Summary on a working paper:
Paul Milgrom, "Putting Auction Theory to Work: The Simultaneous Ascending Auction", May 6, 1998.

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In this paper, the author discusses and summarizes the theoretical considerations in relation with different design properties of the Simultaneous Ascending Auction (S.A.A.) as well as other alternative multi-unit auction mechanisms.

In section 2, a brief description is made of the basic rules of multi-unit auctions in general, and the S.A.A. in particular. Some of the characteristics that define a particular multi-unit auction mechanism are the types of bids that can be presented (separates bids for different licenses[1] or packages of them), the time evolution of the bids (discrete rounds or continuous time), the minimum increment, the activity rules (activity requirements to all the bidders in order to reduce the duration of the auction), withdrawing penalties, waivers (from the activity rules) and closing rules (which in the S.A.A. case, corresponds to no bids submitted in any of the available licenses, whereas in other cases, some licenses are closed after a certain number of rounds without bids and a reduced overall activity level).

The author then investigates the linkage between the ascending auction mechanism and Tatonnement Theory associated with Competitive Equilibria.
Despite the apparent similarities between an auction and the theoretical concept of Tatonnement introduced in competitive equilibrium theory, the authors presents four main differences that motivates the posterior discussion: the commitment that agents make when bidding for different licenses (which can be affected by increases in the prices of related licenses), the monotonicity of prices, the agents responsibility in announcing prices (instead of the "mythical" Walrasian Auctioneer) and the indivisibility of the goods being offered and its mathematical implications for equilibrium existence theorems.
In his analysis, the author introduces the concept of mutual substitutes licenses[2] (as opposed to mutual complements) and relates them to the existence and convergence to a competitive equilibrium solution: in presence of mutual substitutes licenses and a "straightforward" bidding rule[3] for all the players, not only a competitive equilibrium exists (for a sufficiently small minimum increment) but also the ascending auction converges to a nearly competitive outcome. The presence of at least one bidder with complementary valuations can result in the absence of competitive equilibria for a particular profile of individual valuations.
The section also includes a discussion about the apparent puzzle between the predicted potential inefficiency in auctions with complementary licenses with the experience in actual ascending auctions with satisfactory outcomes. The author suggests that in those cases, there was no overlapping licenses between bidders with complimentary and substitutes valuations (assumption implicit in the previous theoretical arguments).

In section 4, the author presents particular applications of game theoretical analysis, partly sustained by hypothetical examples, to three issues in the design of multi-unit auctions: the need for activity rules; free riding problems in auctions where biddings for packages of licenses is allowed (combinatorial auctions); closing rules and their properties in terms of propitiating collusive agreements:

The first application is related to the activity rules. The idea behind this feature (apparently suggested by the author in the final design of the radio spectrum S.A.A.) is the possibility of budget constrained competitors and the resulting advantages from delaying its own participation in the auction. In this section, the author uses a simple example to suggest that bidders in this situation may have incentives to slow their bidding pace. This

[1] Following the author's terminology, I will use the term "license" for the good being auctioned.
[2] In simple terms, the increase in the price of licenses outside a particular set S do not affect my willingness to purchase the licenses included in S
[3] Assuming mutual substitutes, the players are not faced with the risk of committing to purchase a particular license and after realizing that the price of complementary licenses has increased more than expected. In that sense, a "straightforward" bidding rule consists of just biding the minimal increment for those licenses for which a player has excess demand at the current prices (and for which he is not currently holding the standing high bid).

hypothesis is indirectly sustained by the observed behavior of bidders in the PCS auction, which was apparently[4] guided by the minimum necessary increment to maintain its current eligibility.
The second game theoretic application is concerned with the free riding problem in combinatorial auctions. The argument is that inefficient outcomes can arise in equilibrium when bidders with complementary valuations are budget constrained. In the suggested example, two bidders interested in different licenses which are complementary to a third budget-constrained bidder, have incentives to free ride on the other bidder increasing its bid and thus, in equilibrium, the licenses can be inefficiently assigned to the third bidder.
In the third application, based on a simple two-bidders model the author suggests that simultaneous closings can help sustaining collusive behavior by creating an environment where cheating opportunities can be effectively deterred by the threaten of reversion to a competitive equilibrium, whereas with license-by-license closing, the incentives to cheat are substantially increased.

In Section 5, a further analysis on combinatorial auctions is presented, describing the generalized Vickrey auction, its properties and practical problems, and comparing it with the "Adaptive User Selection Mechanism" (A.U.S.M.), an experimental method that accounts for some of the problems previously suggested for more general combinatorial auctions.
In the generalized Vickrey auction, also called the Groves-Clarke "pivot mechanism", every bidder presents his/her value for every possible subset of licenses and the auctioneer chooses the final assignment according to a value maximizing rule, specifying the payment to be made by every bidder. These payments create an incentive structure such that, for every participant, a dominant strategy is to reveal his/her true valuation. The author declares this mechanism impracticable, due to the complicated bidding process and the apparent unwillingness, from the bidders, to reveal their estimated valuations to their competitors. The A.U.S.M. structure is simpler but still maintains the property of allowing the participants to bid for combinations of licenses, while maintaining a "standby queue" for every individual license, in case that the high standing combined bid is surpassed by another combination or several individual bids. Other features of this mechanism are the use of continuous time rounds combined with random closing times. According to the authors, experiments with this mechanism suggest adequate behavior in environments with complementary licenses.

Finally, section 6 addresses two additional auction-design related questions: the first is concerned with the relevance of a sophisticated auction design to achieve efficiency when post-auction trades are allowed. The author argues that for different theoretical reasons, these private arrangements can be difficult to sustain in private values environments with incomplete information and thus, a close-to-efficient auction mechanism can be relevant for the final outcome. The second question corresponds to the trade-off between efficiency and revenue goals in auction design. With a simple two-bidders model with particular valuation functions, any assignment presents a dollar-to-dollar trade-off between allocative efficiency and revenue. Based on this example the author suggests that, more generally, a small number of bidders can contribute to less extreme but still important tensions between both desirable properties.

Comments:

The article include too many different topics with varying degrees of formal treatment and ad-hoc models or examples to show different points. It is not clear, for example, why the A.U.S.M. mentioned in section 5 is not affected by the same criticism as the previously mentioned combinatorial auctions or how or whether the activity rule can prevent the free riding problem in combinatorial auctions. The difficulties mentioned against the Vickrey auction are, in my opinion, superficial and more analysis should be included for such an important result.

However, as an introductory paper to the theory behind ascending auctions, the different arguments and economic intuitions are usefull to guide a new ressearcher in the topic.

[4] Figure 1, which reported the scatter plot between minimum increments and actual bids, was not included in the article.