Using auctions to support effective pricing of spectrum

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Nairobi, Kenya

Introduction to spectrum auctions

- Prior to late 1990s, most countries assigned spectrum for mobile through beauty contests or direct award
- Auctions have since supplanted beauty contests as dominant allocation mechanism
- While auction design can be controversial, the use of auctions is widely accepted by operators and regulators alike

Why regulators and operators typically prefer auctions	
Allocative efficiency	Transparency of outcomes
Consistency of rules	Robustness to legal challenge

First vs Second Price sealed bid

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- The simplest type of auction is the '**single unit sealed bid**'
- A sealed bid auction takes place in just one round and can be implemented with one of two pricing rules:
  - **First price (pay your bid)**

    Highest bidder wins and pays the amount of their bid
  - **Second price (pay opponent's bid amount)**

    Highest bidder wins and pays the amount of the next highest bid
- Bidders compete to win the item, ideally at a profit
- We use the term "surplus" to describe the profit you make if you buy something at a price below your value

First vs Second Price sealed bid

- To illustrate the differences between the two pricing rules, we will play both
- For each auction, you will be divided into two teams, each competing to buy "**The Very Useful Spectrum Licence**"
- You will be given a sheet containing:
  1. Your company's valuation for the licence
  2. Your estimate of your opponent's value for the licence
  3. Paper to enter your bid
- Your objective is to maximise your 'surplus' from acquiring the item

Your job is to decide your bid strategy – how much to bid?

Bids please…

Reserve price for the “useful licence”: 300 gold pieces

1st Price Sealed Bid

Salt

v

Pepper

You have two minutes to determine your bid amount

2:00

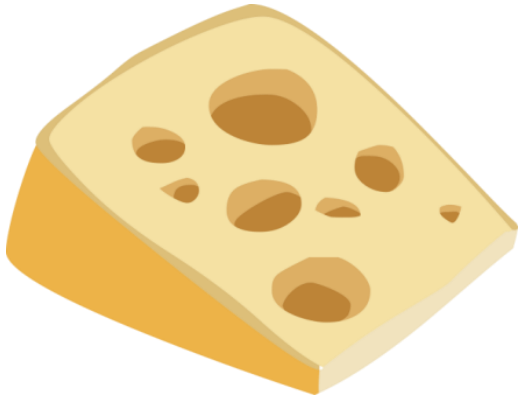
Bids please…

Reserve price for the “useful licence”: 300 gold pieces

2nd Price Sealed Bid

Chalk

v



Cheese

You have two minutes to determine your bid amount

2:00

Auction outcome

- The values in the two auctions were the same, so we can compare results:
  - Salt and Chalk had the same values
  - Pepper and Cheese had the same values

First price auction

Bidder	Value	Estimate of rival's value	Optimal bid	Efficient outcome	Actual bid	Actual outcome
 Salt	463	450-490	450<X<463	Loses		
 Pepper	474	420-470	445<X≤471	Wins		

Second price auction

Bidder	Value	Estimate of rival's value	Optimal bid	Efficient outcome	Actual bid	Actual outcome
 Chalk	463	450-490	463	Loses		
 Cheese	474	420-470	474	Wins		

Lessons from simple sealed bid

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Strategy

- There is no dominant strategy in a first price auction
  - If you bid your value and win, then there is a zero surplus
  - Bidding above your value is irrational as payoff would be negative
  - Rational to **'shade'** your bid below value, trading off:
    - potential for higher payoff; and
    - decreasing probability of winning
- By contrast, in second price auction, dominant strategy is to bid value

Implications

- Second price auctions are strategically much simpler and are more likely to lead to efficient outcomes
- First price auctions require you to estimate competitor values (hard!) and expose more efficient operators to risk of losing

Most spectrum auctions are run using the formats based on the second price concept, as they are more likely to support efficient allocation

Common auction formats for spectrum

SMRA

- Ascending prices for each spectrum block
- Standing high bidders
- Auction continues until no more bids are placed
- Can be implemented with frequency specific or generic lots

Clock auction

- Bidders bid for quantity of generic lots (not individual frequencies)
- Clock price 'ticks' up for categories with excess demand
- Special rules needed on stopping and switching to prevent undesirable 'overshoot'

Combinatorial clock auction

- Multi-round package bid auction
- Clock auction followed by sealed bid stage, with activity rules to "encourage honest bidding
- Winner and price determination based on all bids received

Sealed bid package auction

- One shot auctions, typically for multiple blocks
- Usually implemented with package bidding
- May be implemented with first or second price rule

"Second price" family of auctions

First or Second price

Could spectrum auctions work in Kenya?

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- Next generation of awards in Kenya will involve incremental capacity spectrum
- Not obvious how to divide amongst operators:
  - Safaricom will likely need more spectrum than rivals owing to large customer base
  - Important that lack of spectrum does not choke Safaricom's ability to deliver next generation data services
  - But also important to ensure smaller rivals secure critical mass of spectrum so they can compete
- Auctions can take pressure off regulator, allowing market to identify efficient allocation
  - Can use packaging and competition measures to ensure all bidders have access to sufficient spectrum
  - Can use innovative mechanisms to support policy goals such as rural coverage

Good auction design

Product design	Auction rules
• Lots of 5-20 MHz that can be aggregated • Licence terms promote investment and key policy goals	• Multi-round auctions usually preferred • Rules that lower risk and discourage strategic bidding
Competition measures	**Reserve price**
• Support for business continuity • Spectrum caps to eliminate undesirable outcomes	• Prices below conservative market value estimate • Take account of cost of licence obligations