Fighting Collusion in Auctions

Theory & Experiment

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Motivation

- Fighting collusion is a primary concern of auctioneers (Graham and Marshall, 1987; Marshall and Marx, 2006)
- In the 1980s, 75% of the US cartel cases were related to auctions (Krishna, 2004)
- “It is better to try to create an environment that discourages collusion in the first place than trying to prove unlawful behavior afterwards.” (Motta, 2004)

Motivation

- Purpose of this paper: a theoretical and experimental investigation of the incentives to collude in three auction formats:
  - English auction (EN)
  - First-price auction (FP)
  - Premium auction: Amsterdam auction (AMSA)

- We focus on toughest possible case for auctioneers: no danger of defection within cartel

- Why consider premium auctions?
  - Exploit asymmetries between bidders (Goeree and Offerman, 2004)
  - Stimulate entry of weak bidders (Milgrom, 2004)
  - This paper: to deter collusion

Preview results asymmetric bidders

- Theoretical results
  - FP triggers less collusion than EN
  - Equilibrium selection issue in AMSA: ranking with standard auction depends on passive or aggressive equilibrium played in AMSA

- Experimental results
  - FP and EN equally (un)successful in fighting collusion
  - AMSA induces the least collusion and raises the highest revenue

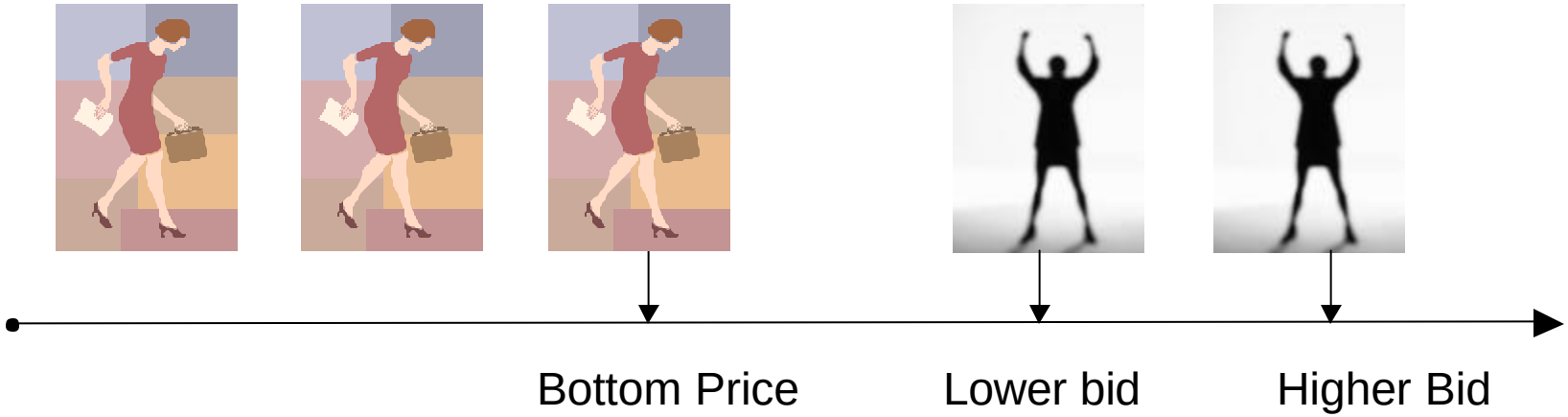
Outline

- Rules of AMSA
- Setting
- Theory
- Experiment
- Conclusion

Amsterdam (Second-Price) Auction

Bidders who drop out at the 1st stage

Two Finalists



- **Premium for winner and highest losing bidder**
- **Premium= a*(lower bid-bottom price)**

The asymmetric setting

- Asymmetric bidders
  - 3 weak
    - $v_i \sim U[0,1]$
  - 3 strong
    - $v_i \sim U[L,H]$, $H > L > 1$

