Comments on the Proposed Electricity Contract Auctions in Brazil[1]

by

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1. Introduction

The Brazilian Ministry of Mines and Energy (the "MME") will hold a procurement auction on 30 November 2004 for five types of long-term energy contract, referred to as Product 1 to Product 5 (P1-P5) respectively. Products 1, 2 and 3 are eight-year supply contracts with start dates in 2005, 2006 and 2007. Products 4 and 5 are five-year supply contracts starting in 2008 and 2009. The auction will involve the purchase of more than 28,000 averageMW.[2]

Most of the energy supplied will be hydro energy. Approximately 59% of the available hydro supply is accounted for by three federal government-owned companies, 26% by state government-owned companies, and 15% by others. Demand for the contracts will come from Brazilian electricity distribution companies.

The MME's proposal is to hold a two-stage procurement auction defined by two "phases":

1. The First Phase is a multi-product, descending clock auction, similar in overall design those described in the recent literature,[3] and which have recently been used to auction 'virtual' electricity generation capacity in France.[4]
2. The Second Phase is a multi-product, sealed-bid discriminatory auction with some complex and apparently novel features.

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2 Approximately 14,000 averageMW for P1, 7,000 averageMW for P2, 3,000 averageMW for P3, 2,000 averageMW for P4, and 2,000 averageMW for P5.

3 For instance, L. Ausubel and P. Cramton (2004), "Auctioning Many Divisible Goods," *Journal of the European Economic Association*, 2, 480-493, and L. Ausubel, P. Cramton and P. Milgrom (2004) "The Clock-Proxy Auction: A Practical Combinatorial Auction Design," forthcoming in P. Cramton, Y. Shoham and R. Steinberg (eds.), *Combinatorial Auctions*, MIT Press, 2005.

4 See L. Ausubel (2002) "Implications of Auction Theory for New Issues Markets," *Brookings-Wharton Papers on Financial Services*, 313-343.

We assume that the purpose of the First Phase is the usual one of "price discovery." The use of a multi-round, dynamic auction should help to reduce "common-value uncertainty," enabling the sellers bidders to bid more aggressively with less fear of the "winner's curse." In addition, when many interrelated products are being sold simultaneously, as is the case here, the information revealed in a dynamic auction can serve another important function. By enabling the sellers to see tentative price information, they will be able to make better-informed decisions about the quantities of each product to sell. This is especially important if some of the products may be substitutes and others complements, as bidding in the absence of price information makes the problem of determining how much the sellers are willing to bid on which products much more difficult.[5]

The purpose of the Second Phase is less clear. It may be intended to generate additional price competition (and hence result in lower average prices), to reduce opportunities for collusive behaviour, or to encourage participation by weaker bidders. However, as we point out below, the particular design of the Second Phase auction makes predicting equilibrium bidding behaviour difficult and it would appear as likely to increase inefficiency via distorting bidding incentives as to serve any positive purpose such as overall price reduction.

In the remainder of this note we describe, in condensed form, the auction rules as we understand them, and then briefly consider some problems with the auction design which in our view suggest the need for a reconsideration.

2. The Auction Design

2.1 Preliminaries

Before the auction begins the system, or auctioneer, will set reserve prices for each of the five products being offered, the quantities (or "lots") demanded for each product, a "Reference Offer," and the initial or starting prices. Only the initial prices will be communicated to the sellers at the outset of the auction, i.e. the quantities demanded and the reserve prices for each product will be kept secret.

The "Reference Offer" is calculated by grossing up the aggregate demand for all products by a "Reference Factor." Exactly how the Reference Factor will be set remains somewhat obscure to us, but its purpose is evidently to allow the First Phase of the auction to complete with sufficient excess supply remaining to generate price competition in the Second Phase.

