USING INFORMATION DISCLOSURE TO DESIGN OPTIMAL ELECTRICITY AUCTIONS UNDER IMPERFECT COMPETITION

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Overview

Since the mid-1980s, policymakers and regulators of several countries around the world have been engaged in the reform of their Electricity Supply Industry – ESI. The motivation for such reform initiatives vary case by case, but are generally driven by the introduction of market competition in order to stimulate the industry efficiency, to make prices more transparent and to transfer more risks to private investor rather than ratepayers or taxpayers.

Moreover, while ESI restructuring has been increasingly refined for the last 20 years, the role played by risks regarding resource adequacy have claimed special attention in the last years, mainly concerning the debate on whether competitive markets can stimulate adequate investment in new generation. Actually, the introduction of formal wholesale and retail electricity markets, in order to allow scarcity price signal to determine the mix and amount of resources to supply end-use consumers, has made possible that free consumers and Load Serving Entities – LSE lean too much on the spot markets to meet their electricity demand rather than procure sufficient resources through long-term bilateral contracts.

After a severe electricity shortage in 2001, caused by lack of investment and poor market design, Brazilian electricity policy changed substantially. The resource adequacy problem, which had been ignored until 2001, was finally recognized and addressed through a set of actions to build a more coherent regulatory setup, reducing investment risk and stimulating economic efficiency. The cornerstone of these new policies is the auction system, designed to grant public concessions for investors intended to build and operate hydropower plants.

Investors intending to participate on those auctions must sell part of the electricity contracts for Distribution Companies – DISCOs (through a power purchase agreement with a 30 years term) and the remaining may be freely traded in the electricity market. The winner of the auction is the participant who offers the lowest bid (electricity price) for the amount of electricity that will be sold for the DISCOs. Thus the investor will have a known and secure cash flow to mitigate the investment risk while the electricity not committed to the DISCOs may be freely traded in the electricity market.

The success of this resource adequacy approach relies mostly on the auction design which should conciliate bidder attractiveness and fair electricity price. However, auction design is not a trivial issue. A good auction needs to be tailored to the specific details of the situation, and must also reflect the specific characteristics of the traded good and the wider economic circumstances.

Much of auction theory can be understood in terms of the Revenue Equivalence Theorem – RET which tells us that, subject to some reasonable conditions, the seller can expect equal profits from all the standard types of auctions, and that bidders are also indifferent among them all. However, in many electricity markets, some of these assumptions are not true; thus an efficient electricity auction design must consider the effect of relaxing some assumptions of the RET.

This paper discusses the role that an optimal procurement auction (that is, auctions that minimizes the consumer's expected expenditure) may play as an instrument to help policymakers to address the resource adequacy problem and how to derive such optimal auction when the assumptions of independent information, private valuation of the good and independent bid strategy fails. The paper is organized as follows: After the introduction the second section gives a brief overview about the electricity supply industry and the resource adequacy problem. The third section presents fundamentals of the auction theory and discuss its application in the Brazilian electricity industry. Section four describes the auctions simulation experiments and makes a comparative analysis between the theoretical results and the outputs of the Brazilian power purchase auctions. In the final section policy implications are derived.

Methods

Game Theory modeling to simulate auctions design with different information policies and a comparative analysis between the theoretical results and the outputs of the Brazilian power purchase auctions.

Results

The information disclosed by the auctioneer has no effect on the auction's results when the participants have complete and symmetric information. However, whenever those assumptions are not fullfilled, the auctioneer may dramatically change the auction's final outcome. For sequential auctions, the paper suggests that not disclosing all information may be optimal for the auctioneer. It is also shown that true information disclosing is the dominant strategy for the auctioneer. Furthermore, we found differences between the auctions of generation plants and of transmission networks. These results are measured in terms of energy prices contracted and long term investments in new generating and transmission capacities, addressing the problem of resource adequacy as well, i.e. the auctions in Brazil have been leading to lower prices and to an adequate expansion of electricity supply.

Conclusions

Power purchase agreements negotiated through electricity auctions are an important instrument to help policymakers address the resource adequacy problem. However, contrary to some theoretical suggestions, special attention must be given to the auction design and to the role played by the available information. Under imperfect competition, full disclosure of information, specially in sequential auction, may facilitate co-operative behaviour in determining equilibrium price. To mitigate collusion and other forms of predatory competition, information disclosure should thus be limited during the auction. This would also simplify decision making, since it would hinder strategies that are not exclusively based upon price signals and on individual preferences.In Brazil the auctions in the ESI have been successful in guaranteeing the expansion of electricity supply at affordable prices. This model has proven to be particularly adequate to markets where electricity demand is still growing in a fast pace, as the Brazilian market.

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