

**Auction Design to Mitigate
Competition Concerns and Enhance
Efficiency and Revenue**

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Introduction

1. The use of auctions has become increasingly widespread, from the allocation of resources like electricity and spectrum, to selling of personal items on online websites like eBay. Auction design is fundamental in affecting allocative efficiency and revenue maximisation, and can affect the susceptibility of the auction to competition concerns. Government-run auctions, like other auctions, can be subjected to risks of anticompetitive behaviours. For example, in Singapore, there were multiple instances of bid rigging by 12 motor traders in government run auctions for the sale of motor vehicles in the period 2008 to 2011, where the motor traders colluded to suppress the prices of the motor vehicles purchased. This article focuses on the situation in which a seller runs the auction and buyers bid for single or multiple items being sold, and discusses proposals to mitigate competition concerns. In addition, similar proposals may be applicable when governments or businesses make purchases through procurement tenders/quotations.

Competition Concerns

2. Allocative efficiency¹ and revenue maximisation are usually the first considerations that sellers take into account when determining the auction type to use. Competition concerns tend to be seen as secondary, but in fact, they can influence allocative efficiency and the revenues obtained. Key competition concerns in auction design relate to collusion and entry.²

Collusion

3. Collusion refers to both explicit, where an overt agreement is struck between competitors to avoid competing, or tacit collusion, where competitors have the incentive and ability to behave collusively without having any overt agreements being made. Explicit collusion in an auction would take the form of bid rigging, whereas the most common form of tacit collusion in auctions occurs through bid signaling.

Entry

4. From the seller's perspective, for an auction to be effective there has to be a minimum number of competitors willing to submit bids in the auction. As such, some auctions require a minimum number of bidders before the auction would be considered valid. For example, the National Environment Agency's ("NEA") allocation of hawker stalls in Singapore requires at least one competing bid to be submitted before allocation is made in the first release of the stall. Should this not be met, the stall will be returned to the tender pool for the following month. The stall will only be awarded to a single bidder in the second release of the stall.³

5. Increasing the number of bidders is particularly important for revenue maximisation given that the set of bids submitted would be greater and the probability of a bid close to

¹ Please refer to **Glossary** for definition/explanation

² Paul Klemperer, "What Really Matters in Auction Design", *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

³ National Environment Agency, Form of Tender, Appendix B

the maximum willingness-to-pay would be higher. An increase in the number of bidders also makes it more difficult for collusive agreements to be struck.

Factors affecting susceptibility to Collusion

6. There are three main factors that would affect an auction's susceptibility to collusion: (i) the ability to monitor deviations by competitors; (ii) the ability to inflict punishment; and (iii) multiple/repeated interactions amongst competitors participating in the auctions.

7. Given that bidders are unable to clearly monitor deviations from the agreements and inflict punishment in a sealed bid auction⁴, it is typically considered that collusion would be more easily sustained in an open ascending auction.⁵ However, collusion is still possible in sealed bid auctions because the same bidders may participate in multiple or consecutive sealed bid auctions. Hence, penalties for the bidders that renege on the collusive agreement can always be dealt out in a later auction, i.e., punishment mechanism. Auction markets that are recurrent, such as that for electricity, are also likely to be more susceptible to collusion, because the repeated interaction gives them more opportunities to develop and cooperate on signaling and punishment strategies.⁶

8. Multiple/repeated interactions allow competitors to develop communication strategies to coordinate bids. For instance, bid signaling is a technique used to facilitate tacit collusion, where competitors communicate their intentions through the bids submitted. An example studied by academics is the 1999 Germany simultaneous ascending auction where they sold ten blocks of spectrum with the rule that any new bid on a block had to exceed the previous high bid by at least 10 percent. Mannesman's first bids were 18.18 million deutschmarks per megahertz on blocks 1-5 and 20 million DM per MHz on blocks 6-10. T-mobil, the only other credible bidder, interpreted Mannesman's first bid as an offer for T-mobil to bid 20 million deutschmarks per megahertz on blocks 1-5, but stay out of the auction for blocks 6-10. As such, the auction closed after just 2 rounds with each of the bidders acquiring half the blocks for the same low price.⁷ Bidders have incentive to coordinate and learn signals through the language of bids (e.g. through bid value, decimal points etc.), with the objective of obtaining the items on auction at low prices.⁸

