Strategic Rebidding Behaviour: Driving Factors in Australian National Electricity Market

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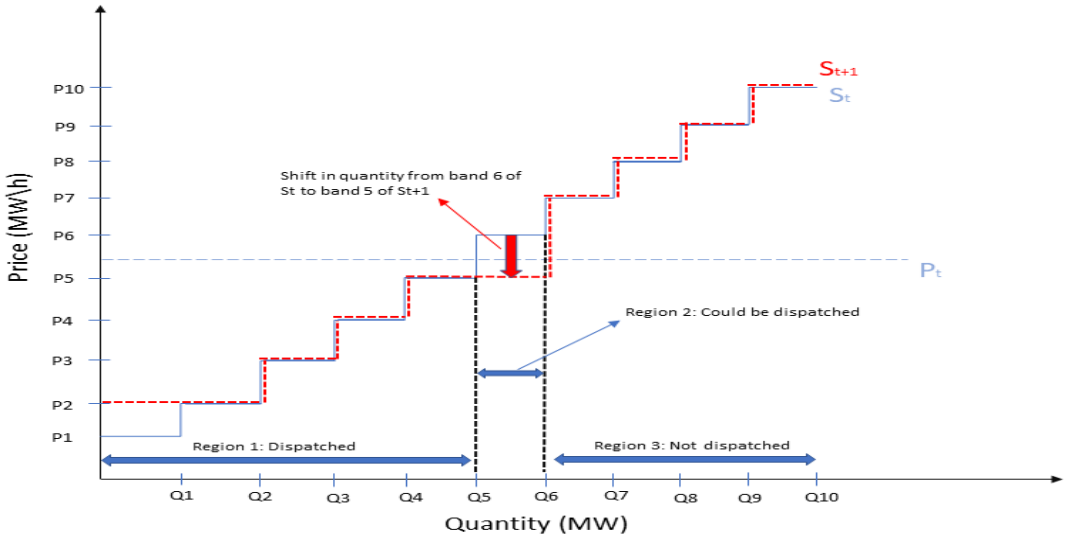
Overview

This paper investigates how the flow of information in Australian National Electricity Market (NEM) provides an incentive for the electricity generating firms to behave strategically. We examine the information disclosed to the generators in real-time at each five-minute auction intervals to see the effect on rebidding behaviour of generators. Utilizing a high frequency dataset of three years from 2015 to 2017 constructed from the Australian Electricity Market Operator (AEMO) dataset which consists of the intra-day supply bids of each generator, we demonstrate that firms actively respond to the market information by shifting/rotating their supply curves within each thirty-minute trading intervals.

Studying each generator's bidding behaviour in the state of New South Wales, we observe that generators react not to the five-minute dispatch prices but to the difference between the five-minute dispatch prices and the price at which the generator is dispatched. Generators move quantities through the rebidding mechanism from the higher part of their supply offer (like the following plot) which carries a higher price to the lower parts which has lower prices and vice-versa depending on what time of the day/dispatch interval generator is operating in. The key implications of our results are that firstly, generators have no incentive to reveal their true marginal cost and secondly, baseload generators engage more actively in strategic rebidding while the intermittent generators like solar and wind engage the least but do so despite of their negligible marginal cost and thirdly, the upcoming market redesign in July 2021 which would be a move to five-minute settlement from the current thirty-minute settlement may not be as effective as it is expected to be since generators will be still gaining the same set of information as before to maintain their strategic behaviour. The consequences of such strategic behaviour have been recent high price spikes. This result is consistent with the report by Australian Electricity Market Commission (AEMC) in 2015 that firms take advantage of the current market design as it provides the firms with incentives to generate financial incentives.



