FINANCIAL ARBITRAGE AND EFFICIENT DISPATCH IN WHOLESALE ELECTRICITY MARKETS

[John Parsons, Sloan School of Management, Massachusetts Institute of Technology, +1 617 324 3745, jparsons@mit.edu]
[Cathleen Colbert, California ISO, +1 916 608-7225, ccolbert@caiso.com]
[Jeremy Larrieu, Federal Energy Regulatory Commission, +1 202 502 8234, jeremy.larrieu@ferc.gov]
[Taylor Martin, Federal Energy Regulatory Commission, +1 202 502 6374, taylor.martin@ferc.gov]
[Erin Mastrangelo, Federal Energy Regulatory Commission, +1 202 502 6188, erin.mastrangelo@ferc.gov]

Overview

Virtual bidding is a type of transaction introduced into wholesale electricity markets to improve competition and pricing. Under certain circumstances, virtual bidding works as advertised. But not always. Situations can arise in which the profits from virtual bidding are a purely parasitic transfer from electricity producers and consumers. Indeed, in these situations, virtual bidding can add real costs to system operation. This paper analyzes how virtual bidding functions and details the situations under which it malfunctions. These are illustrated with specific examples, and the generality of these examples is motivated. The fault with virtual bidding identified in this paper needs to be incorporated into any assessment of the costs and benefits of virtual bidding.

Methods

This paper ties together the theory of wholesale electricity auctions with certain empirical results. In a simplified theoretical framework, the Day-Ahead price should equal the expected Real-Time price so that the expected DA/RT spread is zero. We explain the important practical complications that motivate the use of a mutli-settlement market design and which occasionally give rise to persistent DA/RT spreads. We then explain how the introduction of virtual bidding operates when these practical considerations are present. We use specific examples from the recent experience of virtual bidding, especially in the California market, to help clarify the problems that arise. We provide a detailed numerical example to help understand the problem. We then generalize this specific case and example using other experiences in other markets

Results

The establishes that spreads between the Day-Ahead and the Real-Time price will often arise due to the many necessary approximations differently employed in the Day-Ahead and Real-Time algorithms which clear and settle wholesale electricity auctions; while virtual bidders can profit off of these spreads, oftentimes they cannot help resolve the underlying problem that creates the spread; in these cases, profits earned by virtual bidders can be a purely parasitic drain on the system, adding to the costs paid by load; in addition, virtual bidders may add to system costs; convergence (a narrowing DA/RT spread) is an imperfect metric for evaluating system performance and the contribution of virtual bidders; virtuals may cause the average DA/RT spread to move closer to zero, and nevertheless all virtual profts are a purely parasitic drain, and, in addition, virtual trading has increased system costs.

Conclusions

Virtual bidding is a peculiar beast. It is a form of financial trading that has been carefully grafted onto the design for wholesale trading of physical electricity. Virtual bidders are wanted because they will help drive out any and all disparities between the Day-Ahead and the Real-Time price|to drive DA/RT spreads to zero. Unfortunately, many advocates of virtual bidding have been willing to overlook important cases in which it has proven costly to consumers and hurt system performance, driving up costs. Understanding when virtuals contribute to system performance and when they are parasitic and also hurt system performance is a difficult empirical challenge.

References

Abdul-Rahman, Khaled H., Hani Alarian, Mark Rothleder, Petar Ristanovic, Bogdan Vesovic and Bo Lu. 2012. Enhanced System Reliability Using Flexible Ramp Constraint in CAISO Market. IEEE Power and Energy Society General Meeting, July, pp. 1-6.

Birge, John, Ali Hortaçsu, Ignacia Mercadal and Michael Pavlin. 2013. The Role of Financial Players in Electricity Markets: An Empirical Analysis of MISO, Working Paper, October 22.

Borenstein, Severin, James Bushnell, Christopher Knittel and Catherine Wolfram. 2008. Inefficiencies And Market Power In Financial Arbitrage: A Study Of California's Electricity Markets, Journal of Industrial Economics 56(2): 347-378.

Cain, Mary B., Richard P. O'Neill and Anya Castillo. 2013. History of Optimal Power Flow and Formulations. Optimal Power Flow Paper 1. FERC Staff Technical Paper, August.

CAISO. 2009-2014, miscellaneous market monitor reports.

Chaves, José Pablo and Yannick Perez. 2010. Virtual Bidding: A Mechanism to Mitigate Market Power in Electricity Markets: Some Evidence from New York Market, Working Paper.

FERC. 2012. Order Approving Stipulation and Consent Agreement. Constellation Energy Commodities Group, Inc. Docket No. IN12-7-000. March 9.

Isemonger, Alan G. 2006. The benefits and risks of virtual bidding in multi-settlement markets. The Electricity Journal, 19:26-36.

Jha, Akshaya, and Frank Wolak. 2014. Testing for Market Efficiency with Transactions Costs: An Application to Convergence Bidding in Wholesale Electricity Markets. Working paper, March.

Larrieu, Jeremy. 2014. Impact of Virtual Bidding on the Forward Premium in the California ISO. George Washington University, Working Paper, August.

Ledgerwood, Shaun, and Johannes Pfeifenberger. 2013. Using Virtual Bids to Manipulate the Value of Financial Transmission Rights, Electricity Journal 26(9):9-25.

Nakano, Shoko. 2007. Impact Mitigation for Emergency Events: Their Effects on Day-Ahead and Real-Time Market Locational Based Marginal Pricing at the New York ISO, Hitotsubashi Journal of Economics 48:185-197.

PJM. 2013. State of the Market Report for PJM. 2012. Volume 2: Detailed Analysis. Monitoring Analytics, Independent Market Monitor for PJM, March.

PJM. 2014. State of the Market Report for PJM. 2013. Volume 2: Detailed Analysis. Monitoring Analytics, Independent Market Monitor for PJM, March.

O'Neill, Richard P., Thomas Dautel and Eric Krall. 2011. Recent ISO Software Enhancements and Future Software and Modeling Plans, FERC Staff Report, November.

Saravia, Celeste. 2003. Speculative Trading and Market Performance: The Effect of Arbitrageurs on Efficiency and Market Power in the New York Electricity Market, Center for the Study of Energy Markets (CSEM) Working Paper, University of California, Berkeley.

Werner, Dan. 2014. Electricity Market Price Volatility: The Importance of Ramping Costs, Working Paper.