9. In contrast, there is less possibility of undesirable bid signaling in an ascending clock auction⁹ since only the total quantity bid is reported.¹⁰ Similarly, in a combinatorial clock auction¹¹, only aggregate measures, i.e., report on prices and excess demand for each product, are revealed in each round.¹² This gives bidders sufficient information to predict

⁴ Please refer to **Glossary** for definition/explanation

⁵ Paul Milgrom, "Auction Theory" in Truman Bewley (ed), *Advances in Economic Theory – Fifth World Congress*, Cambridge, England: Cambridge University Press.

⁶ Paul Klemperer, "What Really Matters in Auction Design", *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

⁷ *Ibid.*

⁸ Peter Cramton, "Spectrum Auction Design", *Review of Industrial Organisation*, 42:2, March 2013

⁹ Please refer to **Glossary** for definition/explanation

¹⁰ Peter Cramton, "Ascending Auctions", *European Economic Review* 42:3-5, 1998, p. 745-756

¹¹ Please refer to **Glossary** for definition/explanation

¹² Peter Cramton, "Spectrum Auction Design", *Review of Industrial Organisation*, 42:2, March 2013

prices, but not enough to provide an avenue for tacit collusion through signaling.

10. Repeated interaction by firms across different products could also encourage collusion, given the possibility of a punishment mechanism being set up that spans different markets that the firms compete in. An example cited is the the 1996-1997 multi-licence US spectrum auction, where US West and McLeod competed for a licence in Rochester, Minnesota. US West proceeded to outbid McLeod for the Iowa licence, which it had shown no previous interest in. This was intended as a punishment to McLeod for competing in Rochester. McLeod subsequently ceased bidding for the Rochester licence, while obtaining the Iowa licence at a higher price.¹³

11. Collusion tends to occur more under uniform pricing as opposed to pay-your-bid pricing. Under uniform pricing, bidders can submit demand schedules that signal to other bidders to lower their own bids in an ascending open auction¹⁴ format, which would result in a lower end price.¹⁵ Alternatively, in a sealed bid format, a possible punishment mechanism that would further sustain collusion could be where each bidder bids very high prices for smaller quantities than collusively agreed. If any bidder reneges and bids on a larger amount than initially agreed, all bidders will have to pay very high prices. However, if everyone sticks to their agreed shares, then these very high prices will never be triggered.¹⁶

Factors that would affect Entry

12. There are various factors that would affect entry or participation in an auction, these being: (i) simplicity of the auction – in terms of participation and understanding of the auction rules; (ii) the certainty of the outcome before participation; and (iii) the perceived information asymmetry between competitors.

13. The most basic auction form - the ascending open auction – encourages participation because of the ease of understanding the rules of the auction.¹⁷ However, weaker bidders may be concerned that they would definitely lose in an ascending open auction and, hence, may not enter the auction. If so, greater participation could be observed in a sealed bid auction.¹⁸ The Anglo-Dutch auction¹⁹ is designed with the intention to get round the unwillingness to enter an ascending bid auction against a strong bidder with the incorporation of the sealed bid in the final stage. The sealed bid induces some uncertainty about which of the two finalists will win and entrants are attracted by the opportunity of reaching the final stage.²⁰ For example, eBay, which runs an Anglo-Dutch auction, reportedly

¹³ Paul Klemperer, “*What Really Matters in Auction Design*”, *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

¹⁴ Please refer to **Glossary** for definition/explanation

¹⁵ Peter Cramton, “*Spectrum Auction Design*”, *Review of Industrial Organisation*, 42:2, March 2013

¹⁶ Paul Klemperer, “*What Really Matters in Auction Design*”, *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

