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DESIGN ELEMENTS OF A BONUS-BID AUCTION

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Design Elements:

1. Method of Bid Entry
2. Price the High Bidder Must Pay
3. Duration of Offering
4. Payment or Charge to Participants
5. Bidder Qualifications
6. Limitations Placed by Bidders on Winnings or Expenditures
7. Limitations Placed by Seller on Number of Items Sold
8. Order of Offering Items for Sale
9. Whether and How the Seller Uses Own Evaluation or Data to Influence the Price
10. Method of Payment
11. Information Provided by Seller After Sale
12. Timing of Re-offering

Design Criteria:

1. Increases Bidding Competition
2. Results in High Bids
3. Raises Total Receipts
4. Increases the Value of the Item to the Buyer
5. Has Low Administrative Costs
6. Works Well in a Wide Variety of Circumstances
7. Is Simple and Understandable
8. Aids Bid Acceptance/Rejection Decisions
9. Sells the Item Rapidly
10. Allocates Item to Highest and Best User

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I. Introduction and Summary

This paper relates how the U.S. Department of the Interior (DOI) in 1984-85 used auction and bidding theory to examine its procedure for auctioning Federal coal leases and what policy changes resulted. It also recounts what I learned from this venture that may be of interest to those who have a similar task or who are theorists in the field.

The task force that did the assessment broke the Federal coal lease auction process down into 12 basic elements to be considered for modification. Using auction theory and their own analysis, they identified potential improvements and determined the merits of these changes based on 10 design criteria/objectives. They found the likely benefits to be small from changing the current procedure of sealed bidding, a minimum submissible bid of $100 per acre, and a secret reservation price. Based on the task force's work and the lack of interest in change as indicated by public comments, the Secretary of the Interior decided to retain the current auction method.

In my view, the auction literature was quite helpful to the work of the task force; however, auction theory was much less serviceable for detailed analysis of Federal coal lease sale procedures, in large part because, at that time, auction theory tended to focus on the rather idealized situation of an auction of a single item of interest to a moderately high, fixed number of bidders. But Federal coal lease sales were, instead, a series of multiple-item auctions with each item usually of interest to only one or two bidders.

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II. Background

In April 1982 the Interior Department held a sale of thirteen Federal coal leases in the Powder River Basin of Montana and Wyoming, with a followup sale of two leases in October 1982. Twelve tracts containing 1.6 billion tons of coal were leased for a total of $67 million in cash bonuses. The Interior Department claimed that the sale had been "a resounding success." (U.S. DOI 1982) However, in April 1983, the Surveys and Investigations Staff of the House Appropriations Committee issued a report concluding that the Department had sold the Powder River Basin leases for $60 million less than they were worth. (U.S. House 1983) A month later the U.S. General Accounting Office (GAO) issued a report asserting that the Department had lost approximately $100 million on the deal. (U.S. GAO 1983) The Interior Department maintained, nevertheless, in its formal response to the GAO that it had received "fair market value" for the leases. (U.S. DOI 1983)

In July 1983 the Congress established an independent commission to look into this situation and recommend whatever changes in statutes, and Interior Department policies and procedures, were deemed appropriate. This was the Commission on Fair Market Value Policy for Federal Coal Leasing, under the chairmanship of David F. Linowes.

One of the areas of concern to be reviewed by the Commission was the Department's coal lease sale procedures. A number of controversial changes had been made to these procedures just one month before the April 1982 Powder River Basin coal lease sale.

The basic auction method used by the Department had not been changed. This was sealed-bidding, followed by oral bidding if two or more sealed bids were received for a coal lease tract. However, it had been standard practice for the Department to publish prior to a sale its appraisal of the value of each coal lease tract offered, as the "minimum acceptable bid" for that tract. This was not done for the April 1982 Powder River Basin sale; instead, the Department published "entry level bids," which were generally less than the Department's appraisals. The Department also hurriedly adopted a new bid-acceptance procedure that would rely on bidding competition evidenced in the sale as well as the Department's appraisals.

