban bundling.

There is a next step in that, which I'm going to defer for a little bit, where we then add in the content market, and that's the next part and the answers change. But that's the overall procedure.

[Slide] The benefits: Integrate data with economic theory closely. When you're doing that you make the assumptions about each agent's behavior explicit. Often these legal discussions, or in the regression analysis, it's very murky what assumptions

you're actually making. It's hard to figure where the disagreement is. You can stimulate outcomes for situations you haven't seen before, and you can measure benefits that are defining the model, like consumer welfare.

[Slide] The caveats:

• They are computationally costly. My papers take years to write. The models sometimes take weeks to run, and then, if you want to change one thing and see what happens, that's another three weeks. It can get expensive.

• Data requirements? They don't require that much different data than other — I actually think the data requirements are looser. Through the context of the model you can bring in related data, but they are unforgiving when you have things like missing data. If you're missing data for one firm in the market, what do you do there? It makes it very stark that you have a problem.

• The final thing is, of course, economic

theory is not fully developed in many of these areas. We write down these models, multiple sets of assumptions that are a priori reasonable, and you start arguing about them, and then you're in this —

MR. KEYTE: One question I have for you before we talk to the lawyers. What if in your model, your counterfactual, you're creating new vertical relationships that might result in double marginalization? How do you model those things, changes in a sense — and maybe that's what you were referring to in the content side — changes in the supply chain as part of your counterfactual?

PROF. YURUKOGLU: I want to talk about that.

[Slide] I was talking about a but-for world where all you're changing the distribution to consumers, and I said we're holding fixed the content stuff.

You asked me to talk about what's ongoing and what's coming up next, and that's when I was going to talk about the upstream market in that context, but

I'll definitely get to that.

MR. KEYTE: Let's turn to the lawyers and first ask the basic question of Art and Ken: Did you know this was going on at all, and to what extent; and how have you been exposed to this kind of modeling versus what are just either straight regressions or natural experiments or just correlations? What has been the exposure, if at all?

MR. BURKE: I think the answer is it's fairly limited. We can talk a little bit about the *Major League Baseball (MLB)/National Hockey League (NHL)* case that we worked on where this did play a central role. But I would say that it did actually play a big role in the *Cigna/Anthem* case where the DOJ relied on this kind of modeling.

But I would say it's a bit bleeding edge, and it certainly is not as widely understood as a lot of other kinds of economic tools that lawyers are more familiar with, which is why I think this is a terrific panel to further clarify and expand the understanding

of this area.

MR. KEYTE: Ken?

MR. SCHWARTZ: Absolutely right. It's something we run across. When I work with economists, we try to think about what all the arrows are we have in our quiver, and we always get a menu of "Here's the different analyses we can do."

As an advocate, we're also looking at budgets, and typically you'll start with some basic observations and then go into more complicated regressions. Always at the bottom the last couple of years was this merger simulation or some type of structural modeling. Typically, there was an extra zero in the budget column, and frequently the economists would say, "It's there and it's worth exploring, but let's hold off and see where the agencies are at."

MR. KEYTE: Do you get a sense — and again, you mentioned the *Cigna* merger, where they did a hypothetical monopolist test with structural modeling,

and then the other side was using regressions — that historically the DOJ or the FTC are using more of this?

Sometimes they have more time; they get a head start. Sometimes they're looking at the industry. And they have more data; because they have subpoena power, they get more information. Other than what you see that comes out in the occasional press release or something that's litigated, how long have you been seeing them — we walk in, and they're doing something you're not doing?

MR. BURKE: I think it is something that you encounter with increasing frequency. It does go to the fact that with subpoena power the agencies do have the ability to create more robust models than perhaps the parties do, given that they just perhaps have their own data and maybe the counterparties' data. But they don't have the rest of the marketplace. So, it's something where you're always at a disadvantage.

We've all been in those meetings where the

government says: "We've got this great model that shows your prices are going to go up, but we can't really share it with you. Just take it on faith."

MR. KEYTE: Have you seen a distinction between — UPP, when we were first exposed to, it I realized that my daughter in seventh grade could easily do if I gave her two pieces of information — no offense to those who do a lot of UPP.

