Price responsiveness in retail and wholesale markets: Implications for demand response in Midwest electricity markets

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Executive Summary

Demand response initiatives (e.g., dynamic pricing, time of use pricing, critical peak pricing) offer electricity users an opportunity to reduce expenditures on electricity by shifting or reducing their electricity consumption in response to real-time price changes. Demand response also contributes to lower electricity prices by shifting low-value energy consumption behaviors to a time when electricity prices are correspondingly low (and, similarly, engaging in only high-value energy consuming activities at times of higher energy prices), thereby helping to smooth peak electricity prices (Chao 2008; Cooke 2011). When end-use customers are informed about the variation in price through real-time prices, consumers can respond to the price variation instead of paying the typical, fixed retail rate. In addition, large industrial consumers with more elastic demand are expected to receive higher gains from dynamic pricing (Borenstein 2005) and potentially shift or curtail larger volumes from peak periods than residential and commercial consumers would.

In this paper, we consider the variation in industrial demand response performance across states and estimate the industrial price elasticity of demand at the retail and wholesale levels in the MISO market using a two-stage spatial demand estimation model. We also discuss the implications of industrial demand response on market price-responsiveness. In doing so, this paper makes several

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contributions. First, it contributes to an understanding of how well industrial price responsiveness in the retail market is established in a deregulated state (e.g. Illinois) compared to a regulated state (e.g. Minnesota). Considering state-level industrial productivity and dynamic pricing adoption variation, this study analyzes industrial customers' response to price changes in the long-run (i.e. annually) in a market environment where these industrial customers are assumed to operate, largely, under flat-rate electricity contracts. The industrial sector is a high energy-using sector where electricity consumption varies significantly among industrial processes and peak demand reduction in these large industrial customers can be substantial. Thus, while applications of demand response can also be found in residential and commercial sectors, the industrial sector merits particular focus. Second, this paper provides an estimate of the current price response in the MISO wholesale market where the electricity price is determined on an hour-by-hour basis and where peak demand responds differently to real-time price changes across sub-regional hubs within the system. Third, this paper provides a discussion of the connection between industrial price responsiveness at the state level and the price responsiveness in the wholesale market with respect to state demand response performance over time. There is currently a demand response capacity in the retail market in MISO states; however, demand response has not yet been implemented to its full potential, especially in the context of industrial customers.

We find that there is variation in retail industrial electricity demand across the states. At the wholesale level, we estimate the market demand at different pricing hubs in the MISO region, and we find relatively lower price elasticity in the wholesale market compared to the retail market. Although price responsiveness varies across these two markets, we find a similar pattern in the demand response implementation in Minnesota, Illinois and Michigan. In other words, regions that are price-elastic tend to have more demand response adoption, particularly more dynamic types of demand response adoption (e.g., real-time pricing). This paper also points out that regional differences and customer diversity should be taken seriously before designing uniform demand response programs for the whole system. Future research is needed to build improved understanding of industrial customers in different sectors and explore industrial price responsiveness and adoption of demand response across state regulatory and regional market governance environments.