

# Collusive Bidding: Lessons from the FCC Spectrum Auctions

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## What was for sale in the DEF Block PCS Auction?

- 1479 10 MHz PCS Licenses
- 493 Markets, each with D, E, and F blocks
- F block was set aside for preferred bidders
  - preferred bidders got bidding credits and special financing worth about 50% (can bid \$2 for \$1 of value)

## How were the licenses sold?

- Simultaneous ascending auction
- Bids submitted privately
- After each round, all bids are shown with
  - bidder numbers
  - market numbers and block
- Stopping rule: auction ends when no new bids on any license

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## The Dark Side of a Simultaneous Ascending Auction

- “Negotiation” with other bidders
  - Auction ends when all agree how licenses should be split up
  - Can only communicate with bids
- Use retaliation to coordinate on a split (coordinated demand reduction)
- Use code bids to make retaliation clear

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## Example of Code Bidding

	Marshalltown, IA		Rochester, MN		Waterloo, IA		
	283 E		378 D		452 E		
Round	McLeod	USWest	McLeod	USWest	AT&T	McLeod	USWest
24	56,000					287,000	
...			...	...			
46				568,000			
52			689,000				
55				723,000			
58			795,000				
59				875,000			<b>313,378</b>
60						345,000	
62			963,000				
64		<b>62,378</b>		1,059,000			
65	69,000						
68					371,000		

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## Example of Retaliation

	Canton, OH			Harrisburg, PA	
	65 F			181 F	
Round	NextWave	NorthCoast	OPCSE	NextWave	NorthCoast
56			358,000	1,217,000	
57		409,011			
78	460,000				
82		511,011			
125			562,000		
136		618,011			
158	680,000				
159		748,011			
160	861,000				
161					<b>1,339,011</b>
162				1,473,000	
163		947,011			

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## Market Design Issue: How much information to reveal?

- Displaying entire bid allows code bidding
- Displaying bidder identities facilitates retaliation
- Concealing bidder identities has costs
  - bidder may care which markets competitor wins
  - transparency of auction is sacrificed
  - savvy bidders may still find ways to retaliate

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## Preview of Results

- Code bidding & retaliation used to win in 20 markets
- Prices were not significantly lower in these markets
- Bid signaling appears effective at achieving lower prices
  - Signalers won 40% of spectrum
  - Signalers paid 36% less per pop on D&E blocks
  - Signalers paid 18% less per pop on F block

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# Why study DEF Block Broadband PCS Auction?

- Ripe for bid signaling to be effective
  - Many small licenses
  - Weak competition
  - No reserve prices
- Mercury was fined \$650,000 for making 13 code bids (fine dropped later due to insufficient notice)
- USWest and Western Wireless fined \$2.4 million for voice mail on bidding strategy

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## Bouts of Retaliation in the BTA DEF Auction

Blocks	With Code Bids		Without Code Bids		Total
	D and E	F	D and E	F	
Successful	5	7	3	4	19
Unsuccessful	3	8	4	3	18
Total	8	15	7	7	37

## The Main Retaliating Bidders

	Bouts Initiated		Total
	With Code Bids	Without Code Bids	
21Century	3	0	3
<b>AT&amp;T</b>	1	3	4
Mercury	7	1	8
NorthCoast	0	5	5
OPCSE	7	1	8
<b>USWest</b>	3	1	4

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## Was bid signaling effective?

- Were prices surprisingly low in markets with bid signaling?
- Did signaling bidders pay significantly lower prices?
- We estimate prices with model similar to the benchmark model of Ausubel-Cramton-McAfee-McMillan “Synergies” paper (JEMS, 97)

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### Price Regressions for D & E Blocks

Variable	Log of DE Price (\$/pop)	
	OLS (4)	2SLS (5)
Log of net C price (\$/pop)	0.345 (4.16)	-0.089 (0.71)
Log of AB price (\$/pop)	-0.054 (0.72)	0.022 (0.37)
Cumulative number of bidders on DE blocks in first 5 rnds	0.377 (9.45)	0.211 (3.86)
Log of population density	0.091 (2.25)	0.012 (0.31)
Ten-year population growth, 1990-1999	1.557 (3.52)	0.687 (1.70)
Microwave links per hundred million people	0.453 (2.49)	0.086 (0.52)
Log of 1994 population	0.049 (0.97)	0.123 (2.77)
Fraction of households with annual income > \$35k	-0.922 (1.51)	-1.079 (2.36)
Constant	-2.021 (4.13)	-0.895 (1.69)
Predicted value of the log of F-block net price (\$/pop)		0.658 (3.66)
Sample Size	473	473
R <sup>2</sup>	0.323	0.630
Goldfeld-Quandt F-Statistic	1.310	0.469
p-value of Goldfeld-Quandt	0.051	0.999

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# Signaling Bidders Paid Less

## Per Capita Price Differences Between Signaling and Nonsignaling Bidders

<b>D and E Blocks</b>				
<u>Bidder Type</u>	Means Not Controlling for Market Characteristics		Means Controlling for Market Characteristics	
	OLS (1)	OLS (2)	OLS (3)	2SLS (4)
	Signaling	\$2.45	\$3.05	\$3.06
Nonsignaling	\$5.47	\$4.42	\$4.41	\$5.59
Price Difference	76%	37%	36%	80%

  

<b>F Block</b>				
<u>Bidder Type</u>	Means Not Controlling for Market Characteristics		Means Controlling for Market Characteristics	
	OLS (1)	OLS (3)	OLS (3)	2SLS (4)
	Signaling	\$1.67	\$1.23	\$1.23
Nonsignaling	\$1.65	\$1.47	\$1.47	\$1.77
Price Difference	-1%	18%	18%	19%

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# Further Evidence of Retaliation: Bidders avoid AT&T

## Do Bidders Avoid AT&T more than Small Bidders?

	AT&T	Five Small Bidders <sup>1</sup>	Test Statistic for Comparison of Means
<b>Other Block is 25% More Expensive</b>			
Number of Bids on Other Block	140	16	
Number of Bids on Less Expensive Block	307	71	
Percent Bid on Other Block	31.3%	18.4%	2.75
<b>Other Block is 50% More Expensive</b>			
Number of Bids on Other Block	73	7	
Number of Bids on Less Expensive Block	203	41	
Percent Bid on Other Block	26.5%	14.6%	2.07

**Notes:**

<sup>1</sup>The five smaller bidders are ACCPCS, Comcast, Rivgam, PAccess, Touch, each of whom won between 9 and 14 licenses. AT&T won 223 licenses.

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## Conclusions

- Lots of signaling  
(90+ code bids, 55+ retaliations)
- Strong incentives for coordinated demand reduction when competition is weak
- Revenue effects may be large
  - signaling bidders won 40% of spectrum
  - signaling bidders paid 36% less on DE and 18% on F

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## Recommendations

- If weak competition, make it harder for bidders to split up licenses
  - Eligibility ratio =  
(total eligibility)/(total spectrum available)
  - Eligibility ratio < 2 suggests weak comp.
- Use higher reserve prices
- Use an anonymous auction
- Auction large geographic areas
- Use package bidding

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