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Market Power in Electricity Markets and Congested Transmission Lines

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Overview

The design of electricity markets, including the rules governing the physical day-ahead markets, aims at delivering prices and quantities comparable to a competitive market outcome. A number of empirical studies of the NordPool spot market conclude that the market outcome, on average, is close to the competitive outcome and that there is limited evidence of exercise of market power (Johnsen et al., 1999; Steen, 2005; Damsgaard et al., 2007; Mirza and Bergland, 2011). However, congested transmission lines between markets create opportunities for exercising market power locally and for limited time periods.

In this paper we investigate whether producers in the Southern Norway area of the NordPool system are able to predict when the transmission lines are import congested and if they are able to exercise market power in those situations. The TSOs announce the available transmission capacity between local price areas in the NordPool system before the day-ahead auction start. Information about transmission capacity in the upcoming hours is thus available to market participants before submission of bids to the day-ahead auction, and it is of particular importance to investigate whether knowledge of transmission capacity influences the opportunity for exercising market power.

Methods

Our approach to estimation of market power is based upon the Bresnahan-Lau approach of the New Empirical Industrial Organization (NEIO) tradition (Bresnahan, 1989), and in particular the modeling framework by Lee and Porter (1984). We specify and estimate a structural econometric model of hourly demand and supply in Southern Norway for the period 2004-2008. The strategic behavior of the producers is modeled as an endogenous switching regression between two different behaviors: 1) bidding according to their marginal cost function, and 2) bidding with a mark-up over and above marginal costs. The producers will form expectations about how likely it is that the market will be import congested in a particular hour, and will add a mark-up to the marginal cost if they are sufficiently confident that the market will be import congested. The switching regression model has four different regimes: 1) bids according to marginal cost and no import congestion, 2) bids according to marginal cost and import congestion, 3) bids with mark-up over marginal cost and no import congestion, and 4) bids with mark-up over marginal cost and import congestion. The identification of the last regime allows us to econometrically assess both the extent of market power and the frequency that market power has been exercised. The model is specified in elasticity form and estimated for each hour of a day using a two-step procedure with the generalized method of moments (GMM) estimation technique, and heteroskedasticity-and-autocorrelation-consistent standard errors.

Results

The estimated models show that the producers are able to successfully predict future hours with import congested transmission lines. An important predictor for congestion is the announced available transmission capacity for the actual hour. The mark-up over and above marginal costs in those hours that the producers predict to be congested and turn out to be congested is estimated to be between 20 and 40 percent, depending on the time of day the congestion occurs. The highest mark-up is found during the morning peak hours when demand is high and the import capacity tends to be low. Furthermore, we find that the firms act strategically not only by a mark-up when the market would have been congested with no mark-up, but also by inducing additional hours with import congestion by adding a mark-up even in hours that would not have been congested without the mark-up. This behavior increases the frequency of import congestion and allows for additional

periods wherein market power is exercised.

Conclusions

Our empirical analysis of the NordPool electricity spot market show that producers can predict when import congestion may occur as well as strategically induce additional occurrence of import congestion. Furthermore, producers are exercising market power in the successfully predicted import congested hours resulting in about 30 percent higher prices. In hours without import congestion the producers are bidding into a much larger market and their ability to exercise market power is limited.

The TSOs are often using the import transmission capacity as a means to manage transmission bottlenecks in their transmission grids. The finding that producers are able to use announced transmission capacity to first predict import congestion and then act strategically with respect to market power raises questions regarding the overall impact of the current practice in the NordPool system of announcing detailed transmission capacities. We discuss in the paper if a flow based model of the transborder transmission grid where the prices would be closer to locational marginal prices (nodal prices) and thus not only result in better utilization of the transmission grid but also reduce the opportunity of producers to exercise market power. As the integration of the European electricity market continues this question is also of relevance for the implementation of the market coupling mechanism as well.

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