Here you're getting more to at least the possibility, depending on the data, of really saying: "Here's how the current world is working from a demand side, from the cost or supply side." You remove something, and then — at least from some of the practitioners' perspective — it gets a little murky. In the counterfactual, how much can you do in a sense beyond UPP where you hold all that static?

MR. SCHWARTZ: My reaction — and James and I wrote an article on UPP that was slammed by many critics out there — you don't see the government presenting UPP as evidence at trial whereas you would

see these merger simulations being presented. I know Aviv Nevo presented in *Aetna/Humana*, and the court said: "This is directionally correct. It doesn't have to tell me that there's an exact price increase or what that price increase is, but it shows an incentive," and taken together with the other evidence the court found that compelling.

I still have yet to see the government stand in front of a judge and say, "Hey, we ran the UPPs; why are we here?"

MR. BURKE: To be fair, I think the UPP model was always designed to be a filter that was supposedly to tell you where you need to look in greater detail. It wasn't necessarily meant to be the ultimate predictor of whether a merger is anticompetitive or not.

MR. KEYTE: And there's no doubt that some jurisdictions have made it more of a presumption than others.

I haven't really tested this question to see

whether any of you have views. In *AT&T/Time Warner* —

PROF. PAKES: You should ask him about *AT&T*.

MR. KEYTE: I'm going to ask the question. What was that in Carl Shapiro's model — and Dennis Carlton addressed it — where does it fit in the world of structuring model? Is it 2.0, 3.0? Is there a different 4.0? But where does it fit? We all read about it, we read about the model, and we know how it was criticized by the court, and we know it's on appeal, so if you're obviously on the matter — perhaps not.

PROF. PAKES: Can I ask you one thing before we do? The only thing I want to point out is that computers have gotten a lot better. They're a lot faster. No, quite seriously. The data is better because of computers largely, and the people sitting at the DOJ and the FTC now have doctorates and have learned this stuff. It's true that it takes more time and it has not filtered through yet, but it's going to be coming in. That's for sure.

MR. KEYTE: I'll ask it a two-part question. Does anybody have a view of what you would call that, where it fits in in *AT&T/Time Warner*? And the second question is, what's the next variation of that?

PROF. YURUKOGLU: Okay. Those two tie into two or three slides I have here. Is it all right?

PROF. YURUKOGLU: Thank you.

[Slide] So you suggested that I talk about what's coming next. If you think about the sort of mode of analysis, it's very general. Merger simulation in a downstream market is the most-trodden path, but anything you can model and get data is potentially fair game. That could be things like adding an upstream market, like the content makers. It could be adding dynamics like investment, product positioning, and entry and exit. It could also be thinking about multiple complementary parts.

Think about the input markets, which relates to *AT&T/Time Warner*. If you could think about the mergers between — there was *Dish/DirecTV* in 2000, that

proposed merger, which was a horizontal merger there, and a horizontal merger with content going on.

You can also fit vertical mergers into here, but then you have to extend the model to have the channels, and you have to talk about what are the actions and the chaos of the channels. When we draw that out, it's very complicated. You can think about Comcast setting prices to consumers. What's going on there is a much more fee for negotiations. Everything is interconnected, what Comcast does with ESPN affects DirecTV, and what DirecTV does with [inaudible]. Everything is sort of in this interconnected bargaining world, so you need to model for that.

[Slide] We've built models for that. They're complicated, and that was the model that was at question in *AT&T/Time Warner*. I don't call that what the DOJ described. It's firmly in the world of structural modeling.

There's a question of how well done it was and whether that was the best evidence in that case,

how good the data was. I'm not talking about that. I'm not trying to provide any support for that.

But this is firmly in the world and fits into what we're talking about. They made a model that estimated the broader parameters, they simulated a vertical merger, and that's how they came up with their numbers.

[Slide] In bundling you had a similar thing. It wasn't a vertical merger, but you watch it and take into account what happens when ESPN and the content makers react to the regulation. When you do that you get numbers which are quite different. In fact, we found that consumers are basically no better off on average. The industry is a little bit better off, but consumers are no better off. There are winners and losers, but on average we didn't find anyone was better off for that data and that time period.

Another two places, in addition to adding input markets, which I think are really important and you're going to see over the next several years –

there are already people with their foot in the door, a lot of people knocking – is dynamics, such as entry/exit, channel quality. Like in the bundling, I assume that all the channels would have the same quality after you ban bundling.

