Auctions That are Too Good to be True

By Francesco Decarolis and Michael Klein[1]

November 2011

Auctions are supposed to procure the best deal money can buy. Yet, practitioners who procure complex contracts by auction are well aware of some basic pitfalls. One concern is that winning bids may not reflect the quality of the bidder but strategic behavior like low-balling bids or underestimating costs. Such behavior may then lead to demands for contract renegotiation by the winning bidder that are hard to resist. The problem plagues complex contracts for civil works or equipment as well as contracts for various types of public-private partnerships.

In 1993 two engineering professors[2] *proposed a bidding scheme that aims at preventing excessively low bids. Effectively they developed a way to disqualify bids that are "too good to be true". Several countries, including Colombia, Italy, China, Chile, Japan, Peru and Taiwan have adopted such auction schemes. However, it turns out that the new auctions give rise to new forms of strategic bidding behavior, which create even bigger problems*[3]*. Altogether, the new auctions seem to be "too good to be true". Using standard procedures like first price sealed bid auctions remains best practice as long as well-established disciplines for pre-qualification and control of post-bid behavior are maintained.*

The standard procurement approach: first price or second price auctions

Typically, auctions to procure a public work, like paving a road, or a complex contract like a water concession use a standard format, the so called First Price Sealed Bid (FPSB) auction. In this format, all firms submit sealed envelopes containing their price offer and the lowest price wins. The FPSB auction is known to induce competition between firms, which will lower the procurement cost. Alternatively, one can consider open or sealed second price (also called English) auctions. Under ideal conditions both mechanisms produce an identical assignment of the contract to the same firm and the same procurement cost.[4]

The most serious flaw of the standard approach is that the competition it induces might generate a perverse trade-off between price and performance: a low price in the auction stage reflects a high probability that ex post the firm will fail to deliver the quality promised or will ask for extensions of time or for extra money. Economic theory suggests that in an environment in which there is uncertainty about the final cost of the work and the auctioneer cannot perfectly assess the reliability of firms, the price vs. performance trade-off can be due two distinct sources: adverse selection and winner's curse.

Adverse selection arises if, for instance, there is a limited liability regime and firms have different financial resources. In this case, a bidder with low financial resources has only a low penalty in case of default, so it can "gamble" on the final cost of the project offering a high discount but then completing it only if cost conditions are good and defaulting otherwise. The same type of results can be derived replacing the risk of default with other measures of performance like low quality work, cost overruns and time delays. The key with adverse selection is that firms' actions are intentional: while firms do not know what the final cost will be, they correctly assess the various cost scenarios and intentionally gamble on the possibility that the realized cost will be low.

---

[1] Francesco Decarolis is Assistant Professor at the University of Wisconsin Madison, Michael Klein is Professor at the Frankfurt School of Finance and Management

[2] Ioannou, P. and S.S. Leu (1993). "Average-Bid Method. Competitive Bidding Strategy," *Journal of Construction Engineering and Management*, 119, 1, 131-147.

[3] Conley, T. and F. Decarolis (2011). "Detecting Bidders Groups in Collusive Auctions," mimeo.
Decarolis, F. (2010). "When the Highest Bidder Loses the Auction: Theory and Evidence from Public Procurement," mimeo.

[4] This famous and surprising result is known as "revenue equivalence theorem" and is due to Myerson, R., B. (1981). "Optimal Auction Design," *Mathematics of Operations Research*, 6, 58-73.

The “winner’s curse” occurs in situations involving inexperienced firms or highly complex contracts such that any firm is incapable of correctly estimating the possible future costs. In these cases, bidders might win the contract at a price that significantly underestimates costs despite best efforts to get it right.