¹⁷ Peter Cramton, “*Ascending Auctions*”, *European Economic Review* 42:3-5, 1998, p. 745-756

¹⁸ Paul Klemperer, “*What Really Matters in Auction Design*”, *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

¹⁹ Please refer to **Glossary** for definition/explanation

²⁰ Paul Klemperer, “*What Really Matters in Auction Design*”, *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

has far more users than its rival, Yahoo, which runs a standard ascending auction.²¹

14. Similar to the case under a single-unit auction, multi-unit ascending auctions²² can discourage entry of weaker bidders, given the relative certainty that weaker bidders will lose the auction. This was observed in the takeover auction in 1995 for the Wellcome drugs company. Glaxo made it clear that it “would most certainly top a rival bid” and there were clear indications that Glaxo was the strongest bidder in the field. As a result, even though rivals like Zeneca and Roche were prepared to pay more, there was no contest for the 9 billion pounds bid first placed by Glaxo. This was also, in part, a result of the hefty costs of entering the auction in the first place.²³ This can also be seen as a form of predation, in that, large firms make aggressive claims to prevent entry of competitors.

15. Again, with regard to simplicity of the auction, the simultaneous ascending auction²⁴ has simple rules, but has complicated bidding strategies.²⁵ In contrast, the combinatorial clock auction has more complex rules, but the strategies are straightforward and can be made easier through the use of aids.²⁶ For instance, a smart auction system could be developed, to indicate to bidders the rules in place and indicate any violations of the constraints in the bids inputted. The system could also possibly suggest alternative bids that would satisfy the rules involved.²⁷

16. Further, any requirements to submit detailed specifications together with the auction bid can deter entry. This appeared to be the case in the 1991 sealed bid auction in UK, for the sale of television franchises, which saw undesirable results because of such a requirement. The incumbents in the Midlands and the central region of Scotland correctly guessed that no rival firm would be bothered to come up with detailed plans and, hence, successfully won the auctions at a mere one-twentieth and one-seventh of a penny per head of population respectively. This was in contrast to the average of approximately 11 pounds per head of population in other regions.²⁸

17. For the allocation of public resources, it might be prudent for the auctioneer to obtain feedback from potential bidders on the appropriate auction format to be used prior to the auction design. Ascending auctions are usually preferred by strong bidders; whereas, weaker bidders tend to prefer sealed bidding.²⁹ If, for instance, only a sole bidder favours an ascending auction, this might be indicative of large information asymmetries among bidders in that some bidders may have better information about the value of the items to be auctioned than other bidders. In such a situation, sealed bid auctions may encourage entry by bidders who have poorer information about the value of the items.

²¹ Paul Klemperer, “*What Really Matters in Auction Design*”, *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

²² Please refer to **Glossary** for definition/explanation

²³ Paul Klemperer, “*What Really Matters in Auction Design*”, *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

²⁴ Please refer to **Glossary** for definition/explanation

²⁵ Peter Cramton, “*Spectrum Auction Design*”, *Review of Industrial Organisation*, 42:2, March 2013

²⁶ *Ibid.*

²⁷ *Ibid.*

²⁸ Paul Klemperer, “*What Really Matters in Auction Design*”, *Journal of Economic Perspectives*, Vol. 16, No. 1, Winter 2002, p. 169-189

²⁹ Peter Cramton, “*Ascending Auctions*”, *European Economic Review* 42:3-5, 1998, p. 745-756

Strategies to Mitigate the Risk of Collusion

18. Selection of the most suitable type of auction format for use would help to eliminate much of the competition concerns involved. In fact, there are further tools and alterations of auction design that could mitigate competition concerns to a greater extent.

Bid Restrictions

19. Bidders can make alterations to the language of the bids to signal to other players their intentions. This can be through the use of additional numbers being attached in retaliation bids that were indicative of certain markets they wanted or indicating the possible markets that they could induce punishment (i.e. code bidding).³⁰ This problem can be easily rectified through limiting the set of numbers that can be used, through restricting bids to either three significant digits, 1 bid increment bidding³¹, or 1-9 bid increments³².