In reality, some channels might go out of business and some new channels might enter. Some channels might invest more; some channels might invest less. That's the world of dynamics. You can model it, you can get data on it, and it fits. The problem is it's harder to model and it's harder to get data on it because these are long-term outcomes that require many years of data.

So, I would say that dynamics is the Achilles' heel of this analysis at the moment for antitrust.

[Slide] Another thing I think we're going to see more of is models of mergers between complements. I studied TV, so there was Sony buying Columbia Pictures, a TV manufacturer buying a movie and TV

studio. It wouldn't surprise me if we see proposed mergers like Apple/Spotify, Samsung/Netflix, that sort of thing — maybe not those exact ones, but those are complementary product markets where you'll have to model multiple product markets at once. Again, if you can get data on it or write it down, it's fair game.

That's where I think we're going.

MR. KEYTE: Ariel, just to reiterate — because I think the critical threshold issue is if you can get data on it — is the idea that you have to get enough data to replicate, to solve, to calibrate, for the real-world environment in terms of price shares or other characteristics? Is that the starting point?

PROF. PAKES: Let me just push on what Ali said and then I'll come back to that.

Parts of it, the dynamics, if you tell me who the entrant is going to be, I can evaluate entry in the same framework that I evaluated everything else. I can tell you whether an entrant — you have to tell me who the entrant is, its characteristics, what

kind of product it has, but I can predict whether he or she will make profits or not.

The issue that becomes difficult is when you don't know what is about to come down the road — such as innovation and probably part of the content — we really don't know what new content is coming. And we don't know the incentives, how the incentives will play out to generate new content.

Moreover, it gets harder for R&D and for all of the technologically progressive issues. It gets harder partly because when you're doing research on a particular product or a particular way of doing something — it doesn't matter how many observations you have, it may not be possible to do the thing, so errors don't average out like in the law of large numbers. Those kinds of things are the hard things.

You shouldn't get me wrong. It doesn't mean we can't do any of them, but there are some that —

we can do entry. We could do Ali's changing of the supply chain if you tell me which one

is going to change. Things like that we can do.

On the data side, at some point you come down to the question: can you do better than the next-best alternative? That's really the question. We never get it right. None of our structural models are right. The world is just too complicated for that. But the question is: can we give you a better answer than the next-best alternative?

You look at your data. I can remember when General Motors asked me to do a dynamic of what would happen if we put in certain kinds of cars? I told the vice-president, "You can do that better than me." Right now we're just not set up to do a good job on that.

There is a play-off. It depends what the other guy is — what can you get from the other way of doing it? Can you do better the other way?

I think HHIs, you might look at them, but you shouldn't use them for anything detailed. It's just ridiculous.

There are other things you might know. It might be from the documents that the firm produces you'll know stuff. There are lots of other ways of getting information, and it's just a question of what's better.

MR. KEYTE: Art, I wonder if it would be useful to talk a little bit about, in terms of information and data, the *Laumann* case, as it has been the only litigated case over is there a threshold met in terms of replicating the —

MR. BURKE: Yes. It's a very interesting case where this type of modeling was used in connection with class certification. The issue in the case —

MR. KEYTE: And we three worked on it. I guess we have to disclose that.

MR. BURKE: The issue in the case was similar to what Ali's analysis was. It was a kind of unbundling question but in a somewhat different context.

As folks may know, most of the sports leagues have rules that say that you can only broadcast your signal within your certain team radius, a certain designated market area (DMA), a certain metropolitan area, and if you live outside that metropolitan area, the only way you can get games from a team — if you're a Yankees fan and you live in Florida, there is a certain number of games that are on national networks, but otherwise you can't get the Yankees Entertainment and Sports (YES) Network with all of the games in Florida. That's not permitted by league rules to be sold. The only way you can get those games is if you buy an out-of-league package, which includes not just the Yankees but all the other teams in Major League Baseball. Let's assume it's pretty much similar for hockey and for basketball as well.

The plaintiffs in the case argued that was anticompetitive and, similar to some of the legislative calls for unbundling, they argued that "If

I'm a Yankees fan in Florida, I should be able to buy just the Yankees. I shouldn't have to buy a bundle that includes a lot of teams that I don't want to follow."

