

Does Strategic Ability Affect Efficiency? Evidence from Electricity Markets.

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- This paper goes after an important topic, differences between "equilibrium" and actual policies, in a constructive way.
- Very little prior work to rely on; have to make detailed assumptions that have not been empirically tested before.
- One could question the details, but there are discussions of them in the paper, and if we are to make progress on this issue we are going to have to start somewhere.
- So I am going to focus on
 - broader analytic choices, and
 - additional data analysis that might help us choose.
- Its electricity, but hopefully going after broader issues will keep Joel awake.

Large discrepancies between equilibrium and actual bids.

Three possible explanations.

1. Something is wrong in their specification of primitives or constraints (e.g. costs, transmission constraints, ...).
Ruled out. Their graphs show that this **can not** be all of the problem; still it would have been nice to have an idea of how much this could explain.
2. Firms are not best responding (so they are not "maximizing").
Assumed away. Their tastes coincide with mine.
3. Firms are best responding but have incorrect perceptions on what their rivals are likely to do.

Analyze how beliefs are formed.

- A constructive (and interesting) way of approaching the issue.
- Some prior empirical work on the formation of beliefs on primitives, but very little empirical (in contrast to theoretical or experimental) work on beliefs about rivals' play.
- Likely importance increases with the complexity of the equilibrium calculation. Here they are submitting entire bid functions, but other situations are at least as complex and hence similar issues likely to arise (think dynamic games).
- Not so much a "bounded rationality" issue as a "bounded ability" issue (for the researcher as well as the agents).
- Requires specification of; (i) the information set the decision maker uses, (ii) beliefs conditional on information set.

Some perspective on the problem.

- Need something that does better than "consistency requirement" before we abandon it. In some respects we are doing rather well.
- E.g. Pakes (forthcoming). Wollman's data and demand system (2016).
 - using his demand estimates, construct the markup,
 - regress the estimated markup on "instruments" to obtain predicted markup (not correlated with unobservables), and
 - regress the observed price on the observed cost determinants and this predicted markup.
- Look to R^2 and to coefficient on \hat{markup} (should be one).

Table: Fit of Pricing Equilibrium.

	Price	(S.E.)	Price	(S.E.)
Gross Weight	.36	(0.01)	.36	(.003)
Cab-over	.13	(0.01)	.13	(0.01)
Compact front long cab	-.19	(0.04)	0.21	(0.03)
Wage	-.01	(0.04)	0.03	(0.03)
<i>Markup</i>	.08	(.003)	0.08	(.003)
	.92	(0.31)	1.12	(0.22)
Time dummies?	No	n.r.	Yes	n.r.
R ²	0.86	n.r.	0.94	n.r.

Note. There are 1,777 observations; 16 firms over the period 1992-2012. S.E.=Standard error.

Results.

- Fit is extraordinary for a behavioral model in economics, and coefficient of markup near one.
- Importance of time dummies. Fit of a given product over time 50-60%. Still large (the only thing really changing is the markup as the choice set changes across periods). Clearly though, there is room for improvement.
- The HPLZ paper has a similar markup equation (p.24). Can we see how good the fit of that equation is both cross sectionally and across time?

Analytic Framework: Choices for Belief Formation.

Want to consider two "types" of models.

1. Agents' beliefs change over time (e.g. learning models).
2. Agents' beliefs are fixed (cognitive hierarchy model).

All models' that specify agents' beliefs will (generically) lead to unique actions (which is helpful for analyzing counterfactuals). However they have different properties and implications for policy.

- Learning models may converge to equilibrium play.
- The CH model implies that agents continue to err indefinitely.
- Type (2) requires an explanation of why the firms' survive as independent entities (they don't fail, or get bought up).

- We expect learning to be more of a factor after either institutional or environmental changes in a market.
- This is a restructured market, but there is daily bidding, and the data they use is a full year after the market is restructured.
- On the other hand there are differences across days (weather, maintenance,)
- See some analysis of the evolution of bids over time?
 - Examine bids just after the establishment of the market.
 - Detail the extent of change in the data the data used (& compare to the earlier data.)
 - Build a change in sophistication over time into the CH model, and see if it matters.

The Cognitive Hierarchy Model.

- Every firm has a level of sophistication.
- A firm with level k sophistication believes his rivals' level of sophistication is a draw from a distribution whose entire support lies under k . \Rightarrow the distribution for a given rival differs across agents.
- All distributions for any given firm are draws from a truncated Poisson distribution. Poisson parameters: common knowledge.
- \Rightarrow correlation between two firms beliefs about the level of sophistication of a third firm. If we ordered the distributions of sophistication of each firm for its rivals by first order stochastic dominance, the ranking for any two rivals would be the same no matter which third firm did the ordering.

There is lots to appreciate here (particularly the correlation in perceptions). Next slide lists some possible issues.

- This is a pretty complicated model. It is not clear to me that it is less complicated than computing Nash equilibria, and it is certainly more complicated than alternative models that they have evaluated (a variant of best response to prior bids).
- The market started a year prior to the study, It would be nice to know what kind of learning process would get us from an initial lack of knowledge on rivals bids to something like this.
- The assumption that no decision maker thinks there is another decision maker who is more sophisticated than the given decision maker is questionable. Might be common knowledge that small firms devote less resources to the decision making process than large firms (hire experts, run simulations)
- This is a modeling problem. A decision maker could not account for rivals more sophisticated than itself without being able to make a more sophisticated calculation than the model assumes the decision maker knows how to do.

Empirical Results.

Major comment: I would like to see more (though I realize that some of it is in an earlier paper),

- Measures of fit for your model & the equilibrium model and the difference between them (including standard errors).
- There are only twelve firms so we could show most of this by firm (there are some revealing pictures in the paper). Firm level detail (including characteristics) might give us a feeling for the nature and causes of the the differences across firms.
- Comparisons of profits and dispatch costs from; i) equilibrium estimates, ii) your model's estimates, iii) actual bids.
- Profit differences give us an indication of incentives to learn, and efficiency differences give us an indication of how much we should worry (some of this is in your counterfactuals).

Final Remarks.

- I don't think any of us thought that firms instantaneously shift to a new equilibrium after an environmental change. But this study goes further; it is finding firms' settle into beliefs that are inconsistent with the outcomes they observe and stay with them, despite their being simpler & better alternatives.
- I think we would like to know how we got to these perceptions, and whether this is an intermediate time period, or a longer run phenomena.
- Both prior and later data would help here, and it would also be interesting to modify your model to allow for change.
- The paper shows a clear need for work on; how firms' form perceptions about rivals' actions, how that process impacts market outcomes, and what policy instruments are available to influence it.
- Whatever lies behind the results, we should be thankful to HPLZ for pointing us to the issue of belief formation.