- Start: each bidder learns private value and common collusion cost

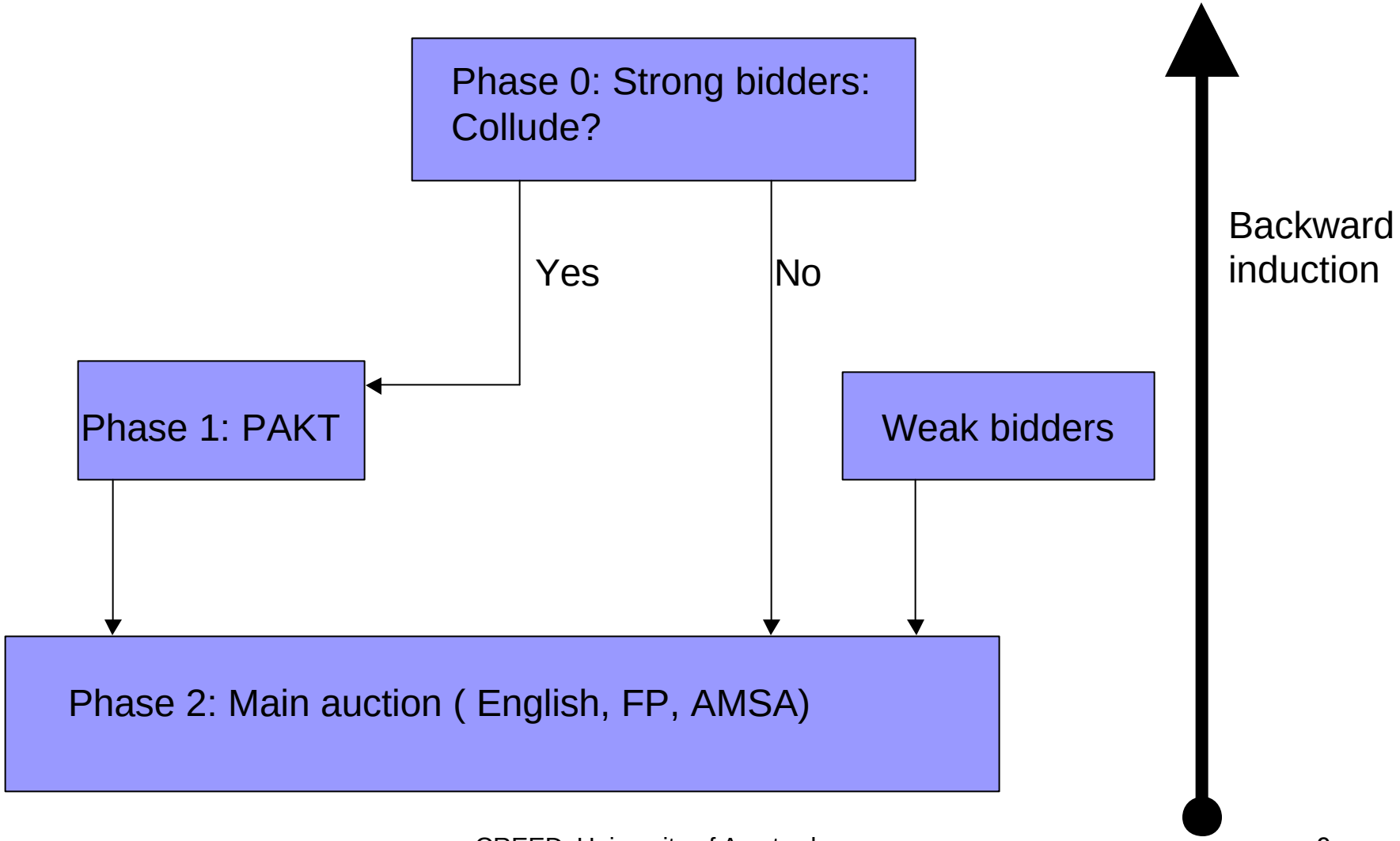
- Phase 0: strong bidders vote to collude (McAfee & McMillan 1992)
  - Only if all strong bidders vote for collusion, collusion occurs
  - Strong bidders only pay cost of collusion in case of collusion

The asymmetric setting

- Phase 1: Pre-Auction KnockouT (PAKT)
  - Only if strong bidders collude
  - Strong bidders submit sealed bids
  - Highest bidder becomes “designated bidder”
  - Designated bidder pays price equal to own bid
  - Other strong bidders equally share this price

- Phase 2: Main auction (EN, FP or AMSA)
  - in case of no collusion, 3 weak and 3 strong
  - in case of collusion, 3 weak and designated strong bidder

The Game


Phase 0: Strong bidders: Collude?
Yes
No
Phase 1: PAKT
Weak bidders
Phase 2: Main auction (English, FP, AMSA)
Backward induction

Theory: phase 2

- No collusion
  - Analysis is standard: revenue equivalence applies

- Price paid under collusion determines the incentives to collude

Theory: phase 2

- Collusion in EN
  - All bid value
  - Expected payment by designated bidder: ¾
- Collusion in FP
  - Designated bidder bids DB[v]=1
  - Weak bidders bid value
  - Expected payment by designated bidder: 1