Of the thirteen coal lease tracts offered in the April 1982 sale, three tracts drew two sealed bids each and went to oral bidding, eight tracts received one sealed bid apiece, and two tracts received no bids. The Commission found that "the

Interior Department experiment with entry level bidding was a failure. Competition, which was relied on in theory to push up bids in the oral auction, did not materialize for most tracts. As a result, the sale itself failed to produce valid new indicators of fair market value for use in the planned post-sale appraisal." (Commission 1984, p. 417)

In fact, this low degree of bidding competition was not atypical for western Federal coal leases. It is often the case that a Federal coal lease tract is of interest to only the one or two coal companies that are in the best position to develop the tract because of nearby mining operations or adjacent land ownership.

In such circumstances, holding an auction might seem like an odd thing to do. In the private coal lease market, negotiation among buyers and sellers is common. But the Department is required by law to award leases by competitive bidding. The Commission recognized the awkwardness of this situation and recommended to the Congress that "where reasonable efforts to obtain competitive bids have failed, the government should have authority to negotiate a fair price." (Commission 1984, p. 234) The Commission also thought the Department could possibly improve its coal lease auction process and recommended that in order "to promote more competitive bidding, the government should test the feasibility of and experiment with a variety of auction techniques." (Commission 1984, p. 224)

Although the Department had accepted virtually all of the Commission's other recommendations, it was loath to fully accept this one. In July 1982, three months after the April 1982 Powder River Basin sale, the Department had dropped its controversial coal lease sale procedures and instituted the same basic system that it had used successfully for so long for Outer Continental Shelf (OCS) oil and gas lease sales, i.e., sealed bidding with secret reservation prices and an announced minimum submissible bid of $100 per acre for all tracts. The Department had done considerable experimentation with the OCS system and was quite comfortable with it. The Department had also taken a close look at its coal lease sale procedures in 1983 and made some refinements to the bid-acceptance process. (Bieniewicz 1983) Thus, in his response to the Commission report, Secretary of the Interior William Clark merely agreed to "request public comments and consider experimentation with a variety of auction techniques." (U.S. DOI 1984a, p. 21)

The responsibility for preparing the request for public comments on options for auction experiments fell upon the Bureau of Land Management (BLM), the agency within the Interior Department that runs the coal leasing program. In the past the BLM had been reluctant to try new coal lease auction methods, reflecting the Bureau's normal desire to carry out its functions in a routine, established manner and the program managers' fears of changing existing procedures until there was a clear political consensus and backing to do so.

These are legitimate fears. The Powder River sale itself is a good example of what can go wrong when procedural changes are made hurriedly. The Commission found, however, that the controversial last-minute changes made to the Powder River sale procedures were ordered by Interior Department policy officials rather than BLM program managers. (Commission 1984, p. 416)

The BLM had, in fact, carefully planned an experiment for the April 1982 Powder River Basin sale to test an auction method, called intertract bidding, that had undergone considerable study within the Department. Intertract bidding was an auction/sale approach originated within and championed by the Office of Policy Analysis, a policy shop within the Interior Department but outside of the BLM. This experiment was scheduled only after the Office of Policy Analysis obtained support for a small-scale test from the Governor's office in the State where the experiment would take place. In this test, four tracts near Ashland, Montana, were to be offered for bidding but only the two tracts receiving the highest bids would be leased. This experiment was cancelled one month before the sale for a reason unrelated to its design--three of the four tracts failed to receive necessary consents to allow coal development from the private owners of the surface estate overlying the Federal coal. (Bieniewicz and Nelson 1983)

In May 1984, the BLM formed a task force to prepare the options for the Secretary on experimental auction design. Leader of the task force was Andrew Strasfogel, a BLM geologist/policy analyst with considerable experience in the Federal coal leasing program. I was the only non-BLMer on the task force, coming from the Office of Policy Analysis. From 1975-1978, I had worked on the design of oil and gas lease auction experiments on the Outer Continental Shelf (OCS). I had been working primarily on coal leasing issues since 1979; in July 1983 I had prepared a lengthy options analysis for the BLM on Federal coal lease sale procedures. (Bieniewicz 1983) At the time the task force was established, I had only recently returned, along with Strasfogel, from a 6-month detail to the staff of the Commission. Besides Strasfogel and me, there were eight BLMers on the task force-- four economists, one geologist, two mining engineers and one mineral leasing specialist.