An alternative approach from engineering

In the 1990s an influential idea came from two engineering professors about how to solve the problems of the standard auction (Ioannou and Leu, 1993). This alternative approach consists in running a sealed bid auction, in which not the lowest price but the price closest to some endogenously defined threshold wins. Often this threshold is a function of the average bid: for instance, the rule can say that the price closest to the average price wins. Otherwise there might be a more complex algorithm saying that the winner is the closest from above (or from below) to the average augmented (or decremented) by a certain percentage (or by the standard deviation of bids).

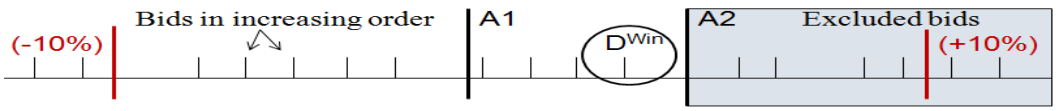
Today, there are many instances of these alternative auctions[5]. They are the main procurement format in Colombia and in Italy, and are of great relevance in China and Japan. They also exist in Chile, Peru and Taiwan. In the USA, they are present in the regulation of the Florida Department of Transportation and the New York State Procurement Agency. Closely connected to these auctions is a rule which can be used in Switzerland and according to which the winner is the bidder offering the second lowest price[6]. To simplify language, we will refer to all auctions in which the lowest price does not win as “average bid” (AB) auctions.

The argument underlying the use of a mechanism like the Italian (see Box 1) one is that a discount above the average discount but strictly below the top 10% of the highest discounts is a good compromise between obtaining a low price and not favoring too much unreliable bidders submitting low-ball bids. The European Commission endorsed a very similar view when it suggested modifying the FPSB rule, typically used in the construction industry in Europe, by eliminating the 20% of the lowest prices and awarding the contract to the bidder offering the lowest non-eliminated price[7].

Box 1: Example of the AB auction used in Italy.

There is a publicly announced reserve price and firms offer their discounts over it in sealed envelopes. When envelops are opened, the discounts’ mean, A1, is computed as the average bid disregarding the highest and lowest 10 percent (rounded to the highest integer) of bids; then A2 is calculated as the average of the bids greater than A1 and below the disregarded top 10 percent bids; the discount closest from below to A2 wins. The winner is paid his own price and ties of winning bids are broken with a fair lottery. If all bids are equal, the winner is selected with a fair lottery. Finally, if there is a tie at the highest bid among the bottom 10 percent of bids (or at the lowest bid among the highest 10 percent of bids), the bids to eliminate are chosen with a fair lottery. Figure 1 illustrates an example with 17 bids. In this example, the winner (Dwin) is the seventh highest discount.

Figure 1: An Illustration of the Italian AB Rule



[5] See the list presented in Decarolis (2010).
[6] In standard second-price auctions the bidder offering the highest price wins, but pays the second highest price
[7] European Commission (2002). "Prevention, Detection and Elimination of Abnormally Low Tenders in the European Construction Industry".

What exactly does the new approach contribute relative to the standard one?

The alternative view of auctions stresses that, applied to the procurement of public works; traditional auction theory has the wrong focus. The traditional theory considers the main problem to be the fact that only firms privately know their cost of performing the job. Thus, the auctioneer needs to promote competition to induce them to reveal their cost (technically, this is known as a problem of "asymmetric information" between the auctioneer and the contractors). However, the main problem in the procurement of a contract may be that nobody, not even the firms, knows exactly what the cost of completing the job will be. Therefore, this shared cost uncertainty implies that, if pushed to compete, the lowest price will be offered by the firm that either underestimates the cost the most (winner's curse) or intentionally takes the riskiest gamble.

In practice, the importance of these problems has been recognized by practitioners of the traditional approach and various solutions have been used. In the case of the winner's curse, the problem is one of both poor information about the cost of the work and of poor estimation capabilities of future cost scenarios. The solutions to this problem are standard and consist in maximizing the amount and quality of information provided by the auctioneer, for instance through an accurate project design or pre-bidding consultations. Also, contracts may be auctioned with some level of cost-sharing thus reducing the impact of ex ante uncertainty over cost, while retaining incentives to select the most efficient bidder.

