Price Formation in Auctions for Financial Transmission Rights

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Motivation

Electricity customers across the country lose money through FTR processes/auctions

- Since 2011, electricity customers experienced a $1.7 billion shortfall in PJM (Monitoring Analytics, 2018)
- California electricity customers lost $520 million in CRR auctions from 2012-2015 (CAISO DMM, 2016)
Motivation

Electricity customers lose money through FTR auctions

In other words: the derivatives are sold for less than what they end up being worth
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- The auction process is inefficient (Olmstead, 2018)
- Financial traders must earn trading profits (Leslie, 2018)
This Paper

What drives price formation in auctions for FTRs?

- Develop a model that describes supply, demand, and trading premia in FTR auctions
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- Empirically test for the drivers outlined in the theoretical model
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- Explore implications of the theoretical model in regions where subsidiary relationships exist
Examine auction outcomes through the lens of Auction Revenue Rights

- Auction Revenue Rights (ARRs) are given to load-serving entities to compensate for congestion rent
- ARR holders choose between converting an ARR into an FTR or selling the ARR in the annual FTR auction
- ARR holders decide where/how much FTR supply is available to bidders for reservation price $0
Figure 1: Stylized FTR supply when ARRs are self-scheduled into FTRs (left frame) vs. when ARRs are claimed as auction revenue (right frame)
Figure 2: Stylized equilibrium when ARRs are self-scheduled into FTRs (left frame) vs. when ARRs are claimed as auction revenue (right frame)
Data

PJM’s Annual FTR Auction 2007-2017

- ARR allocations supplemented with auction prices and realized FTR values
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- Construct variable *Path Capacity* by subtracting self-scheduled FTR quantity (MW) from ARR allocation quantity (MW) for each ARR path
Data

PJMs Annual FTR Auction 2007-2017

- ARR allocations supplemented with auction prices and realized FTR values

- Construct variable *Path Capacity* by subtracting self-scheduled FTR quantity (MW) from ARR allocation quantity (MW) for each ARR path

- Construct variable *Hedging Pressure* using bids from entities that own physical assets
Model

OLS with year and region-year fixed effects

\[ TA_{i,j,k} = \alpha_i + \lambda_{i,j} + \beta_1 AP_{i,j,k} + \beta_2 PC_{i,j,k} + \beta_3 HP_{i,j,k} + \epsilon_{i,j,k} \]  \hfill (1)

where

- \( TA \) is the \textit{ex post} realized value of an FTR along ARR path \( k \)
- \( AP \) is the equilibrium auction price of an FTR along ARR path \( k \)
- \( PC \) is the quantity of ARR \( k \) (in MW) that is not self-scheduled into FTRs
- \( HP \) is the quantity of FTRs (in MW) purchased by physical asset owners in the auctions whose source node is the same as ARR \( k \)
- \( \alpha \) is the fixed effect in year \( i \)
- \( \lambda \) is the fixed effect in year \( i \) \textit{and} region \( j \)
## Table 1: Dependent Variable: FTR Target Allocation ($/MW)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Auction Price</strong></td>
<td>0.83***</td>
<td>0.87***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.09)</td>
</tr>
<tr>
<td><strong>Path Capacity</strong></td>
<td>4.39***</td>
<td>3.21***</td>
</tr>
<tr>
<td></td>
<td>(1.05)</td>
<td>(1.12)</td>
</tr>
<tr>
<td><strong>Hedging Pressure</strong></td>
<td>-1.08</td>
<td>-0.91</td>
</tr>
<tr>
<td></td>
<td>(1.10)</td>
<td>(0.96)</td>
</tr>
<tr>
<td>Year FE</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Region-Year FE</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>9,618</td>
<td>9,618</td>
</tr>
<tr>
<td><strong>R²</strong></td>
<td>0.59</td>
<td>0.67</td>
</tr>
</tbody>
</table>

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Some former vertically-integrated utilities were required to spin off generation assets to induce competition.

Regulated utilities and competitive generation assets are legally separate entities under the same IOU.

Regulated utility can help generation assets acquire cost-effective FTRs.
Ample Supply, Strategic Bidding

Example Exelon FTR Bid Demand Function

Price ($/MW)

ARR/FTR Quantity (MW)

- Exelon Bid Step
- Auction Cleared Price
- Supply Made Available by ARR's
Transmission capacity supplied through the ARR process creates profitable opportunities for speculators and hedgers.

This cheap supply can create an opportunity to transfer wealth from regulated to unregulated subsidiaries of the same IOU.

What is the rate of FTR rent pass-through by unregulated entities?