2.2 The First Phase

In the First Phase the auctioneer announces the initial prices and records the quantities offered by each seller for each product. If supply exceeds demand for any product, it is termed an "Open Product" and its price will be reduced by a preset increment in the following round. If demand exceeds supply for any product it is called a "Closed Product", and its price will remain unchanged in the following round. Units or lots offered on Open Products are called "Free Lots" and these may be offered on other Open or Closed Products in the following round. Lots offered on Closed Products are called "Lots Taken" and these may not be offered on other products in subsequent rounds. A Closed Product may become

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[5] The case for dynamic auctions is further strengthened when it is recognized that it is costly for bidders to determine their preferences. A dynamic auction, by providing tentative price information, helps to reduce these costs for bidders. See Ausubel and Cramton (2004), "Auctioning Many Divisible Goods," *Journal of the European Economic Association*, 2, 480-493.

an Open Product as the auction proceeds when sufficient new lots are offered for it. However, a seller's aggregate supply on all five products may not increase during the auction, i.e. each bidder must offer its maximum aggregate quantity in the first round of the auction.

The First Phase proceeds until the Reference Offer exceeds aggregate supply and all reserve prices have been met. If aggregate demand exceeds aggregate supply and the reserve prices for one or more products have not been met, the quantity demanded for those products is reduced and the process repeats.[6]

Thus the First Phase may finish with all products classified as Closed Products, or with a combination of Open and Closed Products. At the end of each round of the first phase, including the final round, bidders are informed which of their lots are associated with Open and Closed Products respectively, and the current or closing prices for each product.

2.3 The Second Phase

In the Second Phase of the auction each seller submits new bids for its lots associated with each Open and Closed Product. Only one new bid per product is allowed and must be for the seller's entire quantity of lots in that product. Each price offered must be less than the First Phase closing price. Sellers who do not offer a bid will be assumed to willing to supply their lots at the First Phase closing prices (i.e. to implicitly have bid in their lots at these prices).

Bids for Open Products may also include 'conditional bids' stating the price at which the seller is willing to supply any lots which are unsuccessful on that Open Product to one or more of the Closed Products. That is, lots which are "bumped" from an Open Product may be offered on Closed Products. Such lots may not be moved to another Open Product however, and neither may lots be moved from any Closed Product.

Having received the menu of bids for each product, the auctioneer then ranks the bids in descending order, starting with the Open Products and continuing to Closed Products, accepting the lowest bids first and breaking ties with a randomizing device. Successful bidders will be paid their bid prices for each product.[7]

3. Issues in the Auction Design

A number of features of the overall auction design, and some of the particular auction rules, appear to us to be problematic and worth reconsidering. Since we have not had an opportunity to run a full-scale simulation of the likely equilibrium strategies in the auction, we confine ourselves to briefly noting the problems which are apparent from a consideration of first principles.

1. There seems to be no *a priori* reason to believe that the Second Phase of the auction will result in lower prices for the products than those that would result from following a standard descending clock auction design which finishes only when all products are "closed," i.e. when demand exceeds supply for each product. In particular, it is well-known that discriminatory auctions do not typically result in lower prices in multi-unit settings than do uniform-price

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[6] According to what rules or procedures demand for any product will be reduced when its reserve price has not been met has apparently not been specified in the published auction rules.

[7] Note that successful bidders for Closed Products may receive two different prices: the price bid for lots already associated with that product, and the price bid for lots that were unsuccessful in some Open Product and hence moved to compete for the Closed Product.

auctions.[8] Therefore, if the primary purpose of the Second Phase is to generate more price competition, the logic upon which it is based appears to be ill-founded.

2. The Second Phase is a sealed-bid discriminatory auction for which predicting the likely equilibrium outcomes is difficult.[9] These difficulties are compounded by the rules which allow the movement of lots from Open to Closed Products (but not from Closed to Closed Products). This means that to calculate their profit-maximising bidding strategies, sellers will have to first solve for the (possibly mixed-strategy) equilibrium in the last Closed Product , then in the second-to-last Closed Product, and so on until they reach the first Open Product. Given that bidders will have very little information upon which to base their calculations in the Second Phase, determining their optimal bidding strategies will be a formidable, and probably unrealisable, task. This in turn will create great uncertainty in bidders' minds concerning the likely strategies that will be played by other bidders, further compounding their prediction problems. Proposing a one-shot, discriminatory auction of this magnitude for which bidders' optimal second-phase strategies will be surrounded with such a high degree of uncertainty appears to us to be extremely unwise. It seems certain to reduce the overall efficiency of the auction, without being guaranteed (or even likely) to result in lower average prices.

