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Optimal search auctions with correlated bidder types

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Abstract

We study optimal auctions when contacting prospective bidders is costly and the bidders' values are correlated. Although full surplus extraction is, in general, impossible, we can construct a search mechanism that fully extracts the surplus with an arbitrarily high probability.

Keywords: Optimal auction; Correlated values; Search costs; Search mechanism; Full surplus extraction

JEL classification: D44; D82; D83

1. Introduction

It is well known that, in auction environments with risk neutral bidders and correlated values, the seller can generically extract the entire social surplus (see Crémer and McLean, 1985, 1988). But if the seller must incur (search) costs in order to contact prospective bidders, then the seller's optimal mechanism is in the form of a *search mechanism* that, contingent on history, specifies the order in which prospective bidders are contacted, the time at which the process ends, and the participating bidders' payments. While the sequential nature of the mechanism economizes on the seller's search costs, it may prevent the seller from using Crémer–McLean

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lotteries that condition a bidder's payment on all his rivals' reports. We show that although the seller cannot always fully extract the surplus, he can nonetheless achieve full extraction with an arbitrarily high probability.

Our paper contributes to the small, but growing, literature on optimal search auctions. So far, this literature has only considered independently distributed bidders' types.[1] Our paper by contrast, deals with correlated bidders' types.

2. The model

A seller wishes to sell an indivisible good to one out of a finite set I of n prospective bidders. The seller's value is normalized to zero. Bidder i's value from winning the good (the bidder's type) is $x_i \in X_i$, where X_i is a finite set. A vector of types $x \equiv (x_i)_{i \in I}$ is called a *realized state*. Nature draws states, x, from the set $X \equiv \times_{i \in I} X_i$, according to a strictly positive probability measure f. Everyone's discount factor is $\delta \in (0,1]$.

2.1. Search costs

In order to inform bidder i about the auction, the seller incurs a *search cost*, $c_i > 0$. After being contacted by the seller, each bidder i privately learns his type x_i.

The cost c_i has several possible interpretations. First, the good might be very complex (e.g., the controlling block of a state-owned enterprise). The seller then needs to meet potential bidders in person (e.g., hold a road show). Second, the seller may have goals other than profit maximization and would like to ensure that bidders meet certain criteria (e.g., ensure that the privatized state-owned enterprise will be controlled by a qualified buyer). Third, our framework can be easily modified to a procurement environment with a set I of potential sellers; if the procurer's needs are hard to describe, he would need to understand exactly what each supplier can offer before asking for bids.

2.2. Search mechanisms[2]

To economize on search costs, the seller needs to design a contingent plan, called *search mechanism*. This mechanism works as follows: In period 1, the seller contacts a set of entrants, who privately learn their types and decide whether to participate. Each participating entrant signs a binding contract and sends a message. Given these messages, the mechanism either stops or continues to period 2. If it continues, new entrants are invited, privately learn their types, decide whether to participate, and send messages. The mechanism continues similarly until it stops and the good is allocated.

A *search procedure* is the operation-research part of a search mechanism. Given the bidder's messages, it determines whether to continue the mechanism, the identity of new entrants when the

[1] See McAfee and McMillan (1988), Burguet (1996), Crémer et al. (in press), Ye (2004), Bergemann and Pesendorfer (2001) and Bergemann and Välimäki (2002). On the other hand, Crémer et al. (2003) allow for very general correlation.

[2] This section is based on Sections 2.3–2.5 in Crémer et al. (in press).