THE NATURE OF SUPPLY BIDDING IN ELECTRICITY MARKETS

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Overview

The nature of bidding for supply contracts in electricity markets is not well-understood. In particular, it is not clear what drives the number of bidders or the winning bid price. Here we analyze this question. Specifically, we examine what factors impact the number of bidders and the price of the winning bid. Though many jurisdictions worldwide have restructured their electricity markets, the only research on this topic is Hattori (*Energy Economics*, 2010), which only deals with the number of bidders for particular contracts in Japanese electricity markets.

The Penn State Facilities Engineering Institute (PSFEI), which acts as a broker for a large number of state agencies and private entities, and provides recommendations to the Pennsylvania Department of General Services Bureau of Procurement, has agreed to make their contract data available[1]. This data contains information on: date of bid, winning bid price, type of bid, number of bids per account, identity of winning bidder, identity of customer, location of customer, start date of contract, and length of contract.

Pennsylvania's electricity market is among the most deregulated in the U.S., both at the wholesale and more recently retail levels. The PSFEI data therefore provides the base for an analysis of the effect that both wholesale and retail competition had on the contract bidding process within the state, and whether each had a significant impact on the number and level of bids.

Methods

The hypotheses of this research address the effects of various factors on 1) the probability of a facility being awarded a contract, 2) the price of the winning bid, and 3) whether competition existed. First, the probability of whether a facility is awarded a contract depends mostly on the facility's demand. Second, the winning bid price will depend on contract length, facility location, and the future cost of serving electricity. Third, bidding volume will be contingent upon the facility's size and location.

Facility Demand: Given monthly consumption data for each facility from 2009, a percentage standard deviation of monthly consumption and proportions of January and July consumption of annual consumption were calculated to represent load profile.

Facility Location: Annual average nodal prices were calculated by cross-referencing each facility's zip code with PJM nodal busses and obtaining real-time locational marginal prices from the PJM Market Operations website to represent transmission constraints and resulting congestion[2].

Contract Length: Bids may be more likely to be awarded depending on how long the facility has to commit to an electricity price.

Allowable Bid Type: The accounts have specifications of what kind of bids they may accept (Fixed and/or Block & Index bids). Fixed bids prices apply to all kilowatt-hours used at every hour of the day. Block & Index bids have on- and off-peak price components, and the demand is split into a block and variable component. The block (determined by PSFEI's visual assessment of daily load profile curves per month), is the amount of demand that the supplier charges its awarded bid price. The index is any demand above the block (generally the peak hours) that the supplier must provide from the market.

NYMEX Price: Electricity prices are often correlated with natural gas prices. With most of the bids occurring on the ending date of the shopping event, NYMEX 2-year forward prices were calculated over the average length of the contract.

Using these variables, three separate regressions were then run. The "Awarded" and "Number of Bidders" regressions were binary logistic regressions (0 = one bidder and 1 = more than one bidder on the contract for "Number of Bidders" regression).
Since awarded block and index bids have three components (on- & off-peak and the management charge), one cannot compare results to the awarded fixed bid prices. The "Awarded Bid Price" regression is therefore only run with *fixed* awarded bid prices.

Results

Knowing that the awarder often emphasizes annual avoided costs (the cost savings of choosing the supplier contract over the utility), we found that there are other important considerations that both the awarder and bidders take into account. The regression analyses show that the probability of a facility being awarded is most sensitive to the facility's annual demand, the average annual nodal price, the future NYMEX price and whether a facility is allowed only a fixed bid. The variables most significant in the multiple regression model to model the price of the winning bid were contract length, average contract NYMEX price, and the allowable bid type. The probability of whether more than one bidder submitted a bid for a facility was most affected by the NYMEX price, volatility in consumption, and acceptable bid type. Sample size was 100 facilities.

Conclusions

We are able to draw several interesting conclusions from the regression analyses. In terms of the probability of a facility being awarded a contract, we found, surprisingly, that the greater the facility's demand, the less likely it is that it will be awarded; however, monthly variability does not seem to influence the outcome, but there is a slight indication that the more volatile the consumption, the less likely it is that a contract will be awarded. There is also an indication that winter-peaking facilities are more likely to be awarded a contract, and July-peakers are less likely to be awarded a contract.

These results also reveal a great deal about the awarder. First, the awarder seems to be backward-looking, as increases in the average annual nodal price (based on historical data) increase the probability of a facility being awarded a contract. Second, the awarder seems to have an interest in both the consumer *and* the supplier. Not only is it looking for competitive prices for consumers, but given that there is a greater probability of being awarded when bidding on winter-peaking facility (larger fraction of total annual demand), suppliers ultimately benefit because electric prices in January are not quite as volatile or high as in the summer. Lastly, the awarder is risk averse in that it awards more facilities that allow only fixed bids because it avoids exposing any of the facility's consumption to the spot market.

The awarded bid price analysis indicates that price considerations drive bid prices, and there is a hint that competition has a downward effect on prices if we look at the number of bidders. Bidders do not seem overly considerate of consumption and the physicality of the electricity they promise to supply, because again, the quantity and variability of a facility's demand do not greatly influence bid price, but there is a slight indication that the greater the total annual usage, the lower the awarded bid price. And while not significant, there is a slight indication that higher July demand leads to higher bid prices. Longer contract lengths (specified by the bidder) is, however, an important factor in the price of the winning bid, as suppliers seem to offer a kind of bulk discount.

The analysis can also conclude that bidders are forward-looking, as they structure their bids around forward NYMEX prices: the higher the NYMEX price, the higher the bid price. Using the natural gas market as an indictor, suppliers take into consideration that the more expensive electricity will be to supply in the future, the more expensive their bid price will have to be.
And again, a facility allowing only fixed bids will generally see higher bid prices because the supplier has to supply all hours at the same price.

As for competition, the total quantity demanded does not seem as important as the *variability* of demand. The greater the volatility, the less willing bidders are to supply electricity. Winter-peaking facilities attract fewer bidders and summer-peaking facilities attract more, perhaps because they can charge higher prices in the summer. This part of the analysis further shows that bidders seem to be forward-looking and interested in minimizing costs and hedging risk based on the significance of the NYMEX price variable.

References

[1] Penn State Facilities Engineering Intitute, http://fei.psu.edu

[2] PJM Daily Real-Time LMP Files, .csv files 1/1/2007 – 12/31/2010, PJM Market Operations, downloaded from http://pjm.com/markets-and-operations/energy/real-time/monthlylmp.aspx, March 3, 2011