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AUCTIONS

Auction theory is one of economics' success stories. It is of both practical and theoretical importance: practical importance, because many of the world's most important markets are auction markets, and good auction theory has made the difference between successful auctions and disastrous ones; theoretical importance, because lessons from auction theory have led to important insights elsewhere in economics.

Auctions are not a new idea: the Babylonians auctioned wives, the ancient Greeks auctioned mine concessions and, in addition to their notorious slave auctions, the Romans auctioned everything from war booty to debtors' property. In the modern world, auctions are used to conduct a huge volume of economic transactions. Governments use them to sell treasury bills, foreign exchange, mineral rights including oil fields, and other assets such as firms to be privatized. Government contracts are typically awarded by procurement auctions, and procurement auctions are also often used by firms buying inputs or subcontracting work; in these cases, of course, the auctioneer is seeking a low price rather than a high price. Houses, cars, agricultural produce and livestock, art and antiques are commonly sold by auction. Other economic transactions, for example takeover battles, are auctions by another name.

The range of items sold by auction has been greatly increased by e-commerce, and in the last decade or so there has also been an explosion of interest in using auctions to set up new markets, for example for energy, transport and emissions permits. Although many of these markets do not look like auctions to the layman, they are best understood through auction theory. (For example, electricity markets are best described and analysed as auctions of infinitely divisible quantities of identical goods.) Probably the most famous of the new auction markets have been the auctions of mobile phone licences across the world (Klemperer 2002, 2003a).

Two basic designs of auction are most commonly used: the ascending auction, in which the price is raised successively until only one bidder remains and that bidder wins the object at the final price he or she bid; and the first-price sealed-bid auction, in which each bidder independently submits a single bid without seeing others' bids, the object is sold to the bidder who makes the highest bid, and the winner pays his or her bid.

The key result in auction theory is the remarkable *Revenue Equivalence Theorem* that tells us, subject to some reasonable-sounding conditions, that the seller can expect equal profits on average from all the standard (and many non-standard) types of auctions, and that buyers are also indifferent among them all. William Vickrey's Nobel Prize was in large part awarded for his (1961, 1962) papers that developed some special cases of the theorem, and Riley and Samuelson (1981) and Myerson (1981) offer more general treatments.

Much of auction theory can be understood in terms of this theorem, and how its results are affected by relaxing its assumptions of a fixed number of symmetric, risk-neutral bidders, who each want a single unit, have independent information, and bid independently. Myerson's (1981) paper shows how to derive optimal auctions (that is, auctions that maximize the seller's expected revenue) when the assumption of symmetry fails. Maskin and Riley (1984) consider the case of risk-averse bidders, in which case the first-price sealed-bid auction is the most profitable of the standard auctions. Milgrom and Weber (1982) analysed auctions when the assumption of independent information is replaced by one of 'affiliated' information, and showed that the most profitable standard auction is then the ascending auction. (Roughly, bidders' information is affiliated if when one bidder has more positive information about the value of the prize, it is more likely that other bidders' information will also be positive.) Models of auctions in which bidders demand multiple units lead to less clear conclusions. For practical auction design, however, it is probably most important to relax the assumptions that there are a fixed number of bidders and that they bid independently; sealed-bid designs frequently (but not always) both attract more serious bidders and are better at discouraging collusion than are ascending designs (Klemperer 1998, 2002).

The predictions of auction theory have been the basis of much empirical and experimental work. In particular, auctions have become a leading testing ground for game theory because they are particularly simple and well-defined economic institutions, constraining the extensive form of the game so tightly that sharp qualitative predictions are possible (Hendricks and Porter 1988; Kagel and Roth 1995; Laffont 1997). There has been considerable debate in this literature about whether or not bidders really fall prey to the famous 'winner's curse' – the phenomenon that if the actual value of the prize is uncertain but the same for all the bidders, the winning bidder will often lose money if he or she made her bid without allowing for the fact that winning suggests he or she is among the most optimistic bidders.