The difficulty in doing that is that there is no empirical evidence of what the world looks like when that happens, so there wasn't any kind of benchmark. A lot of things that we're more familiar with as lawyers, the usual economic tools that we think of for proving common impact in an overcharge case — you say: "Well, there's a 10 percent overcharge. Who was hurt?" — that kind of simplistic stuff just wasn't available.

The plaintiffs actually used a version of the Yurukoglu-Crawford model and adapted it, or attempted to adapt it, for this unbundling scenario. It was obviously challenged on *Daubert* grounds, a class certification, on a whole host of issues.

But the issue that got the most attention from the court was a question about whether there was

sufficient data to project the demand side. We were talking about each of these models has a demand ecosystem and a supply, and you put them together and you get some kind of equilibrium.

In this case the question was: was there sufficient evidence about consumer demand? What came out was that there really wasn't. The judge concluded there was a very tiny sliver of data for actual consumers and that in the absence of other data it was necessary that the expert who was putting forth the model essentially created what he called "avatars," which I thought was kind of a cool concept, but they're not like the ones in the movie; they're made-up people.

The way the court described it was that they were essentially "mathematical DNA." They were hypothetical people with made-up demand characteristics, but they weren't really derived from actual real-world data.

At the end of the day, the judge concluded

that that was insufficient. Because of the deficiencies in the data, the model produced a number of anomalous outcomes, and that was a big source of dispute. A big issue in the class certification hearing was that, because these avatars weren't really created with real-world data but were just sort of mathematical DNA, when you ran the model and changed certain parameters it spit out a lot of results that didn't make any sense. That was a point which I think was very compelling to the court.

What was interesting again, just to sum up, was the court said, "What should the plaintiff's expert have done?"

The answer was, "He should have gotten more data about consumer preferences." He noted that the Yurukoglu-and-Crawford model was based upon a lot of consumer survey data, and that it is quite common in these kinds of models to go out and, if you've got a deficiency in data, not to make it up with mathematical DNA, but to actually try to get more

robust information from consumers about what their real-world preferences are.

I think it's probably likely, even though there were a host of other criticisms of the model, that if the plaintiffs' expert had gone and done that, there's a pretty good chance the court would have found the model sufficient to get past *Daubert* and probably sufficient to justify class certification.

Certainly, there was no doubt that the model as a whole was broadly accepted. It's published in a scholarly journal, so the whole debate of class certification was not about is this kind of modeling acceptable. That was taken as a given.

It was: is the implementation appropriate? It was an interesting lesson in trying to apply those kinds of models in the real world.

MR. KEYTE: Ali and Ariel, there is a lot more to that, depending on what industry you're looking at. But how often, or is typical that you go out, whether it's academics or part of a project, and

do these conjoint surveys or survey work to try to estimate demand? I don't know if you'd do it on the supply side.

PROF. YURUKOGLU: We use any data that we think has integrity and would be useful for the analysis. Sometimes in surveys you worry that people aren't incentivized to answer in any meaningful way. But mostly we're looking for what choices people made, what products they bought, and how much they paid for them.

MR. KEYTE: In the surveys do you try to import any change? Are these surveys to try to derive some elasticities or —

PROF. PAKES: Conjoint analysis isn't really a survey.

MR. KEYTE: Okay. What is it?

PROF. PAKES: Conjoint analysis is you go to a person and ask them fifteen questions. He never buys anything. He has five seconds to think between each question. He's comparing very detailed things.

You might not believe the answers in the end to something like that.

The surveys that I think Ali is talking about, and that we both use, are data about what people did actually purchase. For example, if you're doing healthcare, there is now a lot of data in the All-Payers Claims data. You can see exactly who purchased what, what hospitals they went to. You can't name people, but you can do the demand analysis with a full set of data on a full state. You know what everybody in that state did, what insurance company they were on, what the insurance company paid, and what they paid out of pocket — the works. It's available. There are industries like that.

For real surveys they actually go out and ask people what they bought, see what they bought in the past, and when they changed what they bought and things like that.

MR. KEYTE: We know, whether it's in a merger context or a litigation context, that sometimes

it takes a handful of documents that can turn a case, that can turn a merger.

