



Brazilian experience in electricity auctions: Comparing outcomes from new and old energy auctions as well as the application of the hybrid Anglo-Dutch design

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HIGHLIGHTS

- We analyze the outcomes from the Brazilian old and new energy auctions.
- We evaluate the Anglo-Dutch auction design.
- Outcomes from both kind of auctions reveal that the prices are statistically similar.
- One kind of auction increase competition and minimize Eletrobras' market power.

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ABSTRACT

Since 2004, the Government of Brazil (GoB) has acted as an intermediary between distribution and generator companies in the energy procurement sector. The GoB procures energy from generator companies through auctions of long-term energy contracts. After an auction, the winning generator companies sign contracts directly with distribution companies. In particular, the GoB runs two different auctions: one for energy from existing power plants (i.e., old energy) and another for energy from power plants that have not yet been built (i.e., new energy). This paper describes these auctions and compares the outcomes from the old and new energy auctions from 2004 to 2010 using final auction prices. The Brazilian case is particularly interesting, not only because energy is predominantly supplied by hydropower plants but also because new energy auctions reach prices below those for old energy. Therefore, it is likely that it is not necessary to run the two different energy auctions. As a secondary objective, this article analyze whether the Anglo-Dutch hybrid auction model is a better design for electricity procurement in Brazil.

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1. Introduction

Although the topic of Brazilian electricity procurement auctions is addressed in some articles, this study brings new information by analyzing the outcomes of auctions that have been already conducted. First, by comparing results from green field power plants (i.e., new energy), and energy from existing power plants (i.e., old energy) auctions, this paper will analyze and question if differentiation in purchasing electricity between new and old energy is still necessary, according to the Brazilian electricity market design. Second, this paper will analyze if the

sealed-bid stage of the Anglo-Dutch hybrid auction achieves its goal to minimize the chances of collusion and therefore reduce the final auction price as much as possible.

This article begins with a brief description about the two reforms of the Brazilian electrical industry, focusing on the electric power competitive auction design and the difference between old and new energy procurement auctions. Then this study presents a very brief description about the government-owned electrical company Eletrobras, which was a monopoly until the 1990s. Moreover, Eletrobras is still the largest Brazilian power generator enterprise and can act as a market leader in the old energy procurement auctions. Then this article analyzes and compares outcomes from both auctions with both graphical analysis and dummy variable regression analysis. This paper will perform an analysis of the results and effectiveness of the second stage of the Anglo-Dutch hybrid auction. Finally, some recommendations are

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made in the conclusion, however, as Brazilian context is more complex than the discussed theoretical models, the results of this study might not be taken as evidence for all electricity markets.

2. Brazilian electricity reform

2.1. Background

Brazil is a large country (8.5 million square kilometers, larger than USA without Alaska), with continental distances, and a sizable power system, both in terms of generating capacity and of grid extension. A prominent feature of the Brazilian power system is the weight of hydropower, like Canada and Norway, but most hydrocapacity in Brazil is associated with large reservoirs, working as energy regulators (Araujo et al., 2008, pp. 553; Harris, 2006, pp. 165–167). The generation in the interconnected system by source are hydro with 450 TWh per year; conventional thermal with 26 TWh per year; nuclear with 16 TWh per year; and other with 2 TWh per year (ONS, 2011). The transmission system has more than 100,000 km of lines at 230 kV and above.

The dispatch is done by the national system operator (ONS), independently of the generation and supply functions. The system operator is closely associated with the transmission function. The trial schedule does not take emissions into account, and it is based on ‘merit order’ (generators must submit the audited marginal cost), in which hydro, nuclear and wind power plants must run.

2.2. Electricity procurement auction

Auctions have become popular in recent years as an instrument to attract and select investors to public utilities. After the 1990s, bidding processes took place in several countries around the world and were increasingly observed in electricity markets that required restructuring processes. The bulk of these processes replaced regulated procedures by market rules; thus, inducing a reliable and efficient energy supply (Dutra and Menezes, 2005; Larsen et al., 2004).

In the view of many experts, auctions ask and answer one of the most fundamental questions in economics: who should get goods and at what price? As in many other markets around the world, the Brazilian electricity market is organized using auctions because this mechanism provides a micro-foundation for markets, thereby attempting to answer the question just noted (Cramton et al., 2006).

