Lessons from the Incentive Auction

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Served as a consultant for FCC and Auctionomics, but views expressed here are own and not of FCC or Auctionomics

Was Incentive Auction Needed?

- Q: How many economists does it take to change a lightbulb?
- A: Zero – free market will do it ("Coase Theorem")
- "*What would happen if the government was not in the middle between broadcasters and wireless carriers? Willing seller broadcasters and willing buyer wireless companies could effect the transfer of 120 MHz of spectrum in about 30 days. Hopefully the government can get it done in only 20 times that long—by the end of 2014.*"

Preston Padden, *Expanding Opportunities For Broadcasters Coalition,* 2012

What Makes Markets Work: Substitutability

- *Competition* between substitutable agents makes them moderate their demands
  - Drives sellers' prices down
  - Drives buyers' prices up
- Competition of many perfect or close substitutes yields "textbook" efficient markets

What Makes Markets Fail: Complementarity

- Complementary agents *hold out* for larger slices of the pie, risking bargaining breakdown

What Makes Markets Fail: Complementarity

- Complementarities in Spectrum Repurposing:
  - Usual - between buyers and sellers
  - Between buyers of spectrum in different regions
  - Between diverse stations needed for clearing usable contiguous spectrum blocks

What Made Broadcasters Compete

- *“Middle Class Tax Relief and Job Creation Act of 2012”* gave FCC the right to retune holdouts, turning stations on different frequencies into substitutes
- Auctionomics’ SATFC software turned distant stations into substitutes
- Clock auction format hid the complexity of repacking subject to >1mln constraints “under the hood,” making it easy for bidders to compete by bidding true values (obviously optimal for single-station sellers)
- Scoring allowed large stations to compete with small stations
- Simplicity of auction format, high opening prices, and FCC’s outreach boosted participation, ensuring competition

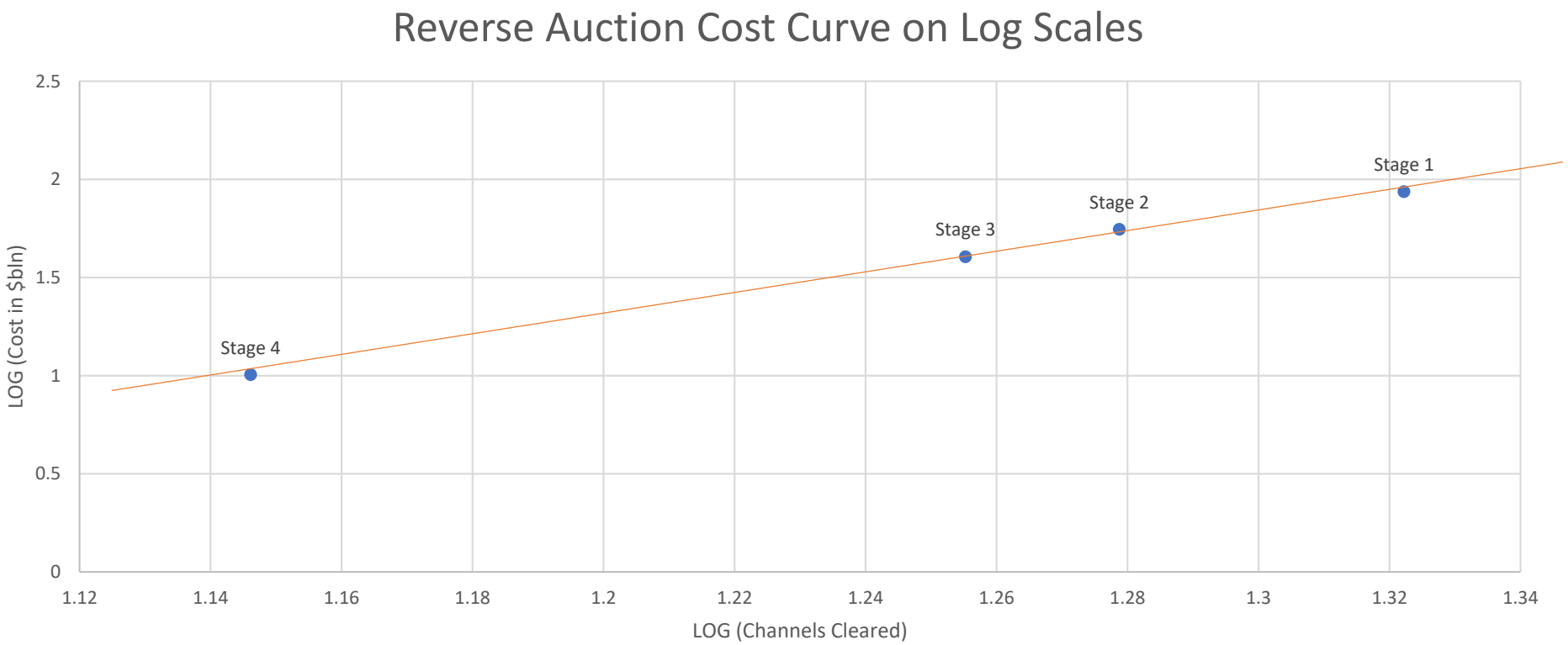
Was the Incentive Auction “Successful”?