The vast majority of public works involve pretty standardized works performed by experienced firms, like paving roads and highways. In this case, the theory suggests that there is a low cost for the auctioneer to provide firms with a very complete project design that allows for little uncertainty. Therefore, a fix price contract and a competitive auction like an FPSB auction should be used in principle. However, even a little uncertainty can be enough to push the most unreliable firms to intentionally gamble on a low-cost job if their penalty for misbehaving ex post is small. This is the reason why also the traditional approach suggests accompanying the use of FPSB auction with some of the following practices[8]:

a. Bidders are typically prequalified based on firms' characteristics like reputation and available technical and financial capacity. In addition, it helps to proceed with bidding in two stages. In the first one technical bids can be made, discussed and technical responsiveness can be determined. Then, in the final bid stage only price bids are given.
b. Third party guarantees may be required in the form of either letters of credit or performance bonds. These provide incentives to complete the contract at the promised conditions
c. Rigid rules may prevent large ex post renegotiations. Once a contract is awarded the auctioneer is typically stuck in a hold up problem and would prefer to offer extra money to the contractor rather than restart the awarding process. Thus, tying the hands of the auctioneer to limited or no renegotiation serves to make the commitment credible.

All these remedies do not modify the fact that the best offer wins – contrary to the "alternative approach".

Theory and practice of the alternative approach

The theoretical reasoning motivating the alternative approach is based on the assumption that it is possible to modify the award rule without substantially affecting firms' bidding strategies. Hence, under the AB auction, awarding the contract to the bid closest to the average is desirable because lower prices are still offered by the most unreliable firms. However, the standard argument in economics is that this will never happen because each firm will foresee that offering a low price is suboptimal. It both increases the chances of being eliminated (because of being "too low") and it worsens the profits in case of victory. Thus firms will strategically revise their bids. In a sense the "engineering" approach treats bidders like

[8] Sometimes it is proposed to use less rigid auction rules to deal with the potential for ex-post renegotiation. This may be involve "competitive" negotiations or using firms' reputation or other measures of their reliability to score bids through a function weighting these criteria along with the price to determine the winner ("scoring rule" auctions). Such formats will be risky if corruption of the auctioneer is a concern.

natural physical or chemical materials and processes that do not think and do not strategically react to an engineer's way of manipulating them[9].

Therefore, there is a methodological difference between the traditional approach, which postulates that firms are strategic, and the alternative approach, which says that they are not strategic. What happens if an AB auction is introduced in practice where firms are strategic? Not surprisingly, the exact answer depends on the precise details of the AB rule considered. However, there are certain features that are common to all AB auctions:

- The reasoning that bidders need to make is more complex than in a FPSB auction. While in a FPSB auction they need to think about which is the most competitive bid that they will need to beat, in an AB auction they need to guess where the others are guessing that the average (or the other relevant awarding threshold) lies.
- Since nobody wants to be far from the average (or the other relevant threshold) the outcome of this reasoning is that all bids must be clustered together. Formally, it is possible to show that the various AB auctions have so called Nash equilibria in which all bidders offer exactly the same bid. The basic idea is that if all bidders are bidding the same value, than for a single bidder to bid something different will result in a zero probability of winning (Conley and Decarolis, 2011).
- There is a very strong incentive for a subgroup of bidders to form a coalition to affect the relevant threshold and, hence, the awarding of the contract. Paradoxically, this lowers procurement costs. The reason is that to increase their probability of winning, coalitions of firms aim to affect the "average" or threshold by having a whole group bid in coordinated way and, thereby, push the relevant awarding threshold to a price lower than would have been reached under competition by independent firms.
- For the same reason, there is an incentive for firms to invest in establishing dummy firms that they can use to submit multiple bids and thus affect the average bid. Investing in having more bids is likely to give much higher returns than investing to become more efficient.
- Finally, having a reservation price becomes tremendously important in the AB auctions. Indeed, while in the FPSB auction the cost distribution across firms mostly determines the bids submitted, in the AB auctions bids are disconnected from costs. Therefore, properly setting the reserve price is essential to avoid paying unreasonably high prices.