Theory: phase 2

- Collusion in AMSA: passive equilibrium
  - designated bidder submits two bids in both stages
  - stage 1: $DB_{1,1}[v]=DB_{1,2}[v]=v$
  - stage 2: $DB_{2,1}[v]=v$; $DB_{2,2}[v]=x$ (x is bottom price)
  - weak bidders bid b[v]=v in both stages
  - Expected payment by designated bidder: ¾ (like in EN)

- Collusion in AMSA: active equilibrium
  - Behavior designated bidder is the same
  - Weak bidders bid b[v]=L in both stages
  - Expected payment by designated bidder: L>1

Theory

- Phase 1: PAKT
  - Expected profit phase 2 determines sealed bids
  - Strong bidder with highest value wins
- Phase 0: vote for collusion
  - Strong bidders vote “yes” iff benefits > costs
- In which auction is collusion more likely?
  - If passive equilibrium in AMSA: EN=AMSA>FP
  - If aggressive equilibrium in AMSA: EN>FP>AMSA

Experimental Design

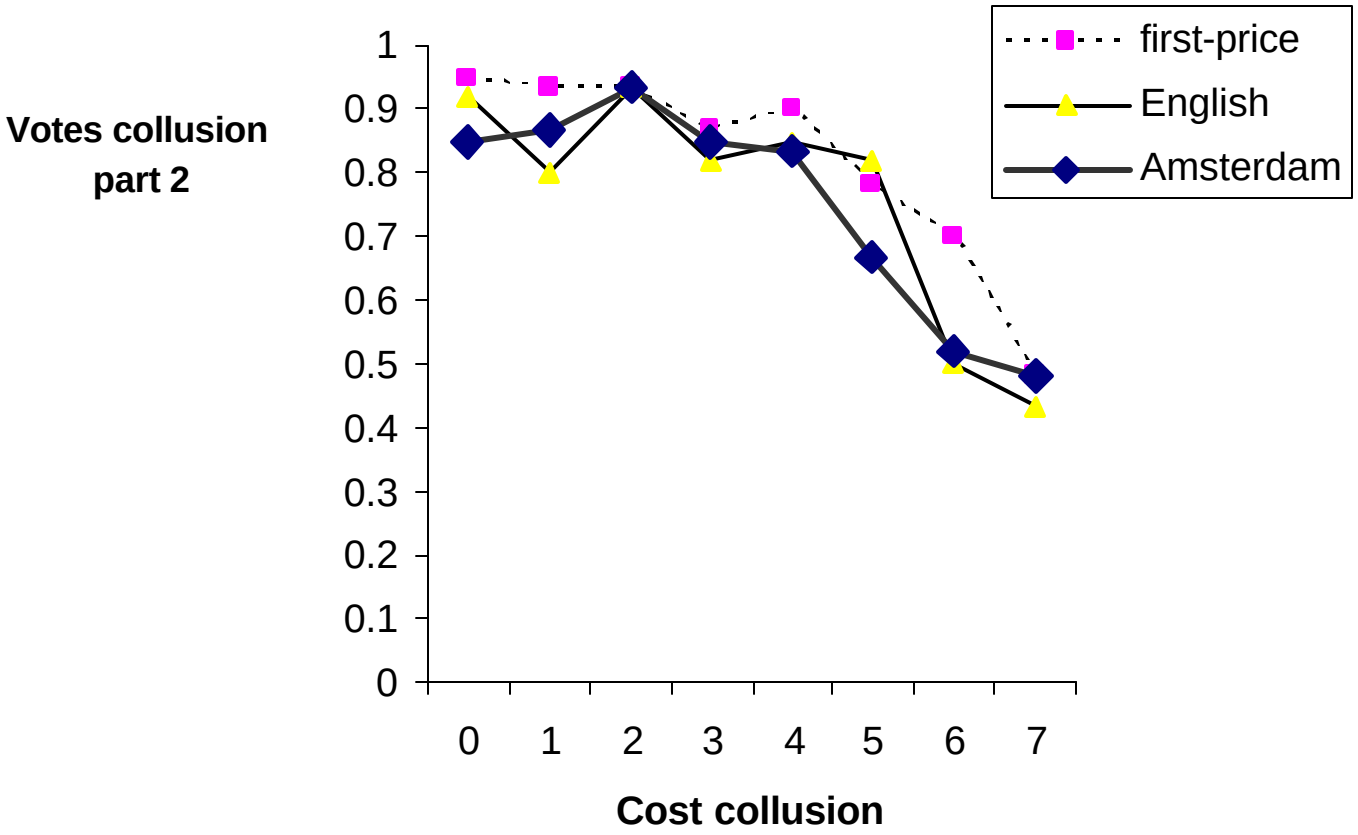
- Three treatments: AMSA, FPA, EA.
  - Random matching
  - Data on 5 groups of 12 subjects each in each treatment