Auction theory has also been the basis of much fundamental theoretical work not directly related to auctions: by carefully analysing very simple trading models, auction theory is developing the fundamental building-blocks for our understanding of more complex environments. It has been important in developing our understanding of other methods of price formation, including posted prices, and negotiations in which both the buyer and seller are actively involved in determining the price.

There are especially close connections between the theories of auctions and perfect competition. Wilson (1977), Milgrom (1979) and others have developed conditions under which the sale price of an object whose value is the same to all bidders converges to this value as the number of bidders becomes large, even though each bidder has only partial information about the value. The fact that the auction thus fully aggregates all of the economy's information justifies some of our ideas about perfect competition and rational expectations equilibrium.

There is also a close analogy between the theory of optimal auctions and the theory of monopoly pricing; the analysis of optimal auctions is 'essentially equivalent to the analysis of standard monopoly third-degree price discrimination' (Bulow and Roberts 1989). Insights can therefore be translated from monopoly theory to auction theory and vice versa.

More recently, auction-theoretic tools have been used to provide useful arguments in a broader range of contexts – including many that do not, at first sight, look like auctions – starting with models of oligopolistic pricing, running through non-price means of allocation including queues, wars of attrition, lobbying contests, other kinds of tournaments and rationing, and extending to models in finance, law and economics, labour economics, political economy, etc. (Klemperer 2003b). It turns out that a good understanding of auction theory is valuable in developing intuitions and insights that can inform the analysis of many mainstream economic questions.

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References

Bulow, J.I. and Roberts, D.J. (1989) 'The simple economics of optimal auctions', *Journal of Political Economy* 97: 1,060–90.
Hendricks, K. and Porter, R.H. (1988) 'An empirical study of an auction with asymmetric information', *American Economic Review* 78: 865–83.
Kagel, J.H. and Roth, A.E. (1995) *The Handbook of Experimental Economics*, Princeton, NJ.
Klemperer, P.D. (1998) 'Auctions with almost common values', *European Economic Review* 42: 757–69.
—— (2002) 'What really matters in auction design', *Journal of Economic Perspectives* 16(1): 169–89.
—— (2003a) 'Using and Abusing Economic Theory', *Journal of the European Economic Association* 1, :272–300 (and Alfred Marshall Lecture to European Economic Association, 2002).
—— (2003b) 'Why every economist should learn some auction theory', in M. Dewatripont, L. Hansen and S. Turnovsky (eds) *Advances in Economics and Econometrics: Invited Lectures to Eighth World Congress of the Econometric Society*, Vol. 1, Cambridge, pp. 25–55.
Laffont, J.J. (1997) 'Game theory and empirical economics: The case of auction data', *European Economic Review* 41: 1–35.
Maskin, E.S. and Riley, J.G. (1984) 'Optimal auctions with risk averse buyers', *Econometrica* 52: 1,473–518.
Milgrom, P.R. (1979) 'A convergence theorem for competitive bidding with differential information', *Econometrica* 47: 679–88.
Milgrom, P.R. and Weber, R.J. (1982) 'A theory of auctions and competitive bidding', *Econometrica* 50: 1,089–112.
Myerson, R.B. (1981) 'Optimal auction design', *Mathematics of Operations Research* 6: 58–73.

Riley, J.G. and Samuelson, W.F. (1981) 'Optimal auctions', *American Economic Review* 71: 381–92.
Vickrey, W. (1961) 'Counterspeculation, auctions, and competitive sealed tenders', *Journal of Finance* 16: 8–37.
—— (1962) 'Auction and bidding games', in *Recent Advances in Game Theory*, Princeton, NJ: The Princeton University Conference, pp. 15–27.
Wilson, R. (1977) 'A bidding model of perfect competition', *Review of Economic Studies* 44: 511–18.

Further reading

Klemperer, P.D. (1999) 'Auction theory: A guide to the literature', *Journal of Economic Surveys* 13(3): 227–86.
—— (2002) 'What really matters in auction design', *Journal of Economic Perspectives* 16(1): 169–89.
—— (2004) *Auctions: Theory and Practice*, Princeton, NJ [draft at http://www.paulklemperer.org].

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