
Selections from the FCC Combinatorial Bidding Reports and Subsequent Developments

Paul R Milgrom

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Summary of Major Points

SMR Auctions

- ◆ Simultaneous multiple round (SMR) auctions
 1. The FCC rules are theoretically optimal in some bidding environments, but have major flaws for others.
 2. Particularly where varying complementarities are important, the “exposure problem” can damage bidding.
 3. The “exposure problem” flaw was manifest in the Netherlands spectrum auction, probably leading to large value losses.

- ◆ Combinatorial assessment
 1. In SMR auctions, some assessment of combinations before the auction is invariably necessary.
 2. Simple solutions involving severely restricted combinations are also possible, as in the 700 Mhz band.

Vickrey Auctions

- ◆ Generalized Vickrey combinatorial auctions
 1. Generalized Vickrey auctions entail bidding on all “admissible” licensing outcomes and involve a sophisticated pricing rule.
 2. Theoretically, the generalized Vickrey auction can entail ***dominant strategies*** and leads to ***efficient outcomes***.
 3. The assumptions about the payoff structure in point 2 often fail to hold in the context of spectrum bidding.
 4. The assumption that bidders will adopt dominant strategies is also sometimes challenged.

SMRs w/ Package Bidding

- ◆ **Dynamic combinatorial auctions**

- Compared to the simultaneous multiple round auction**

- 1. the principal advantage of combinatorial auctions is to eliminate the exposure problem, leading to better value discovery and encourage participation, and
 2. the principal disadvantage is that they create additional opportunities and incentives for strategic manipulations.

- Compared to generalized Vickrey auctions,**

- 1. the principal advantages are that the dynamic auctions may entail lower bidding costs and overcome some of the theoretical flaws identified earlier, and
 2. the principal disadvantage is that, at least in some important environments, they entail poorer strategic incentives

More on Package Bidding

- ◆ Package bidding enhancements
 1. Package bidding can be simplified by specifying packages suitably.
 - Band plans implicitly specify allowed packages.
 - Portland General Electric power portfolio sale entails package bidding aimed to satisfy legitimate interests.
 2. “Bid composition restrictions” (patent pending) can reduce incentives for strategic manipulations in dynamic combinatorial bidding.

Detail on Individual Bidding

Substitutes and Complements

- ◆ Economic Concepts Defined:

1. Licenses are ***mutual substitutes*** if, in a fixed prices arrangement, raising the price of one license could never result in reduced demand for the other licenses.
2. Two licenses are ***complements*** for a bidder if acquiring one license makes the other more valuable.

- ◆ Caveat:

Some commentators have used the term complements more broadly to include all situations in which a package is more valuable than the sum of its individual components. Some conclusions depend on adhering rigorously to the traditional definition.

Individual bidding is theoretically optimal...

- ◆ **Proposition**: Suppose that
 - a simultaneous multiple round auction is used
 - all licenses are **mutual substitutes** for all bidders
 - bid increments are “small”
 - bidders bid “straightforwardly” at each round for the licenses they value most.

Then the outcome will be efficient and all bidders will be satisfied with their allocations.

- ◆ **Remark**: This proposition ignores strategic bidding issues, which are often of primary importance.
 - but see UK UMTS auction or Stanford housing auction

The “Exposure Problem”?

- ◆ With individual bidding, a bidder is “exposed” to the risk of winning a few licenses it wants without winning other, complementary licenses it wants.
 - Fearing that, it may not bid aggressively, or may not even participate in the auction.
- ◆ Theory: When the same licenses are substitutes for some bidders and complements for others, the problems are severe.
 - market clearing prices generally don’t exist
 - differences in aggressiveness are inevitable.
 - Upshot: lower prices and inefficient outcomes. Everyone loses.
- ◆ Scale economies make this situation especially likely when some bidders are incumbents and others new entrants.

Netherlands DCS-1800 Auction

- ◆ On offer
 - 2 lots with 5MHz on the E-GSM band and 15 MHz on the DCS-1800 band
 - 15 lots with about 2.5 MHz on the DCS-1800 band and various restrictions on borders with Belgium, Germany
 - 1 lot with 4.5 MHz on DCS-1800 band
 - Completed February 18, 1998 after 137 rounds.
- ◆ Prices per band in millions of NLG
 - Lot A: 8.0
 - Lot B: 7.3
 - Lots 1-16: 2.9-3.6
- ◆ Theory:
 - market clearing individual license prices likely don't exist.
 - poor packaging leads to low prices, inefficient outcomes

Detail on Vickrey Combinatorial Auctions

Generalized Vickrey Auctions

- ◆ The Rules:
 - Each bidder makes a sealed bids for each combination of licenses it may want to acquire.
 - The auctioneer computes the combinatorial allocation that yields the largest total price.
 - The algorithm then computes for each bidder the smallest bid it could have made while still winning the same package of licenses. That becomes the price the bidder will pay.
- ◆ The Analysis
 - No bidder has an incentive to distort its bids.
 - The outcome is efficient.

Limits of the Vickrey Auction

- ◆ The preceding theoretical analysis ignores important features of the real environment:
 1. bid preparation costs
 - a) evaluating many combinations
 - b) entry/participation costs
 2. limited bidder budgets
 3. price discrimination
 - a) Legal issues
 - b) PR issues
 4. common values and the winner's curse
 5. vulnerability to collusion
- ◆ Experimental evidence that bidders will play a dominant strategy is ambiguous.

Detail on Dynamic Auctions with Combinatorial Bidding

Assessing the Gains

- ◆ Compared to the simultaneous multiple round auction
 - eliminates the exposure problem
 - handles strong and diverse complementarities effectively

BUT

- creates an incentive for strategic bidding on large packages.

- ◆ Compared to generalized Vickrey auctions
 - lower bidding costs
 - less price discrimination
 - better budget management
 - better information transfer (less winner's curse)

BUT

- no dominant strategies
- likely bid distortions include
 - » packages too large
 - » avoid “bidding against self”

Package Bidding Enhancements

- ◆ Role for queues & bid morgues in package bidding.
 - Full optimization generally requires backtracking
 - Near optimization is often fast, requires less backtracking
- ◆ There are many ways to specify allowable packages.
 - Band plans implicitly specify allowed packages.
 - Portland General Electric power portfolio sale entails pricing “decrements” from packages.
- ◆ “Bid composition restrictions” (patent pending) can reduce incentives for strategic manipulations in dynamic combinatorial bidding.

Conclusions

- ◆ Auction design is a practical business involving trade-offs among varying design objectives.
- ◆ Theory and experiments have both left major issues relevant to combinatorial bidding unexplored.
- ◆ The advantages of combinatorial bidding in selected environments is well established.
- ◆ Theory suggests that excessive flexibility to propose large combinations is a disadvantage.