Auction Design for the Real World

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Why Auction Design Matters

Public policy goals can be implemented within auction markets

- Achieving Efficient Allocations
- Preventing Monopolization
- Rewarding Innovation
- Affirmative Action

Poor design leads to inefficient outcomes

- Australian Satellite TV
- New Zealand Second Price Auction
- RCA Transponder Auction
- EPA Pollution Permit Auction

Theory: market design matters with private information

- Akerlof
- Myerson Satterthwaite

Why Auction Design Matters

Examples of Design Failures

Australian Satellite TV Auction

Australia used sealed-bid auctions for Satellite Television Services
No deposits were required
Bidders submitted many bids, and withdrew from high bids

Australian Auction Outcomes (No Deposit)

Initial Winning Bid	Final Price After Withdrawals
A $212,000,000	A $ 117,000,000
A $177,000,000	A $ 77,000,000

Source: John McMillan, "Selling Spectrum Rights," *Journal of Economic Perspectives*, Summer, 1994

Missing Detail: Withdrawal Penalty

Why Auction Design Matters, Examples of Design Failures, Continued

New Zealand used a second-price auction to sell radio spectrum

In a second-price auction, high bidder pays the second-highest bid

No reserve price was imposed

New Zealand Auction Outcomes (No Reserve)

High Bid	Second-Highest Bid
NZ $100,000	NZ $6
NZ $7,000,000	NZ $5,000

Source: John McMillan, "Selling Spectrum Rights," *Journal of Economic Perspectives*, Summer, 1994

Political Problem: Public sees outcome as selling for less than worth

Lesson 1: When little competition is expected, use reserve price.
Lesson 2: Don't use Second-Price Auction

Why Auction Design Matters, Examples of Design Failures, Continued

New Zealand 8 MHz UHF License Rights
Second Price Simultaneous Auction

Lot	Winning Bidder	High Bid	Second Bid
1	Sky Network TV	2,371,000	401,000
2	Sky Network TV	2,273,000	401,000
3	Sky Network TV	2,273,000	401,000
4	BCL	255,124	200,000
5	Sky Network TV	1,121,000	401,000
6	Totalisator Agency Board	401,000	100,000
7	United Christian Broadcast	685,200	401,000

Source: Tom Hazlett, "A Brief History of Spectrum Auctions," unpublished, 1994.

These were similar licenses
Totalisator bid $401,000 for 6 licenses; won one license
Totalisator could have bid on license 4, would have won
Appears that allocation was inefficient
Problem is simultaneous sealed-bid tender -- won't arise with ascending auctions

Why Market Design Matters

Examples of Design Failures, Continued

RCA Transponder Auction

November 9, 1981

A Sequential Auction of Similar Items

Order	Winning Bidder	Price Obtained
1	TLC	$14,400,000
2	Billy H. Batts	$14,100,000
3	Warner Amex	$13,700,000
4	RCTV	$13,500,000
5	HBO	$12,500,000
6	Inner City	$10,700,000
7	UTV	$11,200,000
Total		$90,100,000

TLC sued; results nullified by FCC

Sequential Items of Similar Objects Create Pricing Disparities

Sequential Auctions create high probability of bidder regret

Why Market Design Matters, Examples of Design Failures, Continued

EPA SO2 Auction

Double Auction with Sealed Bids and Discriminatory Pricing Pricing Rule:
Match highest bid price with lowest asked price;
Match second-highest bid with second-highest ask, and so on down.

Each successful buyer pays its bid price.