The most common auction format is the open ascending price or *English* auction (Krishna, 2002). During an English auction, an auctioneer conducts the bidding procedure by postulating a reserve price (the minimum amount the winner is required to pay) and then continuously raising the price, typically in small increments, as long as there is only one single bidder interested (Krishna, 2002).

According to Klemperer (2002), although ascending auctions have the significant property of allocating goods to bidders who most value them, they are vulnerable to collusion and predatory behavior. In particular, in certain markets where auctions are frequently repeated, such as electric contract auctions, the reiteration allows the players to learn how to cooperate. In addition, according to Bulow and Klemperer (1996), ascending auctions are potentially inefficient because they can allow some bidders to deter entry into the auction or to depress the rivals’ bidding. However, there is a variation, or a different format of, the English auction called either the descending price auction or reverse English auction. In this variation, the auctioneer begins

by setting a price-cap, and gradually lowering the price until some bidder shows interest (Krishna, 2002).

For both ascending and descending auction designs, Ausubel et al. (2006) presented the clock auction, which is an iterative bidding procedure in which bidders indicate desired quantities at each price announced by auctioneer until there are no items left. Furthermore, Cramton and Stoft (2007) described a descending clock auction and reported that this dynamic mechanism has excellent efficiency properties due to its robust price discovery.

Besides the open format, another common type of bidding is the sealed-bid auction or the *Dutch* auction. In this procedure, bidders simultaneously submit sealed bids that contain their “best and final” offer. The person who submits the highest (in an ascending auction) bid or lowest (in a descending auction) bid wins the object. In the view of some experts (Klemperer, 2002; Krishna, 2002; among others), Dutch auctions are much less vulnerable to collusion than English auctions. Collusion happens because participants learn to cooperate after recurring interaction. In Dutch auctions, non-cooperative bidders rarely have to deal with retaliation by others, as the bid is sealed and simultaneous. The auction does not happen in a sequence of sealed-bid auctions.

Furthermore, Dutch auctions incentive weaken bidders attempting to participate because, according to Vickrey (1961), increases the possibility that weaker bidders can win, while English auctions do not. Consequently, some researchers (Mead and Schneipp, 1989; Rothkopf and Engelbrecht-Wiggans, 1993; Klemperer, 2002) have reported that sealed-bid auctions attract more bidders than ascending auctions.

Despite these advantages, Klemperer (2002) argues that sealed-bid auctions have weaknesses that can lead to less efficient outcomes than English auctions. This is because sealed-bids increase the possibility that weaker bidders can win. Finally, the author states this design may be susceptible to rule shifting by the auctioneer.

All in all, those two most common formats, English and Dutch auctions, have their advantages and disadvantages. Looking for an answer to the trade-off of adopting the open (“English”) or sealed (“Dutch”) bid designs, Klemperer (1998) proposes combining the two auctions into a hybrid. This hybrid is the two-stage “Anglo-Dutch” auction, and the author emphasizes that it often captures the best attributes of both auction forms. In Klemperer’s (1998) original proposal, the first stage is an ascending auction whose price is gradually increased until each and every one except two players have dropped out. Then the surviving competitors have to bid a final sealed offer that is higher than the current price, and the winner pays the winning bid.

According to this author, the main advantages of Anglo-Dutch mechanism over pure open and pure sealed-bid auctions are its robustness against collusion and its attractiveness to potential bidders. Klemperer (2002) suggested that these proprieties are achieved because the sealed-bid stage induces some uncertainty about who will win, which attracts more bidders and allows bidders to default on any deals without fear of retaliation. In addition, the author reports that the object is more likely to sell at a better price than in a pure sealed-bid auction because, during the English stage, finalists can learn something about all bidders’ perceptions of the object’s value.

On the other hand, Binmore et al. (2004) argue that the goal of the second stage is less clear, leading them to point out three possible objectives: to provide greater price competition (and therefore better average prices), to reduce opportunities for collusive behavior, or to encourage the participation of weak bidders. Subsequently, they believe holding the second auction stage is likely to increase the inefficiency of bidding. Binmore et al. (2004) add that although the second stage would attempt to

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