Informational rents in oil and gas concession auctions in Brazil

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ABSTRACT

This article aims to estimate the informational rents earned by winning bidders in oil and gas exploration and production auctions in Brazil. We estimate the distributions of bids and bidders' private valuations using a nonparametric structural model and assuming independence and asymmetry between participants. Petrobras, the Brazilian state-owned petroleum giant and former oil sector monopolist, was considered a competitor that was distinct from other competitors. Thus, we investigate a database based on information from all auctions held between 1999 and 2008. The results suggest that Petrobras earned significantly higher information rents than other competitors. Such rents ranged from 15% to 63%, depending on the number and type of competitors.

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1. Introduction

The modern regulatory framework for the Brazilian oil industry was instituted with the passing of the Oil Act (Lei do Petróleo, 9.478/97) in 1997. The new law regulated the Constitutional Amendment (Emenda Constitucional, 9/95) that broke the monopoly that Petrobras had enjoyed on oil and gas exploration and production activities. One of the most significant changes was the creation of auctions – known as Bidding Rounds – that controlled the concession rights for exploration in inland and continental shelf areas. The auctions are first-price sealed-bid in which bidders submit concealed bids that are opened simultaneously with one another. The winner is the bid with the highest score on a set of criteria, including the bid offered, the exploration program and the purchase commitment with domestic suppliers. Since 1999, 10 Bidding Rounds have been conducted, and the results have been quite significant in terms of revenue and the entry of private companies into oil and gas activities in Brazil.

There are two significant issues related to the new regulatory framework and the role of these auctions in Brazil. The first concerns the involvement of Petrobras, the state-owned Brazilian oil giant. Because it operated as a monopolist for four decades and has amassed data on the potential of Brazilian oil fields, it naturally enjoys an information asymmetry in such auctions. The second issue is related to the efficiency of the auctions in extracting information rent from bidders, i.e., how closely the bid approaches to the private company's actual valuation of the auctioned area.

The aim of this paper is to estimate the information rents earned by the winning bidders in ten rounds of bidding through the use of a nonparametric estimate of the distributions of auction bidders' valuations. Thus, it is possible to analyze how the government collects the bidders' surplus and how successful bidders are in winning the concession with the lowest possible value. Specifically, we are interested in assessing whether there are significant differences in rents earned by Petrobras compared to the other bidders. The results suggest that asymmetries that favor Petrobras generate higher information rents for the company and that, as expected, auctions with fewer participants generate a lower surplus extraction for the government. Because the Brazilian government plans resumed the auctions in 2013, we aim to contribute to the discussion about improving the concession policies of exploration areas following the pre-salt drilling program.

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Auctions are selling mechanisms that are often characterized by asymmetric information (McAfee and McMillan, 1987). Auctions are attractive to sellers because it may be possible to extract the whole consumer surplus, even though the auctioneer does not know the bidders' willingness to pay. Auctions would be meaningless as selling mechanisms if private valuations were public – if there were perfect information – because the bidder would merely set a price equal to the bidder's valuation of the object sold. Auctions are also useful when the value of the auctioned good is unknown for both sellers and bidders, as in the case of an oil and gas concession area (McAfee and McMillan, 1987).

The relationship between the auctioned object and the auction's information structure has generated two main models (Laffont and Vuong, 1996). The first one is the *private value auction*, in which bidders perform their own valuation of the good, independently or not from the valuations of other bidders. The second model is known as the *common value auction* (also known as the mineral rights model), in which bidders receive a common signal on the value of the auctioned object that is unknown ex ante.

Auctions are the most common form of allocating oil and gas exploration rights worldwide. The choice of the underlying model to analyze them is a complex task and can be controversial. The pure common value model was developed driven by the concession of oil and gas exploration areas (to such an extent that it is also called the mineral concession model) and includes Wilson (1969) and Ortega-Reichert (1967) among its pioneers. An important characteristic of mineral auctions is that companies attempt to estimate a common value for the auctioned goods.

Until the mid-1990s, the common value model was dominant in hydrocarbon concessions because of the specific characteristics of the sector, which involve granting the rights to explore and produce an unknown amount of resources at uncertain costs. Technological constraints that prevailed in the oil industry until the 1950s contributed to the permanence of the mineral concession model. Under this paradigm, participating bidders receive a signal on the value of the auctioned object and thereby set their bids. Reece (1978) shows that increased uncertainty and a reduced number of bidders contribute to raising the rents of the winning bidder at the government's expense. Reece (1979) also simulated the rent sharing between the government and bidders under different contractual arrangements and concluded that expected governmental revenue from auctions is higher under a profit-sharing plan and lower under a single bonus plan.