- Part 1: symmetric bidders, no collusion
  - 6 symmetric bidders $v_i \sim U[0,50]$

- Part 2: symmetric bidders, all-inclusive collusion
  - Costs of collusion: same for each treatment, differs across periods
  - Option to vote for collusion
  - Designated bidder pays 0 for the product

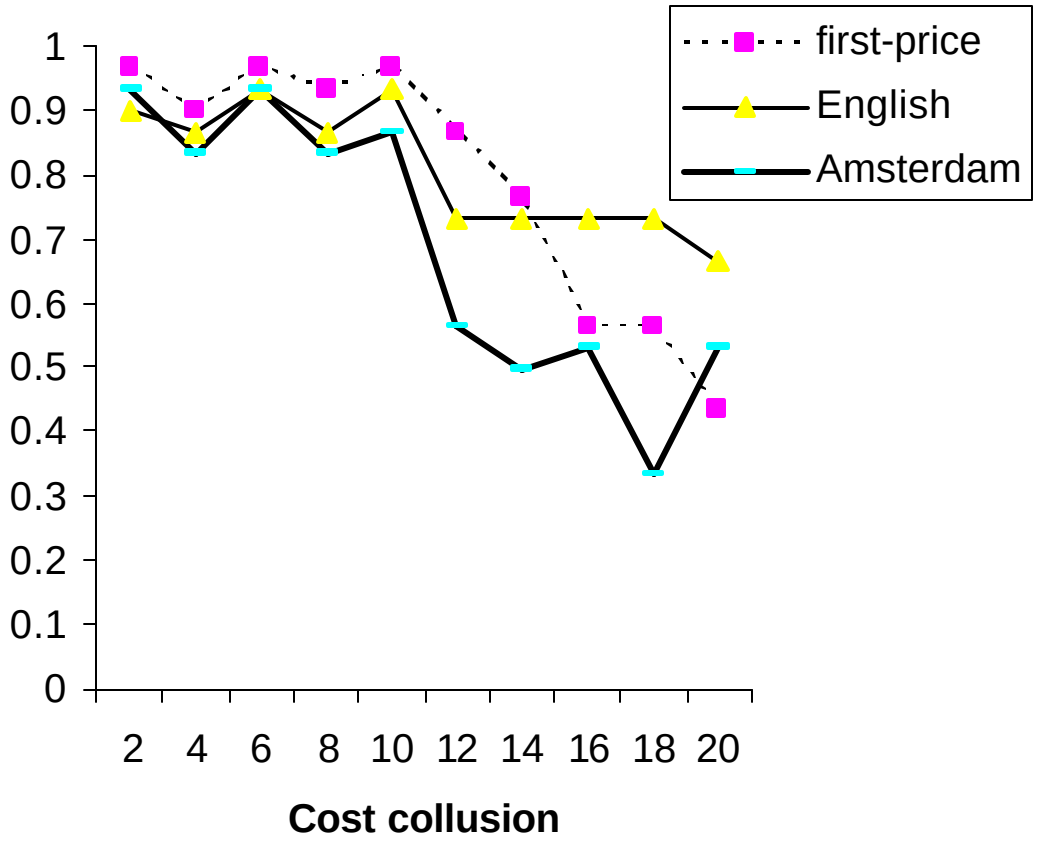
- Part 3: asymmetric bidders, collusion
  - Costs of collusion: same for each treatment, differs across periods
  - 3 weak bidders $v_i \sim U[0,50]$ and 3 strong bidders $v_i \sim U[70,120]$
  - Only strong bidders are eligible for the ring formation

