Auction Design for Market Coupling

Jorge Barrera and Alfredo Garcia
University of Virginia
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The integration of electricity markets which face capacity constraints for cross-border trade has emerged as an important challenge for markets around the world. In this context, the term *market coupling* is used to refer to market-based mechanisms with the goal of implementing an efficient allocation and pricing of cross-border capacity. The recent integration of electricity markets in central Europe (Benelux, France and Germany) is perhaps the first large scale implementation of a market coupling mechanism.

A typical round of trading in a market coupling mechanism works as follows. The owners of interconnection capacity between market areas make available some or all of their capacity to a market-maker. Individual participants in different markets submit bids (through their respective market exchange) for the available interconnection capacity. On the basis of available interconnection capacities and different market prices, the market-maker calculates the flow between the market areas that maximizes surplus and reports back to interested participants a price for interconnection capacity. Each market exchange thus recomputes their own market clearing price on the basis of the given prices for interconnection capacity. Additional rounds for intra-market trading may be followed with further rounds of trading for interconnection capacity.

Designing an optimal mechanism for market coupling is made difficult by the fact that participants in electricity markets possess private information that they may not willingly disclose. For example, power generators (sellers) have private information regarding their cost structure and retailers (buyers) have private information regarding their demand. Yet, this private information must be revealed to the the market-maker (directly or indirectly) in order to compute the optimal allocation of available interconnection capacity. In the jargon of mechanism design, a market coupling mechanism must be strategy-proof, i.e. it is a dominant strategy for participants to reveal (directly or indirectly) their private information.

The celebrated Vickrey-Clarke-Groves (VCG) mechanism is a design that is both incentive compatible and efficient. A VCG mechanism for market coupling would operate as follows: participants across different markets report their private information (i.e. cost curves for generation, demand curves for retailers) to the market-maker who in turn computes the optimal allocation of interconnection capacity as well as discriminatory prices (and possibly, transfers) which guarantee incentive compatibility. There are a number of disadvantages to the implementation of a VCG-like mechanism (see for example [1]). In this paper, we propose an iterative auction design that is both *strategy-proof* and *efficient* and avoids the practical difficulties associated with a VCG mechanism.

References

[1] "Thirteen Reasons Why the Vickrey-Clarke-Groves Process is not Practical", Operations Research Vol. 55, No. 2 (2007), pp. 191-197.