III. The Work of the Task Force

Since I was the task force member who was the most familiar with the subject matter, I was given the general assignment of providing a structure for the analysis and determining what the literature had to offer. My first task was to prepare a list of criteria for rating a bonus-bid auction process.[1] Ten design criteria were identified, some of which are interrelated, as follows:

1. Increases Bidding Competition
2. Results in High Bids
3. Raises Total Receipts
4. Increases the Value of the Item to the Buyer
5. Has Low Administrative Costs
6. Works Well in a Wide Variety of Circumstances
7. Is Simple and Understandable
8. Aids Bid Acceptance/Rejection Decisions
9. Sells the Item Rapidly
10. Allocates Item to Highest and Best User

Each of these criteria reflected the views of various different players with interests in Federal coal leasing. Design Criterion 1 reflected the Commission's view that experimentation with a variety of auction techniques was desirable in order "to promote more competitive bidding." Criterion 2 reflected the revenue concerns of the Congress as indicated by the requirement in the Federal Coal Leasing Amendments Act that the Department "obtain no less than Fair Market Value." Criteria 3-5 and 10 reflected what an economist looks for in a healthy market process-- low transaction costs, high rent capture by the seller and proper allocation. Criteria 6-9 primarily reflected BLM desires as the leasing agency for a successful, non-controversial sale. Criteria 4 and 10 reflected the coal industry's overriding concern that each firm be able to obtain in a timely manner the particular Federal coal that it needed to maintain or expand its mining operations.

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[1] Another of the Commission's recommendations was that "in the conduct of coal lease sales, the government should continue to rely on bonus bidding." (Commission 1984, p.216) The Department concurred with this recommendation, based on **its dissatisfaction with royalty bidding and profit-sharing on the OCS; this decision limited the range of possible experimentation in coal lease auctions to systems using cash-bonus bidding with fixed royalties.** (U.S. DOI 1984, p.19)

The next task was to break down the existing Federal coal lease sale process into basic design elements that could be modified individually. The twelve design elements identified were, as follows:

1. Method of Bid Entry, e.g., sealed bid or oral bid
2. Price the High Bidder Must Pay, e.g., the high bid or the highest losing bid
3. Duration of Offering, i.e., the amount of time bidders would have to prepare for the auction and submit bids
4. Payment or Charge to Participants
5. Bidder Qualifications
6. Limitations Placed by Bidders on Winnings or Expenditures, when bids must be submitted for a number of items simultaneously
7. Limitations Placed by Seller on Number of Items Sold, when the number of items offered exceeds the number the seller wishes to sell
8. Order of Offering Items for Sale
9. Whether and How the Seller Uses Own Evaluation or Data to Influence the Price, e.g., by pre-sale publication of appraisals or use of "reservation" prices
10. Method of Payment, e.g., one lump sum or a series of payments
11. Information Provided by Seller After Sale, e.g., the seller's secret appraisals of what was sold, which might affect the bids in future sales
12. Timing of Re-offering

Each element was then reviewed to identify possibly meritorious changes based on the identified design criteria. Most of this review utilized qualitative analysis. The task force's objective was to identify auction modifications that might offer improvement, not to fully quantify such improvement. Such quantification would be left to the experimental stage if such experimentation was deemed worthwhile.

Elements 3, 4, 5, 10 and 11 were considered poor candidates for change, because such changes would either violate legal requirements, be inconsistent with competitive offerings of all other solid and fluid mineral leases, or would modify procedures that had been recently established after a public comment period. Analysis of element 7 was left to another work group that was developing guidelines for the use of intertract bidding, a sale procedure where the tracts obtaining the highest bids are leased from among a larger set of tracts offered. Accordingly, the experimental auction task force focussed its efforts primarily on elements 1, 2, 6, 8, 9, and 12, which included the elements that had received the most attention in the auction literature.

Turning to the literature, I was able to find a number of works that proved to be helpful, in particular, the comprehensive bibliography by Stark and Rothkopf (1979), the survey of auctions and bidding models by Engelbrecht-Wiggans (1980), the anatomies of the structure of auctions by Arthur (1976) and McGuire (1981), comparisons of sealed to oral bidding by Vickrey (1961 and 1976), Mead (1967 and 1977), Miller (1972) and Johnson (1979), an analysis of the relationship between bid-preparation costs, the number of bidders and bidder profits by Gaskins and Teisberg (1976), and an explanation by Capen, Clapp and Campbell (1971) of how a thoughtful firm bids in the Interior Department's OCS oil and gas lease auction-- an auction that is very similar in design to that used for Federal coal lease sales.

