A wholesale electricity market framework with bilateral trading

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Extended Abstract

During the last 20 years, the traditional vertically integrated structure of the electricity market has undergone a worldwide transformation as many countries have begun to restructure and/or liberalize the sector.
The new electricity markets have been characterized by an oligopoly of generators, very little demand-side elasticity in the short term, and complex market mechanisms designed to facilitate both financial trading and physical real-time system balancing. In many countries, therefore, the cost-based fully centralized dispatch has been abandoned towards a bid-based dispatch and/or a bilateral trading.

In order to figure out in advance the effects of these restructuring policies, more and more researchers have been developing electricity market models. In this research field, thanks to its capability of modelling large-scale complex systems better than the more traditional optimization and equilibrium models, the agent-based (AB) paradigm has become very popular. Moreover, increasingly powerful computational resources as well as the development of toolkits that facilitate the implementation of agent based models in object-oriented programming languages have further pushed the development of the Agent-based Computational Economics (ACE).

An AB model of the England and Wales electricity market is implemented by Bower and Bunn [1] to compare different market mechanisms, i.e. daily versus hourly bidding and uniform versus discriminatory pricing. A very detailed discussion of the results of this model can be found in [2] where the basic model is validated against classical models of monopoly, duopoly, and perfect competition. The same model is also applied to the case of German electricity sector in [3] to analyze the impact of four mergers of large German utilities that were probable at the time of the study (and have actually taken place shortly after). A more detailed model of the New Electricity Trading Arrangements of England and Wales (NETA) is discussed in [5] where, differently from the precedent study, the authors explicitly model an active demand side and the interactions between the bilateral market and the balancing mechanism as a call market with pay-as-bid settlement. An extension of the same model and further analysis is presented in [6] where it is analyzed whether two specific generation companies in the England and Wales electricity market can manipulate market prices to increase their profits. The same model has also been applied in [4] to the analysis of the market power on the electricity market in England and Wales.

In the present work a simplified power generating sector has been modeled. A medium-term bilateral transaction mechanism is combined with a uniform-pricing auction settlement. Generation Companies (GenCos, i.e. companies possibly owning several plants with different generation technologies) and Suppliers (Supps, i.e. the agents purchasing from wholesale market in order to supply end-use customers) are not mandated to submit energy bids in the auction mechanism as they are allowed to sign bilateral medium-term (6 months or more) contracts. In this framework, we envisage a wholesale market with the demand side being price-taking and GenCos offering above the marginal cost.
An Independent System Operator (ISO) daily controls and coordinates the power exchange market whereas it does not have any role in the financial negotiations and settlements of a bilateral contract. In the auction market, clearing is given by the point in the (Euro, MW) space where demand and supply curves meet, resulting in a single price for the whole market, the marginal system price (MSP), assuming no operating and transmission constraints are violated.

Bilateral (B) exchange contracts are included in the day-ahead (DA) market, receiving a scheduling priority, and are concluded after a negotiation process based on a similarity measurement paradigm.

Within this agent-based framework, the proposed computer simulation model allows us to isolate the impact of medium-term bilateral trading on market power and spot prices in a competitive wholesale market setting.

We find that, despite the conventional concerns, the foreclosure effect produced by the bilateral agreement between a generation and a retail business will not necessarily lead to higher prices, and will be manifested only according to the specific market characteristics.

References

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