OPTIMISING MARKET STRUCTURE USING MARKET POWER MITIGATION AND FORWARD CONTRACT IN ELECTRICITY MARKET RESTRUCTURING

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Overview

This paper discusses the law and economics of imperfect competition in electricity markets. Market power, indicating the ability to raise price profitably above the competitive level, tends to be a significant problem in the aftermath of electricity market restructuring. In the process of regulatory reform and the development of competitive electricity markets, it seems desirable and practical to establish an efficient number of competitor generating companies. One approach, using a purpose-built algorithm, is to optimise the configuration of generating companies ex ante (i.e. before restructuring) rather than ex-post. A simulation of an electric power system accounts not only for multi-plant mergers of generating companies subject to a regulatory measure of market power (i.e. the residual supply index) but also for direct current load flow and the topology of the electric power system.

We applied a nodal pricing (perfect competition) and Cournot model in a large market simulation, i.e. IEEE 30 bus electricity market with 13 GenCos. Using Residual Supply Index as for market power mitigation, this research provides an ex-ante solution in creating optimal electricity market structure using recursive optimisation. Numerical simulation shows that the efficient market structure in constrained nodal pricing is six players with a unique mix of generation technology (base, intermediate and peak GenCos). While in Cournot case study, the optimal number of players is five players with slightly different mix with the baseline scenario. Forward contract mitigates market power and gives leverage to create an optimal market structure with less market participant. Thus, this research also found minimum contract coverage needed to make the market structure reasonably competitive. Based on this simulation, we acknowledge that forward contract and balanced mix of generation technology in successor companies will help to mitigate market power and create optimal market structure.

Methods

Locational Marginal Pricing and Cournot Equilibrium using DC load flow, RSI (Residual Supply Index), DC Load Flow, and forward contract.

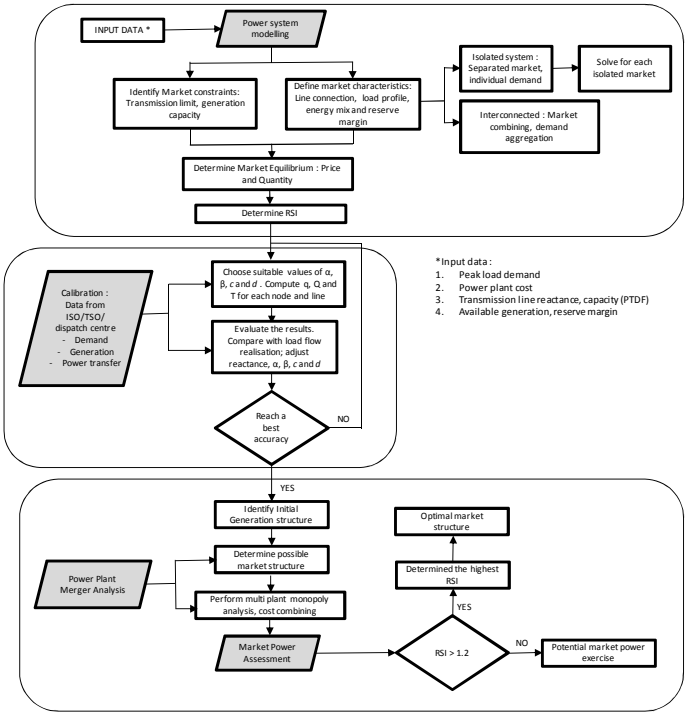

Figure 1. Algorithm in optimising electricity market structure

Results

1. The simulations show that it is possible to determine optimal mix and structure of successor companies using bottom-up merger approach. Based on this case study, and using RSI as market power mitigation, we show that electricity market needs a minimum number of players to make the setting reasonably competitive.
2. This study extends the application of forward contract in Cournot model e.g. Allaz and Villa (1993) and (Willems et al., 2009) by incorporating RSI as an ex-ante tool for mitigating market power. This study also extends the application of RSI in the contract-Cournot study of Newbery (2009) by applying forward contract concept in a more complex market structure (i.e. IEEE 30 bus test system) with DC load flow. The contributions of this paper are that, by following the algorithm for optimising electricity market structure in Figure 1, we found an efficient number of players and optimal market structure for a large power system.
3. The preventive approach applied in the simulations provides a balanced mix of generation technologies for each GenCo. Market setting a la Cournot (5 players) offers lower player participants compare to the perfect competition setting (6 players).
4. Using Cournot modelling and 120% RSI limit threshold, we find that minimum five players with a balanced mix of generation technology are needed to make the market competitive. Using forward contract as an instrument to reduce market power, the market regulator could design a four player configuration with optimal contract coverage 34%.

Conclusions

This study emphasises the importance of preventive approach using ex-ante analysis in creating competitive successor companies. Generator break-up in restructured electricity market should not end up in creating market structures with one or several firms having excessive market power. Bad electricity market restructuration is those that result in a pivotal GenCo that can increase the market price significantly due to strategic behaviour constrained from other GenCos. Good market restructuring is those that create efficient and competitive successor companies.

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