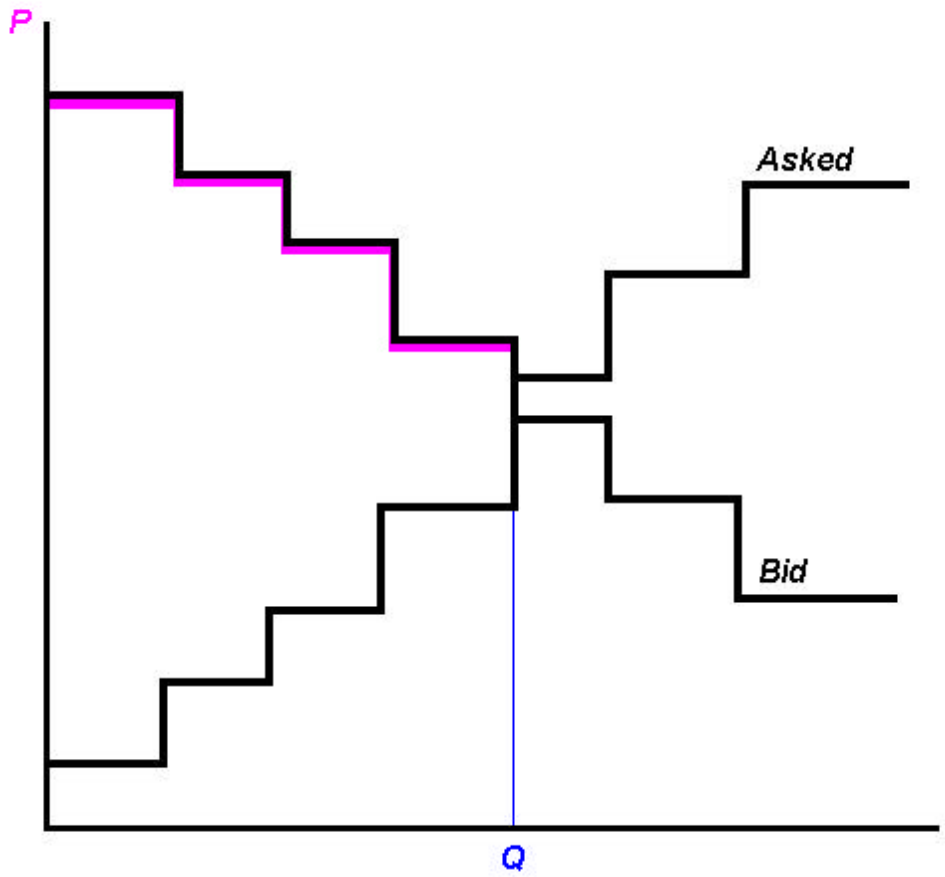
Thus, the seller with the lowest asked price gets the highest payment.

Sellers naturally bid very low, as did buyers.

Created pricing distortions and inefficient allocations.

Lesson: Details Matter. Mechanisms require careful analysis.

EPA SO2 Auction, Continued



Weird pricing scheme led to bids that didn't reveal values

Major Reasons for Auctions

When Are Auctions Commonly Used?

When the value of things is uncertain
- antiques, paintings, rare wine

When the value of things fluctuates frequently
- fresh fish, foreign currencies, commodities like orange juice or tobacco

Design Issues

The M&M Auction

Each M&M is Worth Five Cents

Money is in This Envelope

The Highest Bidder Pays his or her Bid
- gets the Envelope
- not the M&Ms!

The Jar is your information, or signal, concerning the value of the envelope

First Price Sealed Bid: Write your bid on the piece of paper
Ascending (English)

Design Issues, Continued

- Details Matter
- Political Embarrassment
- Information Revelation
- Value Interdependencies
  - Synergies or Complementarities
  - Substitution
- Simplicity of Bidder Strategies
- Efficiency
- Collusion
- Timely Completion
- Favoring Interest Groups

Some of these conflict with each other.

The Winner's Curse

"*I paid too much for it, but it's worth it*."
-Samuel Goldwyn

"The bidder who most overestimates an object's value wins the bidding."

Ascending auctions let bidders see other bidders' willingness to pay

- Reduces risk of paying too much
- Encourages more aggressive bidding
- Raises prices on average

Risk of regret reduces bids

- Bid as if you have the most optimistic estimate

Value Interdependencies and the Exposure Problem

Individual Item Prices Expose a Bidder to Risk of Incomplete Packages

Classic example: Three identical items, two bidders.
One item worth 1, two items worth 4, and three items worth 4.
Each bidder is willing to pay 1 for 1 item, 3 for the second.
Solution must entail one bidder getting 2, other getting 1.

Uncertainty exacerbates this problem--don't know if you are the bidder who values two items the most.

Details of the Simultaneous Ascending Auction

All licenses are open for bidding simultaneously

All license remain open until bidding ceases on all

Bidding occurs in rounds

Bids are announced at the end of each round

Bidders have an initial eligibility based on deposits

Bidders must keep active to maintain eligibility

Activity = standing high bids + new bids

Insufficient activity will reduce eligibility to win

The auction proceeds in three stages

Stage 1: bid at least 50% of eligibility
Stage 2: bid at least 80% of eligibility
Stage 3: bid 100% of eligibility

Bidders may never bid for more than their eligibility

Low activity will reduce eligibility

Closing Rule: No new bids received, and auction closes

Tie-breaking Rule: In event of a tie, a "high" bidder chosen arbitrarily

Withdrawal Penalty:

License returned to auction, withdrawer owes government the difference between bid and final price, if final price is less than bid.

