

Manipulation of Day-ahead Electricity Prices through Virtual Bidding in the U.S.

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Enforcement actions of the Federal Energy Regulatory Commission (FERC) in regard to allegations of price manipulation in electricity markets have been the source of a great deal of controversy in recent years. In several of these cases, the agency has accused banks, energy trading firms and other participants in physical and financial electricity markets of taking uneconomic positions in the physical market to reap gains in related financial positions. Most pending investigations and proceedings have ended with settlement agreements, which typically contain no admission of wrongdoing and no analysis of the underlying claims. Between October 1, 2012 and September 30, 2013, the Commission's approved settlements levied roughly \$445 million in civil penalties and disgorgement against six companies. JP Morgan's \$410 million penalty, the largest one handed down by the Commission so far, is well below the \$488 million proposed for Barclays Bank and four of its former traders for allegedly manipulating electricity prices in California between 2006 and 2008. The tendency to resolve enforcement cases via settlement has raised concerns among market participants and analysts: settlement agreements provide little information about the details of the alleged violations, and thus offer limited insights about FERC's interpretation of its fraud-based anti-manipulation rule.

Real-time physical markets are vulnerable to manipulation, and extensive monitoring and mitigation rules are in place to prevent such manipulation. Absent control over real-time markets, the special nature of electricity cash settlement rules makes day-ahead manipulation more difficult than with storable commodities. So-called virtual trades are day-ahead financial transactions that mimic physical bids and offers, but are settled at the real-time energy price. Financial Transmission Rights (FTRs) are financial instruments that entitle the holders to receive a share of the congestion rents created when the network is constrained in the day-ahead energy market, and provide a hedge against variations in nodal prices and associated congestion charges.

In this article, our focus is on one particular type of market manipulation strategy considered by FERC: placing virtual bids that are unprofitable on a stand-alone basis, but are intended to move day-ahead electricity prices in a direction that enhances the value of related FTR positions. Ledgerwood and Pfeifenberger (2013) show how, given the positions of other market participants, an energy trader would have an incentive to submit an excessive number of uneconomic virtual demand bids at a node representing the sink of its FTR position. Because the FTR pays the holder, for each megawatt awarded, the difference between the day-ahead congestion price at the sink and at the source of the contract, cleared virtual load at the sink could increase the value of the financial position. However, the situation described by Ledgerwood and Pfeifenberger cannot represent an economic equilibrium. By placing uneconomic virtual demand bids at a node, the trader would create a divergence between day-ahead and expected real-time prices. This should promote competition for arbitrage opportunities, in turn leading to price convergence and making manipulation of day-ahead electricity prices impossible to sustain.

How could an energy trader affect day-ahead electricity prices, but avoid allowing other market participants to profit from arbitrage opportunities created by uneconomic virtual bidding? Although this issue presents relevant implications for the design of electricity markets, an economic framework for the analysis of electricity market manipulation through virtual bidding has not been presented. Such a framework may help identify market features that implicate manipulation, as well as conditions that would need to be observed for empirical analysis. Our goal is to adapt an equilibrium model of day-ahead market manipulation, when real-time price manipulation is not possible.

The focus is on the case of an energy trader who does not control real-time power output nor serve load, and does not collude with other market participants. We refer to the extensive literature on price manipulation in equity and other financial markets, and construct examples of equilibrium manipulation in the context of Kumar and Seppi (1992), which in turn draws on the classical work by Kyle (1985).

Kumar and Seppi's equilibrium model allows a trader without superior information on market fundamentals to successfully manipulate the spot settlement price of a stock futures contract. Spot sales are subsequently cash-settled on the delivery date: importantly, there is no manipulation of the cash settlement for spot transactions. Thus, their framework is analogous to the case of day-ahead electricity price manipulation, when the real-time price is assumed not to be subject to manipulation. We begin by considering a single electricity node, where an FTR forward market is followed by a two-settlement, day-ahead and

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real-time, energy market. An informed trader participates in the day-ahead energy market, while noise traders and an uninformed trader participate in both the FTR and the day-ahead markets. All market participants are risk neutral and place virtual bids on the day-ahead market. In particular, the uninformed trader establishes its FTR position, and then submits its virtual demand or supply position to maximize expected profits, given the total quantity cleared in the FTR market and subject to an FTR position limit. In each market, orders are batched and the market-clearing price is set based on the aggregate order flow.

Following Kyle and assuming linear pricing rules and trading strategies, we obtain the unique equilibrium via backwards induction. The uninformed trader successfully manipulates the market and earns positive expected profits by going long (or short) in the FTR market with equal probability, and then buying (or selling) in the day-ahead market, so as to raise (or depress) the day-ahead price, because its trades are confused with those of the informed trader. If its FTR position is larger than the expected day-ahead position, the manipulator will recoup, on average, the losses in the day-ahead energy market through the profits in the FTR market.

The application of the Kumar and Seppi framework yields insights with regard to the possible empirical implications of day-ahead price manipulation through virtual bidding. First, randomization of the manipulator's confidential FTR positions is a critical feature of this equilibrium model. Although necessarily hidden from other market participants, the FTR positions should be fairly easy for FERC to observe. Moreover, in this setting the manipulator does not create a persistent divergence between day-ahead and expected real-time prices: from the perspective of market participants other than the manipulator, the expected day-ahead price is equal to the expected real-time price. Finally, in Kumar and Seppi's framework the efficiency of the day-ahead market is neither raised nor lowered as a result of the manipulation, since the variance of the day-ahead price is the same, relative to the case in which no manipulation occurs. The principal effect of the manipulation is to redistribute trading profits among the day-ahead market participants.

References

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Footnotes

¹ The full report (Heeter et al. 2014) is publically available at <http://emp.lbl.gov/publications> and <http://www.nrel.gov/publications/>.

² In states with restructured markets, the traditional electric utility monopoly—where the utility provides generation, transmission, and distribution—has been split. Customers in restructured states can choose which electric service company will supply their generation. In traditionally regulated states, vertically integrated utilities provide generation, transmission, and distribution service to a captive market (i.e., franchise service territory).

³ Most states with restructured markets include an ACP mechanism whereby a load-serving entity (LSE) may alternatively meet its obligations by paying the program administrator an amount determined by multiplying the LSE's shortfall by a specified ACP price (e.g., \$50/MWh). ACP prices serve, more or less, as a cap on REC prices, because LSEs generally would not pay more than the ACP rate for RECs.

⁴ CT—Connecticut, DC—Washington DC, DE—Delaware, IL—Illinois, MA—Massachusetts, MD—Maryland, ME—Maine, NH—New Hampshire, NJ—New Jersey, NY—New York, OH—Ohio, PA—Pennsylvania, RI—Rhode Island, TX—Texas, AZ—Arizona, CA—California, CO—Colorado, MI—Michigan, MN—Minnesota, MO—Missouri, NC—North Carolina, NM—New Mexico, OR—Oregon, WA—Washington, WI—Wisconsin