3. Further, the auction's Second Phase seems highly likely to distort the sellers' First Phase bidding incentives, for instance by making it appear advantageous to have more supply allocated to Open rather than Closed products when the First Phase closes. This is because lots may be moved from Open to Closed Products in the Second Phase, but not from Closed to Closed Products. Thus bidders with units in Open Products will have multiple opportunities to submit successful bids on a sequence of Closed Products, whereas those with units in Closed Products will not.

4. In any case, the rule forbidding the movement of units from Closed to Closed products seems to serve no particular purpose, and will reduce the overall efficiency of the auction, since with positive probability some units will be discarded altogether which would otherwise have been available for a Closed Product for which demand exceeds supply.

5. The Second Phase of the auction is thus likely to distort First Phase bidding incentives in a way which seems certain to prevent or inhibit efficient price discovery from occurring in the First Phase, as was presumably intended. In addition, the First Phase appears not to provide sufficient information to bidders for efficient price discovery or for overcoming the winners' curse. Limiting bidders' information to the status ("Free" or "Taken") of their own lots will make it difficult for them acquire any useful information as the auction proceeds. At the very least bidders should be informed of the aggregate supply

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[8] See K. Binmore and J. Swierzbinski (2000) "Treasury Auctions: Uniform or Discriminatory?" *Review of Economic Design*, Vol. 5, 387-410, and N. Fabra, N-H von der Fehr and D. Harbord (2002) "Modeling Electricity Auctions, " *The Electricity Journal*, August/September, 72-81, for discussions of this issue.

[9] The equilibria may well be in mixed strategies whenever bidders do not have sufficient lots to satisfy all of the demand for a product, but there is excess supply in aggregate. See N. Fabra, N-H von der Fehr and D. Harbord (2004) "Designing Electricity Auctions," (www. market-analysis.co.uk/publications) where such strategies are described.

offered for each product at the end of each round, and possibly the excess supply for each product (positive or negative).[10]

4. Conclusions

The problems noted above mean that we can see no clear purpose in adopting such a hybrid auction format. The proposed auction does not seem to incorporate any of the particular features of other two-stage auctions which have been proposed in the literature, and which make their designs useful for their purpose.[11] Although the Second Phase may be intended to reduce prices, possibly by limiting opportunities for collusion, it runs the serious risk of distorting the auction's overall performance.

The proposed electricity auctions are of such a magnitude and of such importance for the economy of Brazil that it is dangerous to experiment with an untried and untested auction design of doubtful efficacy. We strongly recommend that the MME re-examine this issue, and consider using an appropriately modified version of the First Phase auction format alone, which has already been successfully employed in not dissimilar circumstances.

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[10] See Ausubel and Cramton (2004), "Auctioning Many Divisible Goods," *Journal of the European Economic Association*, 2, 480-493, April-May and Ausubel, Cramton and Milgrom (2004) "The Clock-Proxy Auction: A Practical Combinatorial Auction Design," forthcoming in P. Cramton, Y. Shoham and R. Steinberg (eds.), *Combinatorial Auctions*, MIT Press, 2005.

[11] For instance, the "Anglo-Dutch" auction proposed by Ken Binmore and Paul Klemperer ("The Biggest Auction Ever: The Sale of the British 3G Telecom Licences," *Economic Journal,* 112, 2002), which was intended to encourage entry at the cost of introducing some inefficiency, or the "clock-proxy" auction which is intended to increase efficiency in combinatorial auction settings (Ausubel, Cramton and Milgrom "The Clock-Proxy Auction: A Practical Combinatorial Auction Design," forthcoming in P. Cramton, Y. Shoham and R. Steinberg (eds.), *Combinatorial Auctions*, MIT Press, 2005).