Under this structure, imperfect information may result in a 'winner's curse' (Kagel and Levin, 1986); i.e., the winning bidder's tendency is to overestimate the value of the object, assuming that the average estimate is non-biased. Thus, the winning bidder would have paid a value above the actual value of the object. In this context, there are several contributions to the literature on oil and gas auctions, including articles concerning the performance of bids when there are information asymmetries between bidders. Hendricks et al. (1994) examined how such information asymmetries affect the strategic behavior of bidders under the common value model. The analysis was performed using a bidder with more private information than all the other bidders (who only have access to public information). The authors conclude that the equilibrium behavior in this information structure often drives bidders with little information to offer less than informed bidders. Similarly, Porter (1995) builds a stylized model with asymmetric competitors (informed versus non-informed bidders). A significant result of this model is that informed bidders are more likely to win the auction and to show positive information rent when they win, whereas non-informed competitors report a null payoff. Thaler and Tucker (1995) report strong evidence of a winner's curse in auctions in the Gulf of Mexico between 1954 and 1969, based on a quantitative survey of unproductive and barely profitable wells.

Although it initially focused on common value, the literature on oil auctions began to recognize the existence of a private component in the bid launching process because of bidder heterogeneity (Cramton, 2007). Indeed, Li et al. (2000) showed that the private component is relevant to oil auctions in the US OCS data while estimating a conditionally independent private value model. This led to a reformulation of the analysis model regarding this form of bidding to include the private component of bids. Moreover, recent technological developments have enabled companies to gain cost advantages that contribute to affect their assessment of the good, which created a rationale for the use of private value that is based on structural models. Accordingly, the number of empirical analyses has substantially increased in recent years. The premise of such models is to estimate the unobserved private values (termed pseudo-values) under the hypothesis that optimal strategies are defined according to an underlying game.[2] Currently, the literature features significant contributions to the structural estimation of auction models using the non-parametric approach, including Guerre et al. (2000), Li et al. (2002), Hendricks et al. (2003), Campo et al. (2003), Bajari and Hortaçsu (2005), Flambard and Perrigne (2006), among others.

In private value auctions, information rent is defined as the winning bidder's surplus, i.e., the difference between the bidder's private value and the actual bid launched. Information rents are so named because the bidder's valuation of the auctioned object is private information that precludes the auctioneer from fully discriminating bidders (Krishna, 2002, chapter 5), and the winning bidder benefits from a rent for the partial disclosure of his private information. The lower the winning bid is relative to the private valuation, the higher the bidder's information rent for the auctioned object.

The presence of information rents is inherent in the private value mode. Depending on the type of auction, the role of the equilibrium bid – the optimal bid as a function of private value – produces a lower offer than the actual private value. This occurs, for example, in first-price sealed-bid auctions (Paarsch and Hong, 2006, chapter 2); the auctioneer will be more efficient the closer the winning bid is to the maximum private value among bidders involved in the auction.

The estimation techniques of these private values became progressively more complex over time. Following Li et al. (2000), Campo et al. (2003) estimated information rents of US OCS auctions in the 1970s using an affiliated private value model with asymmetric bidders. The results show information rents of approximately 65%, which were higher for consortium bids. Using simulated private value bids, Li et al. (2002) estimated information rents of approximately 38% for two-bidder auctions and 29% for three-bidder auctions.

Flambard and Perrigne (2006) estimated information rents and evaluated the inefficiency of auctions in hiring snow removal services in Canada under the hypothesis of independent private value and asymmetry between bidders, which was defined by costs that depended on the location of the company. The asymmetry of costs is conclusively relevant and accounts for inefficient allocations.

The current paper has an empirical nature and aims to apply the methodology of the articles described above to the evaluation of information rents in oil and gas bidding auctions in Brazil. If companies are appropriating large private surpluses, there may be a low level of competition in such auctions, which might indicate that policy measures should be undertaken to correct this.

This article is structured in 5 sections, including this introduction. Section 2 describes and analyzes the database, including a discussion about the main determinants of bids, and Section 3 discusses the theoretical model underlying the estimation of information rent and empirical estimation procedures in general terms. Section 4 describes

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[2] As highlighted by Perrigne and Vuong (1999), there are two approaches for estimating and treating data. The first is parametric, which estimates the parameters through maximum likelihood under a known distribution of unobserved values. The second is nonparametric, which is based on indirect procedures linking private value to observed bids. The disadvantage of the nonparametric approach is that it requires a large database of bids, whereas the parametric one requires less data but utilizes the computation of a function defining the optimal strategy, which may not be feasible.