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OPTIMAL AUCTION DESIGN FOR GAS PIPELINE TRANSPORTATION CAPACITY – THE CASE OF NABUCCO

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OVERVIEW

As a response to the Russian dominance of the European Union's natural gas supplies, major gas transportation pipeline projects are currently under way [1] in order to enhance the EU's energy supply security, one of the top three priorities within the EU [2], in future years. Rather than buying and selling gas itself, many gas pipeline companies are set up as pure midstream gas players: they develop and construct pipelines, and as a requirement to obtain financing, rent transportation capacities on long- and short-term basis to interested shippers. In order to allocate gas transportation capacities special forms of auctions are carried out to allow potential shippers to express their interest in project participation and to make firm bookings. In recent years, auctions have emerged as one of them most successful allocation mechanisms in microeconomic theory and game theory. From an economic perspective, auctions are an appropriate mechanism for allocation as they tend to be beneficial with regards to distributional and efficiency goals [3 and 4]. However, different auction designs and allocation mechanisms can lead to different outcomes. Therefore the choice of auction rules is a decisive one [5]. This paper shall give a mathematical formulation of an optimal auction design for gas pipeline transportation capacity. Furthermore, the Nabucco Gas Pipeline Project – considered by some to be the most economical link to new natural gas sources – is taken as case study to experimentally and empirically show the results of such auction design.

METHODS

The research methods applied in this paper are manifold. In fact, a combination of empirical market survey of auction volumes and bid patterns, mathematical formulation of allocation mechanism design and experimental testing of auction allocation is carried out.

First, potentially optimal auction designs are mathematically formulated to achieve its strategic goals. In this way this paper follows eminent auction theory papers such as [6, 7, 8, and 9]. In the course of doing so different allocation mechanism designs are proposed.

Next, an empirical market survey is conducted with 54 potential gas shippers to investigate the expected auction volumes and bid volume patterns. More specifically, the 54 most likely Nabucco gas shippers (focusing on company size and regional market focus) were selected from a customer-relationship-management (CRM) software. Contacted shippers include the six Nabucco shareholder shippers and the biggest gas companies within the specific Nabucco regional market focus. Subsequently, the market survey participants were contacted in the period 2008 to 2009 per postal letter including a project introduction and a written questionnaire. Out of these 54 potential Nabucco gas shippers, 21 provided a response whereof 17 furnished sufficiently concrete answers to be included in the evaluation of the auction volumes and bid patterns.

Finally, the different proposed allocation designs are experimentally tested using the auction volumes and bid patterns outcomes of the empirical market survey. That is, we use the test bed approach of experimental economics. The use of laboratory as a test bed for complex

auctions in complex environments began with [10, 11, 12, and 13]. The outcomes are evaluated on two grounds: revenue raising potential and fairness. This experimental testing serves as an important input factor for the upcoming Nabucco Capacity Auction and resembles a real life auction application as in [14] and [15].

RESULTS

Results show that the Nabucco auction design is a sequential (non-binding, binding, shareholder shipper / non-shareholder shipper), four-dimensional/multi-attribute (tariff, distance, flow rate, years), and partly first price (i.e. first revenue) auction, with multiple winners. Similar to a Walrasian auction the tariff charged is the one that is concluded when supply and demand balance. The optimal auction design for determining the most beneficial set of auction winners is selected based on four different allocation design mechanisms. Preliminary results show that (i) allocation based on "highest individual revenue" yields the weakest outcomes in terms of both total pipeline revenue raising potential and fairness. Second (ii) allocation based on a mixture of first assigning "highest individual revenue" bids combined with after a certain cap assigning "lowest individual revenue" bids reaches more favourable outcomes on both evaluation criteria than (i). Pure "optimization" (iii) leads to the best results in terms of revenue maximization, but falls short of a fair and transparent allocation design. Finally, "pro rata" allocation outcomes (iv) have an advantage of transparency and simplicity and can result in efficient allocation in the case of truth revealing bidders. However, strategic players under certain incentives might submit not truth revealing bids, and this case is still under evaluation.

CONCLUSION

This paper shows that different auction designs and allocation mechanisms can lead to different outcomes therefore making the choice of auction rules a decisive one. Clearly a trade-off between revenue maximization (i.e. in the interest of the pipeline owner) and fair and transparent allocation design (i.e. wished for by regulators to achieve third party access and competition) can be observed. In future research the real life Nabucco Capacity Auction will be carried out and the results of its auction design presented and analysed.

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