- Did it buy spectrum at a minimal disruption to society and minimal cost to FCC?
  - Auctionomics simulations on computationally tractable regions (using public station value estimates) show TV value loss within 10% of minimal, FCC’c cost 14-30% *lower* than in the Vickrey benchmark
- Did it sell spectrum at a maximal benefit to society and maximal revenue for FCC?
  - Bidders claim their bids reflected true values, implying efficient allocation
  - Potential benefits to consumers through increased coverage and competition
- Did it repurpose an efficient amount?

Stage	Channels cleared	Cost, $bln	Blocks created	Revenue, $bln
1	21	86	10	23
2	19	55	9	22
3	18	40	8	20
4	14	10	7	19

- Repurposing more would likely have been inefficient given expressed demand and supply
- Repurposing less would have been inefficient
- 84MHz target enjoyed extra efficiency from
  - using Channel 37 (RA) as a guard band
  - No impairing TV stations in mobile band

Was Reverse Auction Cost Drop Unexpected?



- As if derived from a supply curve with constant elasticity = 0.23
- Low elasticity means that stations' values are widely varied
- Efficient clearing target acquired low-value stations, not high-value ones

Were All Clearing Targets Worth Trying?

- Auction tried the largest target subject to an *average* impairment constraint
- Economic approach: *marginal* gain of usable mobile spectrum vs. *marginal* loss of TV spectrum from a higher target
- Example: clear 126 MHz vs. 114 MHz?
  - Without impairments, would create 10 MHz mobile spectrum from 12 MHz TV spectrum
  - Impairments given actual participation: on Mexico border (incl. L.A.), 126 yielded *less* usable mobile spectrum than 114
  - Due to those impairments, clearing 126 vs. 114 yielded < 6 MHz usable mobile spectrum on nationwide basis.
  - Yield < 50%, doesn't seem worthwhile
- Example: clear 108 MHz vs. 84 MHz?
  - Yields only 10MHz mobile spectrum from 24 MHz TV spectrum (rest goes to guard bands)
  - Yield = 42% (even without any impairments), doesn't seem worthwhile
- Thus targets 126 and 84 weren't worth trying

Cost of Going through Extra Stages?

- In the classic case of substitutes: when a bid is rejected, it would also be rejected at any lower target. Then extra targets don't affect the outcome
- In the Incentive Auction with complementarities: a bid may be rejected at a higher target when at a lower target it might have been accepted or provided useful competition
- *Forward Auction:* Of the $649 mln undersell, $539 mln was in Mexico-border PEAs that had < 7 unimpaired blocks at the 126MHz target and 7 blocks at the final 84MHz target
- *Reverse Auction:* Some low-value stations may have been rejected/exited due to fitting well with the current target, even though they may have won or provided competition at the final target
- Yet eventual inefficiency may be minimized by post-auction transactions

Another Speed-Up Possibility: Higher Bid Increments and Decrements

- Theory suggests that even without intra-round bidding, efficiency and revenue loss is second-order in bid decrement:
  - Probability that winner is determined by tie-breaking is small
  - Loss of efficiency (or “virtual surplus”) when tie-breaking is used is also small
- E.g.
  - 5% increments yield 0.25% loss
  - 10% increments yield 1% loss

Conclusion: Case study in “Algorithmic Market Design”

- Designing one auction for billions of $$ is different from designing billions of auctions for single $$:
  - Designer and bidders don’t have opportunities to learn/experiment
  - Must rely more on theory rather than data
  - Robustness is crucial
  - Robustness would be enhanced by pre-judging some allocations as not optimal
  - It’s possible to combine complex computations with ease of bidding for non-sophisticated bidders