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Market performance and collusion in sequential and simultaneous multi-object auctions: Evidence from an ascending auctions experiment ☆

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Abstract

We compare efficiency and susceptibility to collusion of two alternative ways to sell multiple objects in independent private values environments: simultaneous and sequential ascending auctions. Both auctions are common in the real world. With explicit communication among bidders, collusion was more frequent in sequential than in simultaneous auctions. We further analyze collusive schemes adopted by bidders.

JEL classification: C92; D44; L41

Keywords: Multi-object auctions; Experiments; Collusion

1. Introduction

Multi-object auctions have become a subject of close attention of economic theorists and experimentalists, both due to an academic interest, and to a growing use of multi-object auctions in practice. Government auctions to sell the electro magnetic spectrum are among the most broadly-discussed recent examples of multi-object auctions (e.g., Cramton, 1998; Jehiel and Moldovanu, 2003). There are many other real-world examples, however. Multiple procurement contracts, real estate, utility procurement and school milk contracts are offered for sale annually (Pesendorfer, 2000). The auction formats vary from case to case, including both simultaneous and sequential auctions. Spectrum auctions in many countries adopted a simultaneous ascending auction format, with an argument that such format allows better coordination and promotes the efficient aggregation of complementary licenses (McAfee, 1999; Cramton, 1998; Cramton and Schwartz, 2000; Klemperer, 2002). In other cases, multiple objects such as estate, used cars, cattle, fish, vegetables, timber and wine are often allocated in comparable lots at sequential auctions (Phillips et al., 2003; Caillaud and Mezzetti, 2004; Raviv, 2006).

In many cases, such as spectrum license sales, the auction format is chosen by the auctioneer with an objective to meet certain performance criteria, such as efficiency, revenue maximization and collusion–

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proofness. The laboratory research that compares different auction formats in view of these criteria is therefore of immediate interest. Indeed, several experimental studies have compared efficiency and revenue-raising properties of simultaneous and sequential multi-unit auction. Lunanders and Nilsson (2004) compare bidding behavior for multiple identical contracts in first-price simultaneous, first-price sequential and first-price combinatorial auctions. They report that when bidders have non-linear average costs of winning more than one contract, combinatorial auctions are the most efficient. Goeree et al. (2006) compare the performances of first-price simultaneous, first-price sequential, simultaneous descending and simultaneous ascending auctions in various bidding environments with single-unit demand. They find that simultaneous ascending auctions are the most efficient, but at the same time they yield lower and more variable revenues than other auction formats. While Goeree et al. note that low and variable revenues in uncompetitive situations yield suspicion of collusion, they do not study collusion per se and do not compare susceptibility to collusion across auction formats. This is what we do in this paper.

We investigate and compare performances of simultaneous and sequential ascending multi-object auctions with an emphasis on their susceptibility to collusion. Vulnerability to collusive bidding has been a major concern in many real-world multi-unit auctions, such as auctions for school milk contracts (Pesendorfer, 2000), or spectrum auctions (Cramton and Schwartz, 2000; Jehiel and Moldovanu, 2003). We focus on ascending auctions, which have been argued both to enhance efficiency, and to be more vulnerable to collusion than sealed bid auctions (Klemperer, 2003). Collusive tendencies may differ between sequential and simultaneous ascending auctions due to strategic or other differences among the institutions. For example, sequential auctions may discourage collusion through backwards induction:[1] Collusive agreements cannot be sustained in the final period, possibly unraveling to earlier periods of the auction. On the other hand, if simultaneous nature of the auctions imposes high complexity costs on boundedly rational bidders, then bidders may find it easier to collude in sequential auctions.

Another objective of this study is to see how bidders collude in ascending auctions. Theoretical literature analyzes collusive schemes supportable as equilibria under different auction institutions. McAfee and McMillan (1992) show that in a static single-object sealed bid auction without side payments, the best collusive scheme a cartel can use is random assignment of the object at the reserve price. Fudenberg et al. (1994) show that in repeated auctions with communication, a folk theorem implies that various collusive schemes can be supported as subgame perfect equilibria. Skrzypacz and Hopenhayn (2004) demonstrate that in repeated sealed-bid auctions with no communication and no side payments, collusion better than bid rotation of objects is feasible. Aoyagi (2003) also argues that if an auction with communication is repeated, then even without side payments, a dynamic scheme payoff-superior to any static one can be implemented. Such dynamic "splitting objects across time" schemes are somewhat similar to the static ranking mechanism discussed by Pesendorfer (2000) for collusion in multi-object auctions, where bidders submit their preferences for the objects. Due to the absence of side payments, each collusive scheme has to give each bidder a sufficiently high share of objects to insure incentive compatibility. Kwasnica (2000) notes that the serial dictator scheme, where an order of bidders is selected randomly, and then bidders proceed in turn each choosing one object, is another incentive compatible mechanism to allocate multiple objects within a cartel. Brusco and Lopomo (2002) show that in simultaneous ascending price auctions for multiple objects, collusion via signaling is possible even in a non-repeated setting without communication. A common feature of the multi-object and dynamic collusive mechanisms discussed above is that they all improve efficiency as compared to the random assignment by assigning each bidder the objects he or she values more with higher probability. In this paper, we allow explicit communication among bidders and consider collusive schemes adopted by bidders in view of the theoretical possibilities discussed above.

The research on collusion in various experimental markets has been extensive, with early contributions including Fouraker and Siegel (1963) and Isaac and Walker (1985). Recently, more studies focus on multi-object auctions. Kwasnica (2000) reports that bidders successfully collude in multi-object sealed bid auctions with communication. He provides evidence that bidders used collusive schemes that were payoff-superior to random assignment; in particular, the ranking mechanism of Pesendorfer (2000) was adopted frequently. Kwasnica and Sherstyuk (2007) study tacit bidder collusion in simultaneous ascending price auctions but do not compare the results with the sequential auction setting. They provide evidence of collusion via signaling consistent with Brusco and Lopomo (2002) in two-person experimental markets. Burns (1985) reports some cases of collusion in sequential auctions. Phillips et al. (2003) give evidence of bidder collusion in

[1] This may be true even in a repeated auctions framework, as long as bidders focus on the stage game.