**Designing Auctions for Renewable Energy Support**

**– Experimental Analysis of Multi-Technology Auctions**

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## Overview

There is an ongoing discussion about the optimal design of auctions for renewable energy support. One of the most pressing questions is the openness of auctions for different technologies. The European Union (EU) obligates its members to use so-called “technology-neutral” auctions when there are not convincing counterarguments (European Commission, 2014). The term “technology-neutral” is discussed critically in this paper. It is explained why the usage is suboptimal and several alternatives are suggested. The main focus of the paper is the experimental analyses of the question whether it really is advisable to conduct auctions with more than one technology. I show that it indeed is favourable for an auctioneer to include different technologies in one joint auction instead of conducting different auctions for different technologies with respect to prices as well as efficiency considerations. Further, I show that the usage of a discriminatory pricing rule, i.e. the so called “pay-as-bid” mechanism, has further positive impacts on auction prices in the experimental setting. From the results of the experiment different policy recommendations are derived.

## Methods

The setting of auctions for renewable energy support (RES) is modelled and analysed with auction-theoretic concepts. Two different technologies are modelled with different underlying cost structures. On the basis of the theoretical results derived in this and other papers (Ehrhart, Hanke, Anatolitis, & Winkler, 2019), hypotheses for the outcome of the experiment are derived. The experiment was programmed in oTree (Chen, Schonger, & Wickens, 2016) and conducted in an experimental laboratory with 144 participants, who were then divided into smaller groups. This approach is often used and well approved in experimental economic research (Kagel & Roth, 2016). In the experiment, each participant played 40 independent auction rounds in her assigned group and was assigned both technologies in the course of the experiment. Half of the auctions rounds were played groupwise with both technologies competing against each other in a single (joint) auction. In the other half of the groups’ auctions rounds technologies were separated in two different (separate) auctions and could not interact. Each participant only used one pricing rule in the experiment. The implemented pricing rules are the most common mechanisms in auctions for RES , pay-as-bid and uniform pricing. Four different treatments were conducted, two with pay-as-bid and the other two with uniform pricing. A second differentiation between treatments was the order of joint and separate auctions to exclude order effects. The analyses of the experiment results are statistically examined in descriptive and inductive ways. This includes the comparison of different auctions outcomes as well as the statistical significance of the design variants.

## Results

The experiment results show that it is favourable for an auctioneer to conduct only one auction for both technologies. For both pricing rules and independent of the order of auction rounds, the joint auctions result in lower prices. This result is statistically significant. Also, the degree of efficiency, i.e., the share of awarded bidders with the lowest costs, is significantly higher in the joint auction than in the separate auctions. Further, lower prices can be observed in auctions with the pay-as-bid rule than in auctions with uniform-pricing. Although theory predicts similar prices under both pricing rules, the experiment shows that this can deviate in real-life applications. In all auctions there is a tendency of bidders to underbid the theoretical equilibrium bid. Another striking result is that the danger of too low bids, i.e., bidders bidding under their costs in order to raise their award chances, is higher in uniform-pricing auctions. These bidders are awarded, but in many cases face high losses.

## Conclusions

The experimental results have important implications for real-world applications for auctions, especially for auctions for RES. they indicate that the intended conduction by the EU is indeed reasonable and predicts lower prices and a higher level of efficiency. Still, if one aims at expanding all technologies, i.e., also the weak ones, equally, it might be helpful to conduct extra auctions for these technologies or include other design elements such as quotas or boni/mali in the joint auction, which is at the expense of higher costs. Further it is advised to implement the pay-as-bid pricing rule, since especially inexperienced bidders face a risk of miscalculations in the uniform-pricing auctions, resulting in a financial ruin. Such bankruptcies need to be avoided in order to establish a functioning and growing market for renewable energies. This paper also urges to abolish the term “technology-neutral” from its usage, since true neutrality can never be achieved even in auctions open for all technologies due to different characteristics of the various technologies. The use of “multi-technology” or “technology-open” is the preferred wording, which can be further classified according to a state’s exact design of auctions. All these conclusion need thus be considered while deciding on new policies for the establishment of renewable energies.

## References

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