Market Power in Sequential Electricity Markets

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Overview

Construction of the North Sea Link cable (NSL) connecting the UK with Norway was well underway when the UK referendum on leaving the EU (BREXIT) happened. The original design of the NSL project had UK participating in the same market coupling day-ahead auction as Norway. The conditions of BREXIT left UK outside the European day-ahead electricity market, and an alternative design for the NSL was sought. The implemented trading mechanism induced a sequence of markets with the UK day-ahead market clearing before the NSL auction, and then finally the European day-ahead auction.

In general, sequential markets are an opportunity to try to game the markets and electricity markets are no exception as documented for the Iberian wholesale market by Ito and Reguant (2016). The question addressed here is if there is evidence of strategic behavior related to the NSL auction and the day-ahead market in Norway. In particular we explore if Norwegian producers strategically commit to sell to UK using the NSL auction and thus induce a higher local market clearing price in the European day-ahead market. We model the producers' strategic bidding behavior as a switching regression model for the supply curve using a hidden Markov model with time varying transition probabilities.

Methods

The available data include prices and volumes on the NSL cable, day-ahead prices for UK, day-ahead prices and planned flows for the European day-ahead market as well as realized aggregate production in the Norwegian bidding areas. Furthermore, there are forecasts for wind and solar production in the European market. The model specification builds upon earlier work by Mirza and Bergland (2015) and Bergland (2024). If Norwegian producers commit to sell a given quantity to the UK on the NSL cable the production capacity available in the European day-ahead auction will be reduced with this quantity, i.e. the supply curve in the Norwegian bidding area will shift to the left. As argued in Mirza and Bergland (2015) if the bidding area is congested there may be a substantial price increase offsetting any "losses" incurred on the sale to the UK.

The model is estimated using hourly data for the 2022-2024 period, and is estimated with a customized version (instrumental variables regression) of the EM/EP algorithm based on the input-output hidden Markov models in the machine learning and signal processing literature. The time-varying transition probabilities are modeled as multinominal logit models with forecasts for continental wind and solar wind production, transmission line capacities, NSL volumes and UK price.

Results

The estimated model distinguishes between several supply function regimes depending on the time of the day and week, and the hydrological balance of the local power system. Furthermore, one estimated regime with limited supply is associated with congested periods and sales on the NSL cable to the UK at a lower price than the realized

Norwegian price. This is consistent with the behavior of one or more producers strategically committing a part of their production to the NSL in periods when it is likely that the local bidding area is import congested.

Conclusions

These results are in line with economic theory suggesting that sequential markets can be used strategically to increase prices and profits. Producers are, of course, trying to sell their product as dearly as possible. Empirically seeing prices and aggregate quantities that are in line with theories and models for non-competitive behavior does not imply intended "abuse of market position" and a violation of relevant competition laws. Further empirical analysis may get closer to an answer to that question, but legal action would typically require more direct evidence. These results may, however, serve as a warning that sequential markets are susceptible to gaming, and should be avoided if a all possible in market designs.

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