Reserve Prices

20. Reserve prices refer to the minimum amount winners would need to pay should they win the auction.³³ In other words, the seller would probably not sell the item if the highest bid is below the reserve price.³⁴ Reserve prices can be seen as catalysts for the auction process, removing the need to go through the initial low price rounds. This, in turn, would give bidders less time to synchronise or tacitly agree in any way. Further, the effect of demand reduction³⁵ might be reduced through the appropriate use of a reserve price. This would be both beneficial to efficiency and revenues.³⁶ On the flip side, insufficiently high reserve prices could serve to incentivise collusion. Typically, the trade-off for stronger bidders in an ascending auction would be either to tacitly collude at a low price or bid high to deter weaker bidders. The lower the reserve price, the higher the probability of collusion occurring.³⁷

Reporting Bidder Identities

21. The revelation of identities increases the risk of collusion for the following reasons:³⁸

³⁰ Peter Cramton and Jesse A. Schwartz, *Collusive Bidding: Lessons from the FCC Spectrum Auctions*, Journal of Regulatory Economics, 17, p.229-252, May 2000

³¹ As known as “click-box bidding”, where bidders click on the licences they wish to bid on. All bids are exactly one increment above the standing high bid, rather than allowing bidders to bid any higher dollar amount.

³² Once some bidder has placed the minimum opening bid, bids in subsequent rounds were constrained to be 1-9 bid increments over the standing high bid.

³³ Paul Klemperer, “*What Really Matters in Auction Design*”, Journal of Economic Perspectives, Vol. 16, No. 1, Winter 2002, p. 169-189

³⁴ David Easley and Jon Kleinberg, “*Networks, Crowds, and Markets: Reasoning about a Highly Connected World*”, Cambridge University Press, 2010, Chap. 9: Auctions

³⁵ Please refer to **Glossary** for definition/explanation

³⁶ Peter Cramton and Jesse A. Schwartz, *Collusive Bidding: Lessons from the FCC Spectrum Auctions*, Journal of Regulatory Economics, 17, p.229-252, May 2000

³⁷ Paul Klemperer, “*What Really Matters in Auction Design*”, Journal of Economic Perspectives, Vol. 16, No. 1, Winter 2002, p. 169-189

³⁸ Peter Cramton and Jesse A. Schwartz, *Collusive Bidding: Lessons from the FCC Spectrum Auctions*, Journal of Regulatory Economics, 17, p.229-252, May 2000

- (i) It allow for direct retaliation;
- (ii) Bidders can identify the parties that they would need to cooperate with; and
- (iii) It discourages competitive bidding since some bidders might avoid bidding against certain competitors, e.g., strong bidders with deep financial resources or reputation for aggressive retaliation.

22. Characteristically, only one cartel member would win and pay for the item and the other members of the agreement would receive the agreed payouts separately. By withholding information about the identities of the registered bidders, the auction designer potentially can create opportunities for the winning cartel member to circumvent payments to its co-conspirators. This uncertainty would reduce the level of confidence in coordination and, hence, might lead to them giving up collusion altogether.³⁹

23. Similarly, bid signaling can be mitigated by limiting the information revealed. In an ascending open auction, for example, the auctioneer can simply announce the standing high bids without the bidders' identities. This would necessitate direct illegal contact between bidders for them to come to a collusive agreement.⁴⁰

24. However, there could be instances where items are complements and their relative values are interdependent. For instance, in spectrum allocation, the valuation for one licence could vary in relation to the winners of the other licences in the market or neighbouring markets. In such a scenario, it might be beneficial to the auctioneer, in terms of revenues and efficiency, as well as the bidders, to avoid guesswork and save resources spent on obtaining the information, for the identities to be revealed.⁴¹