The task force's analysis suggested that several of the design elements were plausible, though not necessarily promising, candidates for experimentation.

For element 1-- Method of Bid Entry-- the task force identified three methods as having merit: sealed bidding (the then-current system), oral bidding, and sealed bidding followed by oral bidding if two or more participants submitted sealed bids of at least 25 percent of the Department's secret pre-sale estimate of lease value. Sealed bidding was clearly indicated as preferable by the literature for most situations where low numbers of bidders were expected; sealed bidding was more robust and discouraged collusion and bidder apathy. The task force found, however, that in some cases, such as emergency Federal coal lease sales where an ongoing mining operation had an immediate need for the Federal coal or the coal would be bypassed, oral bidding, with its better allocation properties, might be the superior choice from the perspective of good public policy. Oral bidding also appeared to have merit for intertract bidding sales because weak bidding competition was a lesser concern in such sales.

For element 2-- Price the High Bidder Must Pay-- the task force concluded that no change from the then-current system of having the high bidder pay the high bid seemed advisable. A second-price auction method appeared unworkable given the low expected number of bids and near impossibility of defending the system before Congress.

For element 6-- Limitations Placed by Bidders on Winnings or Expenditures-- the task force found that allowing firms to specify spending limits might be worthwhile for the situation where several tracts were offered simultaneously under sealed bidding. This approach would allow each firm to bid on as many tracts as it wished without fear of exceeding its financial resources, thus potentially increasing the number and size of bids.

For element 8-- Order of Offering Items for Sale-- a sequential sealed-bid auction, with bypass tracts and tracts with highest estimated values per ton to be offered first, was considered a favorable option for experimentation.

For element 9-- Whether and How the Seller Uses Own Evaluation and Data to Influence Price-- several options were developed: no pre-sale announcement of the reservation price (the then-current approach), pre-sale announcement of the reservation price, and "second-chance" bidding. The task force proposed pre-sale announcement of the reservation price for bypass tracts only, to reduce the risk of failing to lease such urgently needed tracts and to avoid the administrative cost of a re-offering. Second-chance bidding was proposed for bypass tracts if the policy of secret reservation prices was continued. Under second-chance bidding, if all bids for a tract were below the (unannounced) reservation price, all firms that submitted bids of at least 25 percent of the reservation price would be given one more chance to submit a sealed bid that exceeded the reservation price.

For element 12-- Timing of Re-offering-- the task force recognized that the bypass tract problem could be overcome by a policy of quick re-offering of tracts whose high bids were rejected, but at some likely reduction in bonus-bid revenues. It was proposed that "new mine" tracts not be re-offered for a period of one year after an unsuccessful offering but that bypass tracts be available for immediate re-offering.

The task force developed four example auctions, with all design elements specified, to illustrate the range of possibilities for experimentation. These example auctions, along with an explanation of the 10 design criteria, 12 design elements, and a brief history of Federal coal lease sale procedures were published in the Federal Register in October 1984 for public comments. (U.S. DOI 1984b) This Federal Register notice was re-printed in the Draft Environmental Impact Statement-- Federal Coal Management Program of February 1985 in order to solicit additional public comments. Copies were also sent to several bidding theorists.

IV. The Decision

Eight parties submitted written comments in response to the Federal Register notice: three coal industry associations, two coal companies, the National Wildlife Federation, the Governor of Utah and a local citizens group. (U.S. DOI 1986, p. II-55)

Coal industry respondents generally expressed a preference for oral bidding, at least partly because of its allocation properties. Each Federal coal lease tract usually has but a single coal company that is interested in mining that tract's coal. Oral bidding would virtually assure that that firm would be able to obtain the Federal coal it needed. Oral bidding would also allow such firms to avoid leaving money on the table.

Industry also uniformly favored the pre-sale announcement of the government's reservation price. There was virtually no support for any other changes in auction procedures expressed by industry or by any other of the commenters.

