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Bribing in second-price auctions

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ABSTRACT

An IPV 2-bidder second-price auction is preceded by two rounds of bribing: prior to the auction each bidder can try to bribe his rival to depart from the auction, so that he (the briber) will become the sole participant. Bribes are offered sequentially, according to an exogenously given order. Restricting attention to pure strategies (and imposing a certain refinement), I study the efficient equilibria of this game. In any such equilibrium, whenever the first mover offers a strictly positive bribe, this bribe is given by his *surplus*: his valuation minus the payoff that he would have received in the dominant-strategy equilibrium of the auction. I derive a necessary and sufficient condition for the existence of such an equilibrium. I also extend this equilibrium's construction to a model with general valuations, not necessarily IPV.

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1. Introduction

Collusion among participants in auctions is a serious and well-documented problem.[1] In the simplest collusive scenario, the cartel members meet prior to the auction in order to decide on side-payments and on a representative bidder, who will bid in the auction on behalf of the cartel. The existing literature typically assumes that this pre-auction interaction takes the form of a revelation game or a "knockout auction".[2] In a revelation game, each cartel member reports a valuation, and the collusive agreement is determined as a function of the profile of reports (and possibly further information, such as the behavior of non-cartel-members). A "knockout auction" is an auction that the cartel members run among themselves, for the right to participate in the real auction.

A general revelation game as well as the more specific "knockout auction" are both *one-shot* mechanisms. In reality, however, collusive situations are a special kind of *bargaining situations*, and the latter, by their very nature, are *sequential*: the parties go through a "face-to-face" negotiation process that leads to a collusive agreement (or disagreement). During such a negotiation phase there is signaling (the players' moves signal their private information), which gives rise to an adverse selection problem—full revelation of a player's private information is not incentive compatible for him, and without full information revelation efficiency cannot be achieved in a non-competitive manner. Static models, therefore, miss a central aspect of the strategic interaction, an aspect that has major implications on efficiency. The goal of the current paper is to focus on this signaling aspect, with a special emphasis on its relation to efficiency. This will be done in the context of the following model.

I consider a 2-bidder second-price auction with independent and private values (henceforth IPV) which is preceded by two rounds of bribing; each bidder, in his turn, can offer his rival a bribe in exchange for the latter's departure from the

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1 See, for example, Baldwin et al. (1997), Cassady (1967), and Porter and Zona (1993).

2 Leading examples include Graham and Marshall (1987), Mailath and Zemsky (1991), Marshall and Marx (2007), and McAfee and McMillan (1992).

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auction. Bribes are offered sequentially according to an exogenously given order, and if both offers are rejected then the pre-auction phase ends, and both bidders go on to compete against one another in the auction. This game is an extension of the "take-it-or-leave-it" (TIOLI) game of Esö and Schummer (2004, henceforth ES), which consists of a second-price auction and a single pre-auction round, in which a designated player has the opportunity to offer his rival a bribe in exchange for the latter to depart, and bribe-rejection terminates collusion and leads to the (non-cooperative) auction. That is, the present model is obtained by adding one round of bribing to that of ES.

Contrasting the current analysis with that of ES will clarify the differences between the case where one side has all the bargaining power and the case where both parties can initiate collusion. The consideration of a longer and richer bargaining protocol will shed light on the scope of collusion via simple bribing contracts, and on the strategic reasoning that underlies it.

The simplicity of the collusive contracts studied in this paper is important; in particular, it shows that efficient collusion can be achieved under weak commitment assumptions, in contrast to stronger assumptions that are often made when collusion is assumed to be carried out with the help of an incentiveless third party (see Section 1.2 below).

1.1. Summary of the results

In a bribing game, the amount a briber offers depends on his valuation (type); his behavior when he bribes is summarized by a *bribing function*, defined on his type-space. Considering the TIOLI game, ES derived (under some regularity conditions on the type distribution) the unique bribery-involving equilibrium in which the bribing function is continuous. In this equilibrium, inefficiency results with a positive probability, because all the types of the briber above a certain threshold offer the same bribe, which is accepted by all the types of the respondent. The reason for this "nonseparation at the top" is that it is enough for a briber to signal that he is "sufficiently strong" in order to make sure that his bribe is accepted.

In contrast to ES, I show that with two rounds of bribing, efficiency can be achieved. I show that in any efficient equilibrium, whenever the first mover offers a strictly positive bribe, this bribe is given by his *surplus*: his type (or valuation) minus the payoff that he would have received in the dominant-strategy equilibrium of the auction. That is, with the first and second mover being player 1 and player 2 respectively, with i's valuation denoted by θ_i and with the expected payoff in the dominant-strategy equilibrium of the second-price auction of type θ_i of player i denoted by $\pi_i^*(\theta_i)$, player 1's offer in any efficient equilibrium, if it isn't zero, is given by $b^*(\theta_1) \equiv \theta_1 - \pi_1^*(\theta_1)$. I provide a necessary and sufficient condition for the existence of an efficient equilibrium whose bribing function is b^*. This is an equilibrium in which the first mover reveals his private information entirely, because b^* is strictly increasing.

In the aforementioned equilibrium, player 1's payoff coincides with his non-cooperative payoff, $\pi_1^*(\theta_1)$, independent of θ_2. The reason is that conditional on $\theta_2 < \theta_1$ player 2 accepts the offer so player 1 becomes the sole bidder in the auction and ends up with the net payoff $\theta_1 - b^*(\theta_1) = \pi_1^*(\theta_1)$, while conditional on $\theta_2 > \theta_1$ player 2 rejects the bribe and makes the counteroffer $\pi_1^*(\theta_1)$, which player 1 accepts.[3]

I also construct an analogous equilibrium for the case of general valuations, not necessarily IPV.

Throughout the paper, attention is restricted to pure strategies. Additionally, some of the results require additional assumptions (i.e., refinements); these will be described in detail in Section 2.

1.2. Related literature

This paper contributes to a growing body of literature on collusion in one-shot auctions.[4] Most of this literature takes the mechanism-design approach to collusion and studies direct revelation mechanisms, which, in many cases, the cartel operates with the help of an incentiveless third party. Seminal contributions to this literature include Graham and Marshall (1987), Mailath and Zemsky (1991), Marshall and Marx (2007), and McAfee and McMillan (1992). These papers take the standpoint of the cartel and seek to design mechanisms that are desirable for the bidders.

The other side of the "mechanism-design coin" is to take the standpoint of the seller, and look for auction formats that are immune to collusion. Che and Kim (2009, henceforth CK) take this approach, and derive a collusion-proof auction. It is important to note that the work in CK does not invalidate the contribution of the current paper. First, the current paper assumes that the seller is not strategic and that he employs a standard auction format (second-price). CK considers a strategic seller who employs a nonstandard format. More importantly, the focus of the current paper is on pre-auction signaling among the bidders, an aspect which is absent from CK, since it models collusion as a one-shot signaling-free stage.[5]

[3] Note that this equilibrium implements a version of the "*Texas shoot-out*" rule (see McAfee, 1992). For division problems between two agents, this rule is as follows: one agent offer a payment, and the other agent chooses whether to buy or sell for that proposed payment.

[4] A related branch of research considers collusion in a repeated-game setting. Contributors to this literature include Aoyagi (2002, 2007), Athey and Bagwell (2001, 2008), Blume and Heidhues (2006), Hörner and Jamison (2007), Rachmilevitch (2013), and Skrzypacz and Hopenhayn (2004).

[5] Dequiedt (2007) and Pavlov (2008) also study collusion-proof auctions. In both of these papers, as in CK, there is no signaling among the bidders at the pre-auction stage.

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