Withdrawal Rules

25. Withdrawals may be necessary in a simultaneous ascending auction for heterogeneous complementary items, where there are no packaged bids, given that it might be more socially efficient to allow bidders to pull out if they had failed to obtain the full set of items they intended to acquire. However, in the United States Federal Communications Commission ("FCC") spectrum auctions, it was observed that withdrawals were used in multitudes of ways that was counter to this intention (e.g. parking strategies, retaliations, reduce withdrawal penalties etc.) The FCC's solution was to implement a two-round limit – a bidder can withdraw in at most two rounds. Alternative rules include making withdrawals irreversible or implementing a time lag (e.g. 3 rounds) before allowing bidders to return to bidding on a withdrawn license. These rules make signalling or punishments difficult for bidders.⁴²

Addressing Concerns due to the Creation of a Downstream Monopoly

26. A scenario could arise in which the highest bidder has a high valuation for the item

³⁹ Robert C. Marshall and Leslie M. Marx, *"The Vulnerability of Auctions to Bidder Collusion"*, Working Paper, Aug 2008

⁴⁰ Peter Cramton, *"Ascending Auctions"*, European Economic Review 42:3-5, 1998, p. 745-756

⁴¹ Peter Cramton and Jesse A. Schwartz, *Collusive Bidding: Lessons from the FCC Spectrum Auctions*, Journal of Regulatory Economics, 17, p.229-252, May 2000

⁴² *Ibid.*

due to the prospect of acquiring monopoly power in the downstream market. This may arise because the buyer would face significant competitive pressure downstream if the asset under auction is allocated to a competitor, but would face only weak competitive pressure if it secures the asset. In such a situation, efficiency should not be limited to considering only the total surplus of the buyers and the seller in the auction upstream. The surplus of the buyers in the downstream market should also be taken into account in determining efficiency in this situation.

27. Such a case occurred in the Government Land Sales (“GLS”) auction for a land parcel in Yishun town centre. Frasers Centrepoint Group (“Frasers”) made a S\$1.43 billion bid for the land parcel, which was 47.4% higher than the second highest bid of S\$969 million. Property analysts suggested that a possible reason for this strong bid could be because Frasers owned Northpoint, the adjacent mall in the vicinity, and, hence, could keep competition away in the Yishun retail space by acquiring the Yishun town centre land parcel for construction of a new mall.⁴³

Preventing Incumbent Entry

28. To preserve total welfare of the market, governments may need to forego some auction revenue for the purpose of preserving social welfare. One option would be to entirely block entry by the incumbent that owns adjacent plots of land parcels to prevent the creation of monopoly power, even if it is expected that the incumbent would bid more because of anticipated monopoly rents. This is similar to the concept of set-asides⁴⁴ used in spectrum auctions to prevent incumbents from obtaining too many licences.⁴⁵ However, in the sale of land parcels, governments may want to avoid such draconian measures. To the extent feasible, another option may be to divide the land parcel into two or more lots such that the incumbent may be permitted obtain certain lots but not all of the lots.

Altering Evaluation Criteria

29. An alternative option could be to determine the outcome based on additional factors, such as prices in the related downstream market, services etc. Parties participating in the auction could be asked to submit bids for both the price to obtain the item as well as the price it would be sold at in the downstream market. For instance, in the sale of land parcels, a market-based benchmark for rentals charges to tenants could be included in the tender evaluation.

30. A similar system was used by the Early Childhood Development Agency (“ECDA”) and the Housing Development Board (“HDB”), when they jointly announced a revised tender evaluation process in June 2013, which assessed the quality and affordability of the bidder’s child care programmes in addition to the bid price. The intention was to ensure that rental costs for child care centres in HDB estates were kept reasonable and this would be

⁴³ TODAY Online, “Frasers’ S\$1.43billion top bid stuns market”, 6 Sep 2013.