In this modeling exercise, almost from the academic side, how do you deal with essentially qualitative evidence? Is it just a lead if it can't be reduced to data? How do you deal with intent in business documents and emails and the kinds of things that often are attractive to courts or juries but may not be quantifiable?

PROF. YURUKOGLU: The only way I can think of using that is it might help you specify your model, how you lay out what the agents can and can't do, and it might give you qualitative support for the assumptions in your model. But I'm not quite sure without more context how to —

MR. KEYTE: What's the difference between a specification and an assumption?

PROF. PAKES: I think the way you would use it is you're going to do something, something in the world is going to change, and if some document says,

in response to that kind of action "I'll do *X*," then you have to model *X*.

MR. KEYTE: You have to.

PROF. PAKES: It makes sense to investigate *X*. That's the way we would use the documents.

MR. KEYTE: Then it's explore data and then you might use it —

PROF. PAKES: You explore it in the context of your — they said they were going to do something, so you explore what the implication of that would be in the context of your model.

MR. BURKE: As the lawyer, I think then you would have to marshal the model with other evidence. I'm just a simple country lawyer. I start with the documents. We start with the win-loss data, and then you get some other stuff, and then maybe you have one of these models too, and hopefully they roughly all point in the same direction, and whichever one doesn't you try to explain why it doesn't. You try to marshal as much evidence across all those different things.

It's not just in isolation.

MR. KEYTE: And, Ken, in the merger context, in the old days you would have a shadow team that's saying: "Well, let's see how this works out. I don't necessarily want everybody to be exposed to that." Is there still that approach to modeling where you might have a testifying, you have a non-testifying, you have a whole separate —

MR. SCHWARTZ: It comes back to what's the profile of the matter and again what's the budget. But we certainly will Red Team our economists at times, go to a different economist shop and say, "Put on your government hat, put together the government's best case," so that you have some independent thought there.

It's also a way to present to your client: "If you're thinking of litigating this challenge, here's the government's best case, and they're getting it from someone who hasn't spent the last year trying to develop the affirmative arguments." That does

happen. That's fairly common.

MR. KEYTE: In structural modeling, or whatever you called it, data-intensive modeling of some nature — it sounds like it can apply to anything where you have a counterfactual that you're trying to explore, whether it's a regulatory change, whether it's antitrust related, non-antitrust related. Are there any limits in a sense on what it could apply to?

PROF. PAKES: It's just when you can apply it well. It's just a question of what you have in your hand that you can analyze it with, including documents, by the way.

MR. KEYTE: Whether it's in a horizontal setting, vertical setting, mergers, class action, what do you see as, in a sense — and maybe this is an unfair question — the next big thing, a paper or work that's going on now that might say, "Hey, this is a new aspect of structural modeling that's going to stick and that is useful"? There is always a lag, especially with the lawyers who are going to see

something, or the agencies, your grad students, yourselves. What's 4.0 of structural modeling?

PROF. YURUKOGLU: Stuff I talked about, dynamics. People write papers with dynamics in, but I don't think we've nailed it to the point where it's being used in the court system credibly.

Models of investment. I have a PhD student I'm advising whose dissertation is about modeling 4G investment to model a mobile merger.

PROF. PAKES: My only comment on that is I've been saying dynamics is the next thing coming for the last fifteen years.

MR. KEYTE: Just to be clear, when you say "dynamics" what do you mean? What's the breadth of that?

PROF. YURUKOGLU: Like in the cable bundling, you ban bundling, you see what consumers buy; but then there's another level where the content makers might change the quality of their content, the genres that they're offering, the casts, that sort of

thing.

MR. KEYTE: It's the effects from different agents that flow from what you're changing.

PROF. YURUKOGLU: It'll take time to happen and change the product mix.

PROF. PAKES: It's investments. It's development of new products and investment in the cost structure.

MR. KEYTE: In a dynamic environment, which from an antitrust perspective — at least if you were doing the defense side of things and you're trying to assess market power — if you have dynamic markets, you say you can't even assert that. But in structural modeling you're trying to capture that to the extent you can. Is that fair?

PROF. PAKES: Yes. Again, what Ali said is right, which is this is the place where if a lawyer asks me, I'm not sure I would know more than asking somebody in the industry who knows a lot about the industry. Maybe I would. It would depend on the

problem.

