The Impact of Virtual Trading on Wholesale Electricity Markets

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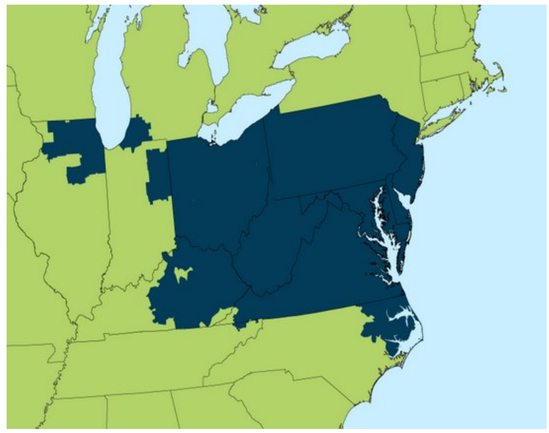
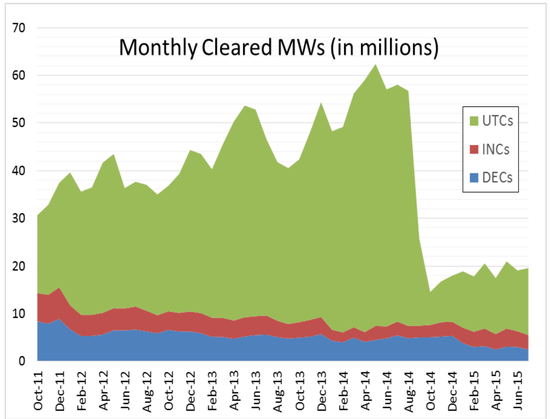
Introduction

- Virtual bids are a financial product for buying or selling electricity without physically consuming or producing it
- In the PJM Interconnection market there are three types of virtual transactions, an increment bid (INC) which is virtual generation, a decrement bid (DEC) which is virtual load, and an up-to-congestion transactions (UTC) which is a virtual transmission bid.
- Virtual bids are used by financial participants to engage in price arbitrage between the Day Ahead (DA) and the Real Time (RT) market and they are supposed to increase market efficiency and provide for price convergence between the DA and RT market.



PJM Market Footprint



Data Source: http://www.pjm.com/markets-and-operations/energy.aspx

- Trade volume in virtual bids had been steadily increasing , driven by UTCs, until a FERC order in September 2014 which determined that UTCs were henceforth liable for uplift charges
- The precipitous decline exposed the fact that much of the UTC trade volume was based on low margin persistent price differences between the DA and the RT market
- The large decrease in virtual trades with no obvious detrimental effects on the market calls into question the value of such trades for the physical market participants (load and generation)

Objectives

- Understand the bidding strategy of financial participants given different load expectations in the DA and RT market
- Understand the effects of virtual bidding by financial participants on consumer and producer surplus
- Understand where the profits for financial participants are coming from

Model Description

Model Assumptions:

- constant elasticity supply function: $S = \alpha p^{\varepsilon}$ inverse supply function: $P = S^{\frac{1}{\varepsilon}}\alpha^{\frac{-1}{\varepsilon}}$
- price differences between the DA and the RT market are only the result of differences between expected load and realized load

Parameters:

FixDemand = load serving entities' forecast of electricity demand
Δ = difference between forecasted and realized demand, $\Delta \sim U$ [dlower, dupper]

Variables:

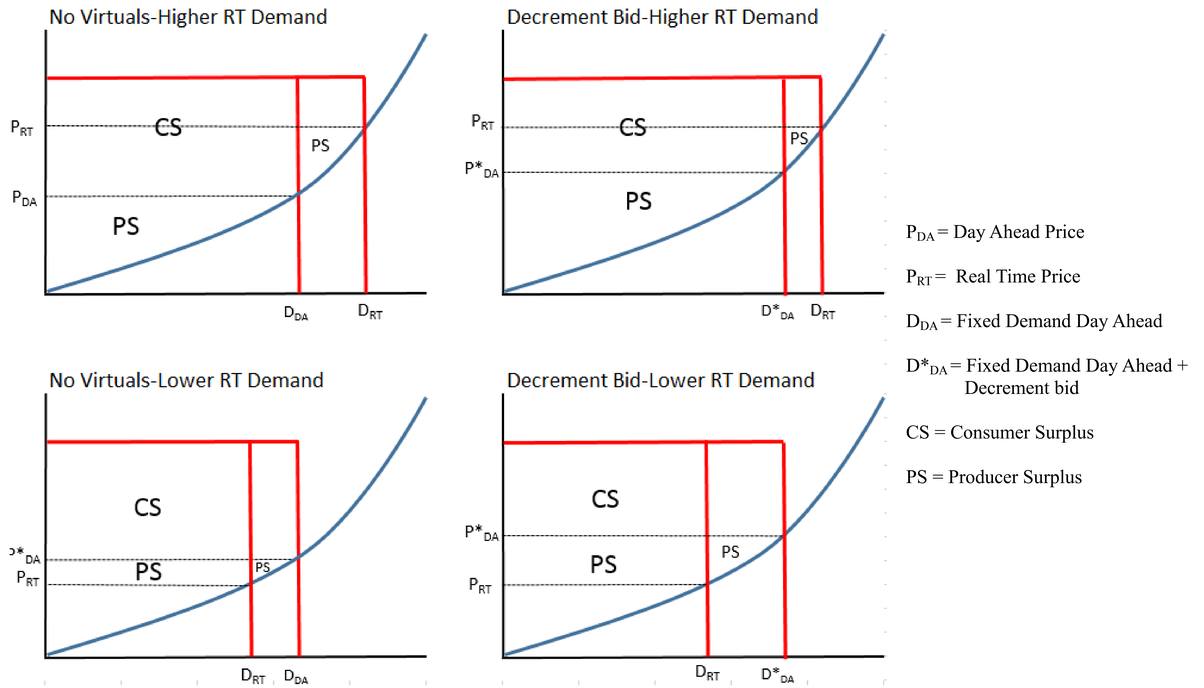
V = quantity of virtual MWs to buy or sell

Model

$$\int_{dlower}^{dupper} \frac{(FixDemand+\Delta)^{\frac{1}{\varepsilon}}\alpha^{\frac{-1}{\varepsilon}}V-(FixDemand+V)^{\frac{1}{\varepsilon}}\alpha^{\frac{-1}{\varepsilon}}V}{dupper-dlower}\,d\Delta$$

- The FOC indicates the if the distribution of Δ is centered around zero the expected value of V and expected profits for financial participants will be positive
- Any positive value of V will increase the DA price and thus result in higher prices DA prices

Results



- A bidding strategy with a constant amount decrement bid results in lower consumer surplus and higher producer surplus
- The opposite is true if a bidding strategy called for a constant increment bid
- When the welfare of financial participants is taken into account the results indicate that such bidding strategy cannot result in higher market efficiency, just a transfer of welfare among the different participants

Conclusions

- While no consumption or production occurs in the DA market it's the more important of the two because it determines the prices at which the bulk of electricity will be settled at
- Given that actions by financial participants affect the welfare of both consumers and generators it is important that bidding strategies do not automatically advantage or disadvantage one party over the other
- The results could have more widespread implications once grid congestion is taken into account