URL: <http://www.todayonline.com/business/property/frasers-s143b-top-bid-yishun-site-stuns-market>

⁴⁴ Set asides are where the regulator reserves one or more blocks of the good or service (e.g. spectrum) for a particular type of bidder (e.g. new entrants)

⁴⁵ Peter Cramton, Evan Kwerel, Gregory Rosston and Andrzej Skrzypacz, “Using Spectrum Auctions to Enhance Competition in Wireless Services”, *The Journal of Law & Economics*, Vol. 54, Nov 2011, p. 167-188

translated to better value child care services. With this system, the highest bidder might not win the bid since there are other factors considered, i.e. the downstream fee charged, track record, programme quality and staffing qualifications etc.⁴⁶

31. Practically speaking, this suggestion may not always be feasible given that the prices downstream and services might not be easily comparable, particularly if bidders compete in different product markets. For example, assuming hawker stalls are allocated via an auction process, the final food sold might be entirely different and, hence, prices would be non-comparable.

32. Although taking into consideration downstream prices in the auction design may not maximise revenues for the seller in the auction, it would provide for a more balanced consideration of revenues for the seller and allocative efficiency.

Conclusion

33. In synthesis, auctioneers should consider competition matters in the design of auctions. Some markets might be more susceptible to collusion and predation than others. Auction design can be seen as a preventive measure to competition concerns – reducing the risk of collusion, while ensuring greater entry – which, in turn, have beneficial effects on revenues and efficiency. Policymakers should keep in mind that an auction may in certain circumstances create a downstream monopoly. Although this may enable the government agency to achieve greater revenues, this could be at the expense of allocative efficiency and higher prices for customers downstream. In the design of such auctions, there may be scope to consider whether tender evaluation criteria could be adjusted to account for the impact on customers downstream.

⁴⁶ Early Childhood Development Agency (“ECDA”), *“Revised Tender Evaluation Process for Commercial Child Care Centres in HDB Premises”*, 13 June 2013. URL: <http://www.ecda.gov.sg/Pages/revised-tender-evaluation-process-.aspx>

Glossary

Allocative Efficiency	Attained by allocating items such that the total surplus of buyers and sellers is maximised
Anglo-Dutch auction	Hybrid auction with an ascending open auction system until there are few bidders left. Thereafter, there would be a final sealed bid round. The highest submitted bid would win the auction.
Ascending clock auction	Bidders submit quantities they are willing to buy at the indicated clock price. The clock price is increased if there is excess demand for the quantity available, and bidders submit the quantities they are willing to buy at the new clock price. This process continues until demand is less than supply at the prevailing clock price, and bidders pay the immediate previous round clock price.
Ascending open auction	Bidders are able to observe one another's bids and there is a sequence in the auction through which bidders are able to outbid other bidders until the point is reached when the highest bid that is not outbid will win the auction.
Combinatorial clock auction	<p>This auction typically has three rounds.</p> <p>The first round involves simultaneous ascending clock auctions on preset packages of items (e.g. spectrum licences). Bidders bid on any number of categories as they wish and the round would only conclude when there are no additional bids for any of the lots in any category.</p> <p>The second round is a sealed bid auction where bidders would make best and final offers for any combination of items they want.</p> <p>The final round is an assignment round where all bids in the first two rounds are optimized to determine the value-maximising assignment and prices.</p>
Demand reduction	This may occur in the context of multi-unit auctions, where bidders may submit bids equal to their true value for the first unit, but submit lower bids for additional units with a view of reducing the price paid for the earlier units.

Multi-unit ascending auction	This deals with the allocation of multiple units of homogenous items. It can be conducted in two forms: with a demand-schedule or an ascending clock.
	In the demand-schedule approach, bidders will submit a demand schedule in each round, which will be aggregated into a demand curve. A clearing price, where demand meets supply, would be determined and any bids below that would be considered a losing bid. For any losing bid, the bidder can increase his bid in the next round. The auction ends when no bidder increases his losing bid.
Sealed bid auction	Bids are submitted to the auctioneer who would determine the winner. The highest submitted bid would win the auction.
Simultaneous ascending auction	This deals with the allocation of multiple units of heterogeneous items. All items would be auctioned at the same time in an ascending open auction format. Bidder can bid on any number of items in every round and the auction only closes when no bidder raises the bid on any of the items. The highest bid for each item would determine its price.