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The nature of information and its effect on bidding behavior: Laboratory evidence in a first price common value auction☆

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ABSTRACT

We study in the laboratory a series of first price sealed bid auctions of a common value good. Bidders face three types of information: private information, public information and common uncertainty. Auctions are characterized by the relative size of these three information elements. Only half of our subjects bid differently depending on whether the last piece of information obtained is private or public but they do not react to each type of information as predicted by theory. The other half of the subjects do not distinguish between private and public information and either consistently underbid or consistently overbid.

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1. Introduction

Common value auctions have been extensively studied in the laboratory. Two major findings are behavioral heterogeneity (Crawford and Iriberri, 2007) and the pervasiveness of the winner's curse (Kagel and Levin, 1986, 2008). Despite the existing literature, our knowledge of bidding behavior in those games is still incomplete. The goal of this paper is to improve such understanding. To this purpose we introduce two novel features in the design of an otherwise standard first price sealed bid common value auction with two bidders. First, we assume that the value of the good is the sum of N independent components and that each bidder observes the content of a subset of these components. Subjects always know which components are observed by the other bidder. Therefore, there are three clearly identified possible types of information in the game: private information (the components observed by only one bidder), public information (the components observed by both bidders) and common uncertainty (the components observed by no bidder). Second, we vary the number of components observed by each bidder, which affects the information structure in the auction. We consider five different structures: two with private information and common uncertainty, two with private information and public information, and one with private

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information only. Assuming risk neutrality, we show that the Nash Equilibrium (NE) bid in this auction is the sum of different elements each reflecting one type of information. With respect to private information, bidders shade their bids like in a typical common value auction (see e.g. Milgrom and Weber, 1982). With respect to common uncertainty and public information, bidders compete à la Bertrand and bid the expected value and the realized value respectively.

This auction is run in the laboratory and the experimental data is analyzed in different ways. First, we perform descriptive statistics of aggregate bids, aggregate payoffs, and changes in aggregate bids as we vary the information structure. We show that, on average, bidders do not distinguish correctly between the three different types of information. In our experiment, half of the subjects change their bids in a similar way whether the new piece of evidence is observed privately or observed also by the other bidder. This suggests that subjects do not make a rational strategic use of private information, resulting in deviations from NE predictions. Our aggregate analysis also reveals a large dispersion, implying a high level of behavioral heterogeneity in our population. To study this issue in more detail, we then conduct a cluster analysis. Since deviations from NE predictions seem to be driven by a wrong understanding of the information structure, we compute for each subject the average deviation from the NE prediction in each information structure. Given this new dataset, we conduct a model-based clustering method to endogenously determine clusters of individuals. This method reveals the existence of 6 distinct clusters in our population, differing in the size of their departures from NE as a function of the information structure. The analysis of each cluster separately reveals that heterogeneity across individuals is largely due to their different comprehension of the information structure. Only 63% of our subjects (clusters 1, 2 and 5) bid relatively close to equilibrium. Of these, 46% (clusters 1 and 2) realize the existence of the different types of information. They bid differently depending on whether the new information is private or public, although they still exhibit deviations from Nash: they overbid common uncertainty and underbid public information. The other 17% (cluster 5) have a much more imperfect grasp of the different types of information. Finally, 37% of the subjects (clusters 3, 4 and 6) hardly differentiate between public and private information and consistently overbid or consistently underbid.

Our analysis relates to two strands of the experimental literature: common value auctions and auctions with variable amounts of information. Kagel and Levin (1986) is the classical reference on common value auctions in the laboratory. They assume the value of the good is drawn from some distribution (typically uniform). Bidders receive a signal which is drawn from another distribution centered around the true realization. We use a slightly different model where the value of the good is the sum of several independent signals, and each signal may or may not be observed by bidders. This is formally closer to Albers and Harstad (1991), Avery and Kagel (1997), and Klemperer (1998).[1] As noted above, the novelty of our paper lies in explicitly modeling different types of information and varying their relative importance.

The experimental literature that varies the amount of information in auction settings is also related. Andreoni et al. (2007) study a series of private value auctions in which bidders know not only their own valuation but also the valuation of some other bidders. Naturally, the private value setting precludes any winner's curse problem. Mares and Shor (2008) analyze common value auctions with constant informational content but distributed among a varying number of bidders. The paper explores the trade-off competition vs. precision of estimates. Grosskopt et al. (2010) experimentally investigate the role of asymmetric information by varying the number of bidders who receive a signal about the common value of the good. Like our study, they find that the winner's curse increases with private information. However, they do not study how the existence of other types of information may affect the bidding strategy of subjects. Finally, in Brocas et al. (2014a) we study a similar problem than here using a second price auction and a slightly different design. The objective is to determine whether the imperfect differential treatment of private and public information also occurs under alternative mechanisms. The answer is affirmative: we also find that in second price auctions subjects differentiate insufficiently between private and public information. The paper however focuses on the study of individual strategies to explain the deviations from Nash equilibrium rather than a cluster analysis to understand common patterns of choice.

The paper proceeds as follows. The theoretical framework is briefly described in Section 2. The experimental setting is developed in Section 3. The aggregate analysis of the experimental data (aggregate bids, aggregate payoffs and changes in aggregate bids as a function of the type of information revealed) is discussed in Section 4. The cluster analysis and the regression analysis are performed in Section 5. Final conclusions are presented in Section 6. A sample copy of instructions can be found in the online Appendix.

2. Theoretical model

Consider a single good made of N components (with N even and greater than or equal to four). Each component $i \in \{1, \ldots, N\}$ has a value x_i independently drawn from a continuous distribution with positive density $g(x_i)$ on $[\underline{x}, \overline{x}]$ and cumulative distribution $G(x_i)$. The total value of the good is the same for every individual and equal to the sum of the components, $V = \sum_{i=1}^{N} x_i$.

[1] In the first study the good is the sum of the signals and each bidder observes only one signal, hence the number of bidders is equal to the number of signals. In the last two studies, each bidder has one private signal. The value of the good is the sum of the signals for one bidder and the sum of the signals plus a private value component for the other bidder. Therefore, when the private value component is zero, their model is equivalent to our treatment with only private information.

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