Methods

To characterise the rebidding behaviour, an empirical framework is established. This framework categorises each generators supply offer into three regions. According to the above figure, region 1 is the dispatched area below the market price. Second region covers the area after the first region until the price band adjacent to market price. Third region is the remaining part of the supply offer. These regions help us to map the movement of quantities along the the supply offers and hence observing the shift/rotation in supply offer. To understand what factors lead to the submission of a rebid by an individual generator at each region, a panel is constructed containing the characteristics and bidding behaviour of all the generators for each 5 minute dispatch interval from 2015 to 2017. This allows us to

study the impact of the flow of information in each 5 minutes interval has on generators decision to submit a rebid. That is, capturing all the equilibrium points within each trading interval at which the information is released and observed by the generators in order to see whether the occurrence of the rebid in between two 5 minutes equilibrium points is derived by the information flow in the latest 5 minute equilibrium point just before the rebid. For instance, a rebid that occurred at 4:17am falls in the fourth dispatch interval which is 4:15am to 4:20am where 4:15am is the equilibrium point at which the information was released. Hence, the rebidding behaviour of each generator within each trading interval can be observed through the six equilibrium points. To capture how flow of information affects the supply offer of each generator, an empirical model is employed for each region. This method allows us to infer how individual generator responds to this information. This model is utilised in three different steps. First step is when the key variable is just the difference between the observed dispatch price and the price at which the generator was dispatched. Second step is when the key variable is interacted with another variable which is the type of the generator; this allows to see how each generator rebids given their type of generator. Third step is to have the variable in the second step interacted with dispatch intervals; this allows us to see how generators behave at each dispatch interval.

Results

The results show that there is a statistically significant link between the changes in supply curves and the flow of information observed by the generator before submitting a rebid. This statistically significant relationship between the key variable and the left hand side variables demonstrates that generators engage in strategic rebidding behavior in different regions (To understand the regions, have a look at the attached plot). Generators use the price information as a signal of their rivals' bidding behaviour. Therefore, a greater gap between the market dispatch prices and the bid prices (prices at which the generator is dispatched) prompts a change in the supply curves through a rebid in order to make the gap smaller. In the first step (restricted models), the generator's rebidding behaviour in region 1 is more influenced by the total market demand than the change in the prices shown by its higher magnitude while the opposite is observed in the other two regions. In region 1, the generators respond to fluctuation in the total market demand is more than the change in prices and adjust their offer accordingly to assure their quantity is continuously dispatched. However, generators' rebidding behaviour is more responsive to the DIP variable (difference between the market price and the bid price) in regions 2 and 3 since the total demand has a smaller magnitude and bigger significance level in these regions. This demonstrates generators' bidding behaviour; moving quantities to higher regions to increase prices. Given such a behaviour occurs throughout all the trading intervals and that it happens more often in higher regions; regions 2 and 3, such a behaviour cannot be due to maintenance or technical reasons. This evidence inclusively establishes the presence of strategic rebidding behaviour in the state of New South Wales. The results for the other two steps are almost on the similar line but with more details regarding rebidding behaviour of each type of generator and the dispatch inetrvals.

Conclusions

In the past few decades, electricity markets around the globe have undergone market reforms to establish a competitive price for this non-storable product. The Australian National Electricity market was established in 1990 with the goal of creating a competitive market for electricity. However, since then an upward rise in wholesale prices has become a salient feature of this oligopolistic market in the world. The literature has investigated the 30 minutes market clearing prices and despite multiple proposals and theoretical frameworks designed to alleviate such a high prices, the Australian NEM is still suffering from inefficiently high prices. Previous studies have suffered from neglecting the rebidding mechanism which allows generators to restate their initial offers after they have been submitted. This mechanism has been a part of the market design which allows the generators to adjust their position according to the market conditions but has been criticised as a main factor facilitating strategic behavior. This paper focuses on this mechanism by inspecting the flow of information within each thirty minute trading intervals to observe the determining factors in submitting a rebid and the problems emerging from such behavior. Using a rich high frequency data set related to six equilibrium points within each trading interval of the Australian NEM, we have for the first time, to our knowledge, demonstrated that high wholesale prices in Australia are due to strategic rebidding behavior. We observed that each generator type reacts differently to price information disclosed at each of the six dispatch equilibrium points throughout the day in order to maximize profits. This indicates that generators will engage in rebidding as long as the same set of information is available and that they can change their offer in quite close to dispatch time in real time.