MR. KEYTE: Does the academic world in this kind of modeling try to keep track of how it's playing out in the courts, whether it's accepted, whether it's this whole *Daubert* debate?

PROF. YURUKOGLU: I read all the testimony. I was actually working a little bit on the other side on that case, but I read all your guys' testimony in the *Laumann* case.

MR. KEYTE: Well, they were using their model without using you.

MR. BURKE: That was their fatal mistake.

MR. KEYTE: It was their fatal mistake.

PROF. YURUKOGLU: I was in the background.

MR. KEYTE: Any other comments about this relatively esoteric yet extremely fundamental, grounded topic?

PROF. PAKES: I have one comment, which is I think it's actually easy to explain. I could explain to you — we didn't do it today — exactly how the

demand system works. It's easy to explain when you understand it.

It's harder to do because there are a lot of details. There are just a lot of things that have to fit together, but the basic principles of it are actually very simple, and the reason we went after the issues we went after in detail are actually very easy to explain.

For example, in BLP the major issue is an ability to allow, especially in retail goods, an unobserved product characteristic because you can't put in all the characteristics of a car. The unobserved product characteristic, because it's everything that you don't measure, is probably correlated with price. What BLP does is it allows you to do that.

I could explain to you every detail in a way that you understand it. It's not magic.

MR. KEYTE: I would have to take your class.

PROF. PAKES: No, you wouldn't. You

wouldn't have to do it; you'd just have to understand what's going on. It's very simple ideas.

MR. KEYTE: I have one more technical question.

PROF. YURUKOGLU: I agree. What all this is is really just organized common sense. We're running down our assumptions, we're bringing in the data, and we're putting it all together in explicit fashion. Sometimes people think that's just too fancy, too complicated, but I really think of it as just organized common sense.

MR. KEYTE: If somebody goes and reads, some of this has been worked out both academically and in some of the decisions, and they will run across the generalized method of moments.

PROF. PAKES: Ali just finished telling you what it is. You take the data.

MR. KEYTE: And somebody won the Nobel Prize.

PROF. PAKES: You have a model, and the

model has a bunch of parameters that have to be fit; you find the parameters that make it look like the data and those are the right parameters. That's all method of moments is. He got a Nobel Prize for that.

MR. KEYTE: He did. You start with just, is it the intuition or qualitative information that says, "Eh, I think this is something that it may match"?

PROF. YURUKOGLU: No. It's all these methods on the computer. There are automated ways of doing that.

MR. KEYTE: Let's open it up to questions. Guy, identify yourself because we have a record.

QUESTION [Guy Ben-Ishai]: I'm Guy Ben-Ishai with The Brattle Group as well.

You actually mentioned something that resonated with me. You mentioned a scenario where the model that was applied to the litigation was essentially the very same model that was developed and perhaps even received some legitimacy or was certified, if you will, in academic research.

What's really interesting about structural models — and I was wondering, Ali — really is that in most scenarios that's not the case.

What we do know about the model is, contrary to what we saw if you were working a PhD in industrial and organizational psychology in the 1990s, or twenty or fifteen years ago perhaps, you weren't going to look at a merger and HHI and concentration. That applies to such a wide range of industries. I understand how it would be very generic, it would be very broad because it has much more than just a system of thinking about these issues.

But what we see now with the structural models is that they're so highly specified that it's not just a specific issue, at least to an industry — although this is not something we've mentioned — that typically when you work on these models they're not necessary the very same model that I would even say frequently was published before.

I guess the question is: as an attorney, how

do you claim confidence that this is indeed a reasonable model; and for an economist, how do you get enough confidence to actually convince the court that, yes this is the right model for this case?

MR. BURKE: As the attorney, I will answer that. I don't think that in order to advance a model the particular model has to have been published. Even in the case of *Laumann*, it was a version of the model that was then tweaked.

But I think there are many cases where a model is created specifically for a litigation or for a particular merger. Assuming it follows the methodologies that have been broadly accepted in the industry, I think it's potentially a valid model. I don't think you need to have a particular industry modeled in a published paper in order to be able to use modeling in a litigation or a merger.

MR. KEYTE: Any other questions?

[No response]

Thank you to the panel. A very interesting

topic, and there will be more in the months and years to come. Thank you very much.

[Adjourned: 4:33 p.m.]