FCC Experience with Simultaneous Ascending Auctions

"The Greatest Auction in History"
William Safire, *New York Times*, March 16, 1995

"The Auction of the Century"
Liberation, Paris, March 15, 1995

"The most dramatic example of game theory's new power. It was a triumph, no only for the FCC and the taxpayers, but also for game theory (and game theorists)." (Fortune, February 6, 1995)

"The government is smoking something to think they are going to get $10 billion for these licenses."
MCI chairman Bert Roberts, October 20, 1993
[$17 billion raised]

"For once, the government is doing a great job of dragging money out of people."
-McCaw chairman Wayne Perry, June 6, 1994

FCC Experience with Simultaneous Ascending Auctions, Cont'd

Nationwide Narrowband

Name	Type	Final Bid	Minority Credit	Winner	Round
N-1	50-50	80,000,000	0	Pagenet	37
N-2	50-50	80,000,000	0	Pagenet	37
N-3	50-50	80,000,000	0	McCaw	33
N-4	50-50	80,000,000	0	McCaw	33
N-5	50-50	80,000,000	25%	MTel	37
N-6	50-12½	47,001,001	0	AirTouch	24
N-7	50-12½	47,505,673	0	BellSouth	25
N-8	50-12½	47,500,000	25%	MTel	24
N-10	50-0	37,000,000	0	Pagenet	45
N-11	50-0	38,000,000	25%	Pagemart	46
Total		$671,006,674			

Prices for similar licenses were similar or identical

Companies purchasing two similar bands purchased adjoining bands

No evidence that "gaming" helped bidders

-jump bids apparently didn't change final prices

-jump bid by Pagemart on N-11 may have cost it US $1,000,000

FCC Experience with Simultaneous Ascending Auctions, Cont'd

Winning Bidders by region and spectrum block

Size (KHz):	50-50	50-50	50-12½	50-12½	50-12½	50-12½
Region\Block	1	2*	3	4	5	6*
Northeast	Pagemart	PCSD	Mobil Media	Advanced Wireless	AirTouch	Lisa-Gaye Shearing
South	"	"	"	"	Insta-Check	"
Midwest	"	"	"	"	Ameritech	"
Central	"	"	"	"	AirTouch	Benbow
West	"	"	"	"	"	"

Discounted Final Prices ($ millions) by region and spectrum block

Size (KHz):	50-50	50-50	50-12½	50-12½	50-12½	50-12½
Region\License	1	2*	3	4	5	6*
Northeast	17.500	14.850	9.471	8.950	8.675	10.251
South	18.400	18.780	11.800	11.543	8.000	11.262
Midwest	16.810	17.360	9.291	10.057	9.500	10.251
Central	17.340	17.136	8.250	8.791	8.262	10.488
West	22.549	22.800	14.857	14.281	14.281	10.921
Total	92.599	90.931	53.669	53.622	48.718	53.173
Nationwide	80.000	80.000	47.336	47.336	47.336	47.336

* = Blocks with the 40% woman/minority credit

FCC Experience with Simultaneous Ascending Auctions, Continued

Regional Narrowband observations

Prices for similar licenses were similar, not as close as nationwide auction

- Prices higher than nationwide
- Pagemart's attempt to "game" the system may have cost it money again

Prices paid, net of bidder credits, were similar to licenses without bidder credits

Bidder Credits had little effect on prices

Four bidders successfully assembled nationwide licenses on a single frequency

No bidder made purchases on two different frequencies

Simultaneous auction design assisted in efficient allocation

Experience with Simultaneous Ascending Auctions

FCC Broadband PCS Auctions: Over $15 Billion raised

Mexico PCS: Over US $1 Billion raised

Also used in Canada, Australia, and New Zealand

New Auction Designs

MDI for the FCC

MDI 2 with new activity restrictions

Caltech 1 (Charlie Plott) Design

Caltech 2 (Ledyard et al) Design

New Applications of Multiunit Auction Technology

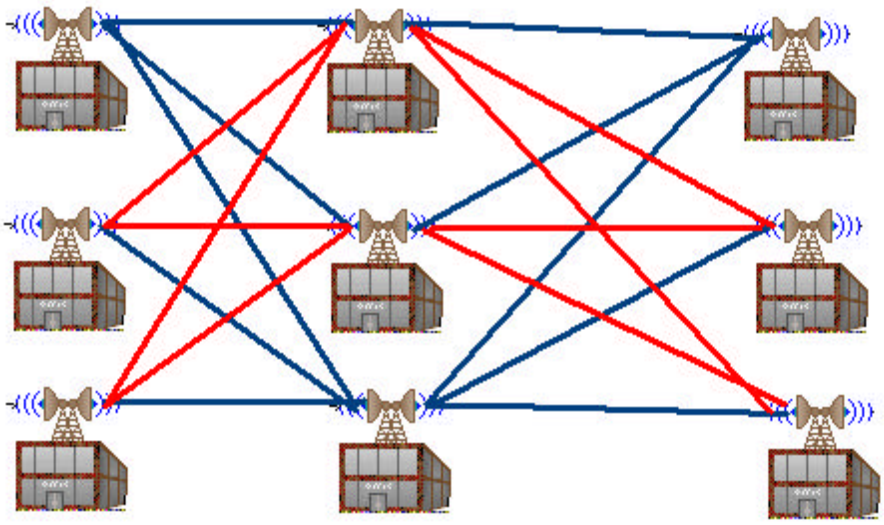
- Electric Power Auctions
- Electric Generation Capacity
- Airport Landing Rights
- Off-shore Oil
- Privatization of Microwave Spectrum

