Available online at www.sciencedirect.com
ScienceDirect
Journal of Economic Theory 131 (2006) 179–211
JOURNAL OF Economic Theory
www.elsevier.com/locate/jet

Private monitoring in auctions

Andreas Blume[a], Paul Heidhues[b,*]

[a] *Department of Economics, University of Pittsburgh, Pittsburgh, PA 15260, USA*
[b] *Department of Economics, University of Bonn, Adenauerallee 24-42, 53113 Bonn, Germany*

Received 4 August 2003; final version received 24 May 2005
Available online 24 August 2005

Abstract

We study infinitely repeated first-price auctions in which a bidder only learns whether or not he won the object. While repetition of the stage-game equilibrium is the unique Nash equilibrium in public strategies, with patient bidders there are simple Nash equilibria in private strategies that improve on bid rotation. Sequential rationality is appropriately captured by *essentially perfect Bayesian equilibrium* (*EPBE*), which ignores behavior after irrelevant histories. Our main result is the construction of *EPBEa* that improve upon bid rotation. Assuming symmetry, the exclusionary schemes of Skrzypacz and Hopenhayn [Tacit collusion in repeated auctions, J. Econ. Theory 114 (2004), 153–169], including asymptotically efficient ones, are supported as *EPBEa*.

JEL classification: D44; C73; L13; L12

Keywords: Auctions; Tacit collusion; Repeated games; Cartels; Withholding information

1. Introduction

Many resources are allocated through auctions and collusion in auctions is widespread.[1] Experimental evidence as well as theoretical arguments support the intuitive belief that

* Corresponding author. Fax: +49 228 737940.
E-mail addresses: ablume@pitt.edu (A. Blume), heidhues@wz-berlin.de (P. Heidhues).

[1] For example, Froeb [21] points out that 81% of all Sherman Act cases filed by the Department of Justice between 1979 and 1988 involved auctions. Aoyagi [4] mentions that in 2001 alone, the Japan Fair Trade Commission (JFTC) issued warnings to 928 firms in 33 collusion cases regarding government procurement auctions. In all cases the warning was based on allegation that firms "collaborated to predetermine a winning bidder." Porter and Zona [40] discuss bid rigging in procurement auctions. Baldwin, Marshall and Richard [11], Cassady [16], Hendricks and Porter [24], and Pesendorfer [39] report evidence on the occurrence of collusion in auctions for timber, antiques, fish, wool, oil drainage leases, and school milk.

0022-0531/$ - see front matter © 2005 Elsevier Inc. All rights reserved.
doi:10.1016/j.jet.2005.05.007

collusion becomes harder if the auctioneer releases less information about bidders' behavior in the auction.[2] Thus—unless there are other benefits from information release—the auctioneer appears to have an incentive to suppress as much information as he can to fight collusion. We say that the auctioneer *withholds all information* if after each auction each bidder has only the information that cannot be concealed from him. In the case of the first-price auction of an indivisible object, which we consider in this paper, the information that cannot be concealed includes a bidder's own value, his bid, and whether or not he received the object.[3] Perhaps somewhat surprisingly, we will show that even by withholding all information, the auctioneer cannot prevent collusion.

We study the effect of limiting information release on collusion in a repeated-game environment. The same set of bidders repeatedly participates in a first-price auction for a single object. Valuations are drawn independently across bidders and time. The literature on repeated auctions, e.g. [4,5,44,14] thus far has focused on studying perfect public equilibria under variety of assumptions on communication among and information available to bidders. It follows from standard results on repeated games (see [22]) that in similar environments approximately efficient collusion, where bidders pay an approximately zero price and the good is allocated efficiently in every period, can be supported as a perfect public equilibrium if bidders are sufficiently patient and the auctioneer reveals all information that is available to him—i.e. all bids and the identities of the bidders who made them. In contrast, we have shown elsewhere [14] that the payoffs from perfect public equilibria are bounded away from the efficient frontier for repeated second-price auctions in which only the identity of each period's winner is observed.

In the present paper, we study bidders' use of *private strategies*, defined as strategies that condition behavior on more than only publicly available information. This additional information may include the history of own actions (bids) as well as the history of own wins and losses (and of course the history of valuation realizations). Our definition of private strategies is slightly more inclusive than the one originally introduced into the literature by Kandori and Obara [30] and further analyzed by Mailath et al. [33] who define private strategies, in the context of games where all information except the history of own actions is public, as those that depend on own past actions as well as public signals. In the extreme case, where the auctioneer withholds all information, it is easy to see that given a unique equilibrium in the stage game, no collusion is supported by public Nash equilibria as there is no relevant public information. This raises the question of whether any collusion can be supported by *private equilibria*, equilibria that condition on more than only publicly available information, and whether there exist sequentially rational collusive equilibria.

[2] See [18,34].

[3] The auctioneer may in some circumstances be able to try to withhold information by delaying giving out the object. In case he gives out the object at the end of period $t + k$ rather than at the end of period t, our results go through. A more detailed examination of delay would have to address (at least) three further issues. First, one would need to specify how delay affects the bidders' valuations for the object. Second, delay may in effect create a multi-unit environment (the seller could collect T bids in T rounds for the delivery of T objects every T periods), which would take us outside the repeated game setting of the present paper. Third, information revelation and delay could be made contingent on past bidding behavior, which again would take us outside of the repeated game setting of this paper.