Secretary Donald P. Hodel's decision was that "<u>at this time</u>, the Department will <u>not</u> consider experimentation with a variety of auction techniques." (U.S. DOI 1986, p. DS-27) [emphasis in original document] The Department would stay with sealed bidding and would not announce its appraisals or reservation prices before the sale; however, the door to experimentation at some later date was left open.

Why this decision? The then-current auction policy was clearly the safest choice. The Department was appropriately leery of using oral bidding, which had the onus of being the practice used in the Powder River sale. Also, there were minimal, if any, gains in bonus receipts foreseen from any of the other changes proposed by the task force.

V. Conclusions

The design-elements/design-criteria approach used by the task force provided a sound basis for the Secretary to make a decision. Breaking the sale process down into its elements greatly facilitated the integration of auction theory into the analysis; and the use of multiple design criteria allowed all to see who the various winners and losers would be from the changes that theory indicated might be worthwhile.

In retrospect, I could have expanded the list of design elements to include at least one further element-- configuration of the items to be offered for competitive potential.[2] I also could have organized the design elements more neatly into three categories: before-, at-, and after- the sale. It would also have been helpful to have listed and discussed the "non-design factors" of the auction process, i.e., those factors, such as the degree of risk aversion of the bidders, that are outside of the auction designer's control but to which the design elements are sensitive.

Even though the literature proved to be helpful, I felt there were a number of difficulties or concerns, even as I made use of it, as follows:

- much of the literature was mathematical-abstract and somewhat untested experimentally-- what Mike Rothkopf refers to as "high theory";
- the literature tended to focus on rather idealized situations, most commonly that of a moderately high, fixed number of bidders for a single item. But Federal coal lease sales were, instead, a series of multiple-item auctions with very weak bidding competition, where the number of bidders was sensitive to our minimum-bid/bid-rejection policy;
- the majority of the literature was from the bidder's perspective, rather than from the seller or auction designer's perspective;
- the auction design advice that was available tended to focus on one aspect or element of auction design at a time rather than discuss complete auction systems; the sensitivity of the element to other auction system elements or factors tended to be missing;
- auction theory tended to focus on only two objectives-- bonus maximization and optimal allocation-- but a government agency has many other objectives than these. In fact the BLM's primary legal requirement in selling Federal coal leases is to obtain no less than Fair Market Value, an objective not equivalent to simple bonus maximization;
- some important aspects of the Federal coal lease auction process, such as the bid-rejection procedure, were not much analyzed in the literature; and
- the literature did not always distinguish which aspects of the auction or bidding process were under the control of the designer or bidders and which were not.

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[2] Two examples of this element are cooperative leasing, where Federal coal and adjacent private coal needed to form a mining unit are leased together as a package, and, whenever possible, the delineation of Federal coal tract boundaries so that the tracts contain enough coal to support a new mine.

But on the other hand:

- o the literature was quite helpful for our purposes, even though somewhat incomplete;
- o even though much of the theoretical work was essentially untested, it was very plausible and the public and the Department were willing to accept it as authoritative. In all of the comments and the internal work of the task force the use of this literature was never questioned; and finally
- o our analytic approach-- multiple design criteria and a focus on design elements-- proved workable for real-world decision-making, even if not entirely satisfying from the standpoint of identifying the unambiguously "best" solution.

What would have made the literature even more helpful to our task would have been the following:

- o more analyses from the auction designer's viewpoint;
- o analysis that reflects a larger set of auction design objectives and identifies which aspects are design elements and which are non-design factors; and
- o an expanded concept of the auction process, beyond that defined by Engelbrecht-Wiggans (1980) or more recently by McAfee and McMillan (1987), to include more real-world elements.

I do see a welcome trend in this direction evidenced in some recently published work, such as the article on reservation prices by Engelbrecht-Wiggans (1987). As auction theory moves closer to becoming a science, I expect to see developed a standardized system for complete description of real-world auctions, including all important elements and factors. Personally, I would like to see a taxonomic classification system for auctions from the point of view of the seller as the auction designer. I think this is a sensible approach, but I must admit it at least partly reflects my professional role as an analyst of market mechanisms for the sale of Federal mineral leases. I want a system of classification of auctions that would be of practical use to those who wish to make policy prescriptions for real-world sale situations.

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