Market for Microwave Connections

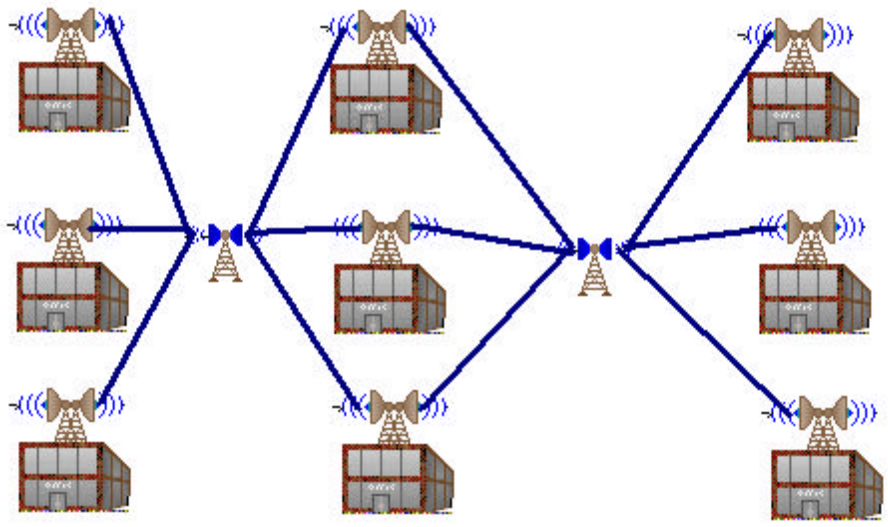
Microwaves are used for

- High capacity phone line links (building to building)
- Connecting mobile phone towers to the system
- Line of sight communications
- Telephone exchange connections
- Satellite connections (non-conflicting use)

Two microwave transmitters



Point to point microwave links. Crossed lines are conflicts unless they occur at different heights.



A point to multipoint system. Eliminates conflicts by using a central tower. (Hub and spoke system)

Traditionally links allocated by government administration

Problems

- Slow bureaucracy (2+ years in Mexico required for approval)
- Complicated feasibility
  - U.S. uses private companies to establish feasibility
  - Slight reconfigurations may have dramatic effects
- No mechanism for reconfiguring connections
  - Incentive to hold existing link
  - New technology: point to multipoint
- No pricing of (occasionally) scarce resource
- Mexican legal requirement that spectrum be auctioned
  - How to price 1,000,000 unique goods?
  - Shadow prices difficult to estimate

Solution:

Create a competitive market for supply of microwave links

Microwave links are an ideal candidate for deregulation

- No serious scale economies
- Sufficient spectrum available to endow many firms
- Many major users are natural spectrum administrators

Market Design Goal in Mexico:

Create a competitive market in supply of links

Mexican Microwave Auction

Number of Licenses	Type	Band	Size	Coverage
15	Point to Point	23 GHz	56 MHz	National
10	Point to Point	23 GHz	100 MHz	National
10	Point to Point	15 GHz	56 MHz	National
5 per region	Point to Multipoint	10 GHz	60 MHz	Regional

2.7 GHz of radio spectrum divided into 80 Licenses

Different bands are imperfect substitutes

- Propagation distance
- Scatter (size of cone)
- Volume of data transmission per MHz

Other substitutes

- Copper wire
- Fiber optics
- Satellite link

Outcomes in Mexican Microwave Market:

Company	23 GHz	15 GHz	Regions
Alestra	56	56	Three
Amaritel	368	112	Three
Bestel	156		Four
BNMexico	268	56	Three
Constel	56		
Dipsa	156	56	
Iusacell	200	56	
M_Cable	112		
Marcatel		56	
Miditel	100		Five
TCA	56		One
Telinor	100	112	All Nine
Telmex	156	56	All Nine
Unitel	56		

Telinor assembled nine regions on the same frequency Telmex assembled nine regions, all but one on the same frequency.

The results of the auction indicate that spectrum caps were not binding. Whether a single bidder would have cornered the market in the absence of spectrum caps is unclear.

Nevertheless, the results corroborate models in which auctions do not lead to excessive concentration.