As a concrete example, in the case of the Italian AB auction described in Box 1, the only structure of bids that we should see if all firms were competing independently is one in which all firms offer a discount of zero (i.e., they offer to complete the work at its reserve price). Technically, for all firms to bid zero regardless of their true cost is the unique Bayesian Nash equilibrium of the auction. However, this situation is unstable because even a small coalition of bidders will have a strong incentive to deviate from it.

An analysis of the data reveals that all these predictions of a strong strategic response to the incentives posed by the AB auction actually occurred. There is broad evidence about the AB auctions used in Italy because since 1999 they are the most widely used procurement mechanism for public works. Between 2000 and 2007, AB auctions were used to procure 77% of all contracts, corresponding annually to about 12,000 contracts or euro10 billion. Analyzing empirically both bidders behavior within these auctions and what happened when these auctions were (in part) replaced by FPSB auctions we observe that:

- Within the AB auction: (i) about 10% of the firms in the market form groups that coordinate their members bids to affect the threshold (despite this being an illegal activity); (ii) bids are driven not by firms costs but by the intent to guess or manipulate the threshold; (iii) many groups include dummy bidders fictitiously owned and managed by family members of the main company owners; (iv) members of the same groups coordinate their entry to maximize the number of bids usable for the manipulation.

[9] Ioannou and Leu (1993) noted at the end of their paper that such strategic behavior did in practice occur, but did not analyze the consequences.

- When the FPSB auction replaced the AB auction: (i) the winning price substantially declined (resulting in a saving of about 10% of the reserve price); (ii) performance, as measured by defaults and changes in cost overruns and time delays, did not significantly worsen; (iii) the number of bidders declined from about 50 bidders per auction to about 7; (iv) the amount of subcontracts declined by 1/3.

These results confirm that there is a quantitatively large strategic response by bidders to the use of AB auctions. Instead of resembling a typical auction, bidding in AB auction resembles betting in a (possibly rigged) lottery. The firm that either by chance or because of a manipulation wins the auction is unlikely to be the most efficient and, hence, it will subcontract out the work. The AB auctions realize a sort of transfer in which the auctioneer implicitly delegates to the winner the choice of which is the best firm in the market to perform the work. This simply shifts the problem of selection of the most efficient bidder and the control of strategic behavior to someone other than the auctioneer.

Attitude towards the alternative approach

Theoretical and empirical analysis of AB auctions suggests they are problematic. They induce substantial gaming by firms. Some of this results in pure waste, for example, all the investments made to create dummy bidders. Gaming also produces some paradoxical results: an auctioneer might like some firms to coordinate their bids because this lowers the auctioneer procurement cost and subcontracts are needed to steer the execution of the work toward the most efficient firm.

There are, however, also some (half)-positive aspects of the AB auctions. First, by making the selection of unreliable bids automatic and non-discretionary, they limit the scope for corruption on that score. Yet, at the same time, corruption is also made easier by the greater importance that the choice of the reserve price has in these auctions relative to FPSB auctions.

Second, the AB auctions may achieve their aim of limiting the scope for renegotiation, through two channels: first, since the winning price is higher than in the FPSB auction, the winner of an AB auction will typically have a lower incentive to renegotiate the terms of the contract. Secondly, since the allocation is quasi-random, the firm that has the highest probability of failing to perform does not have any advantage over any other firm. In a sense, these are almost unintended side effects of the AB auction which emerge from the complex interplay of the incentives present in it.

Overall auctioneers should stay away from this kind of mechanisms. The basic prescription should be:

- Use only auction formats in which the lowest price (or highest score) wins
- Make sure safeguards are in place to prevent non-performance after the auction such as assessment of bidders' technical and financial capability or third party warranties