Results: collusion



Results: collusion

Votes collusion part 3



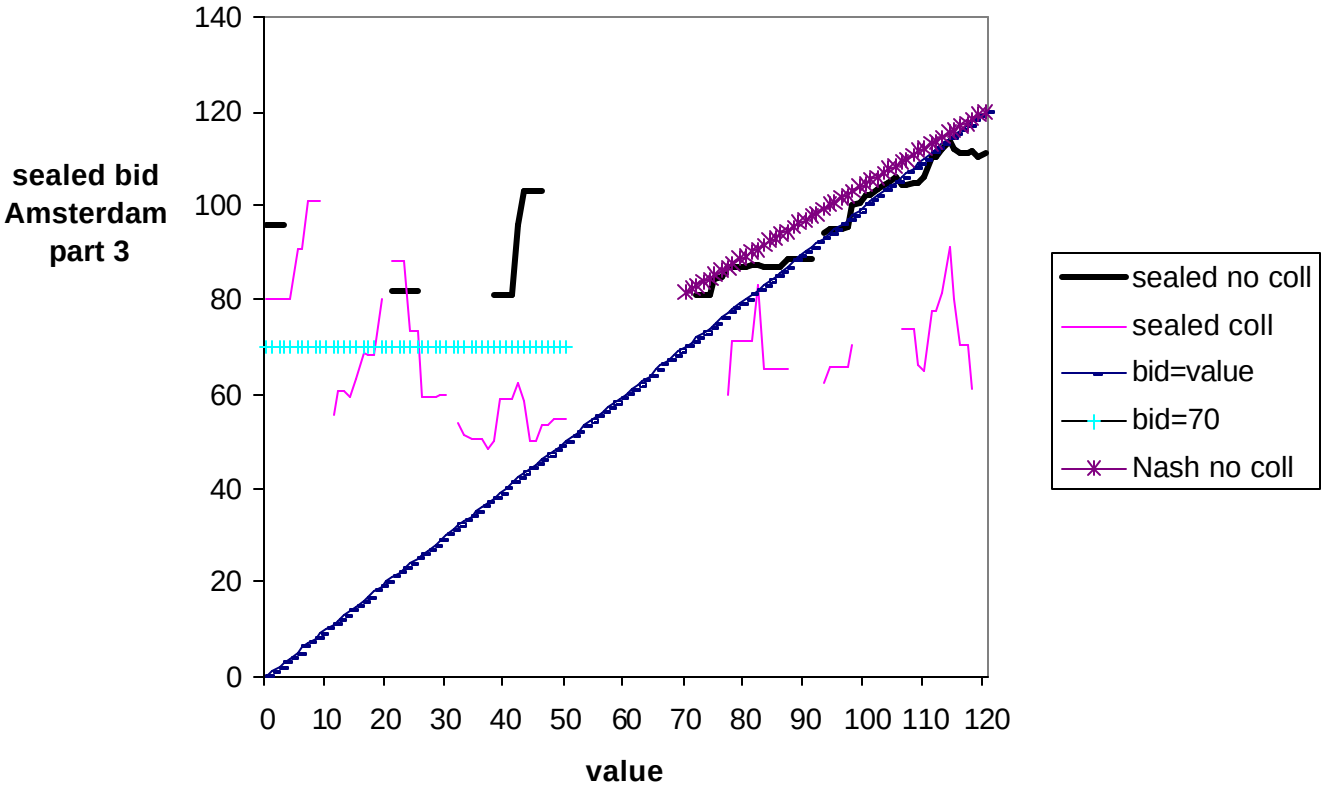
Results revenue

		part 1	part 2	part 3
FPA	realized	35.7 (5.7)	21.3 (18.8)	70.9 (25.2)
	Nash	34.9 (6.1)	9.5 (16.6)	63.7 (21.4)
EN	realized	33.5 (8.1)	26.4 (17.7)	68.0 (33.8)
	Nash	35.8 (7.5)	9.8 (17.3)	45.2 (20.5)
AMSA	realized	34.3 (8.0)	24.9 (17.5)	76.8 (25.3)
	Nash (passive)	35.7 (5.5)	9.6 (16.8)	45.0 (19.4)
	Nash (aggressive)	35.7 (5.5)	9.6 (16.8)	86.1 (14.5)

Results: efficiency

	part 1	part 2	part 3
FPA	95.4 (13.9)	96.0 (12.6)	92.7 (15.3)
EN	95.4 (16.0)	97.0 (13.1)	96.1 (11.9)
AMSA	86.7 (27.1)	94.4 (18.3)	90.9 (21.5)

Results: bidding behavior



Explaining the results: part 2

- (mild) break-down of revenue equivalence in part 1
  - realized revenue FP: 35.7
  - realized revenue EN: 33.5
  - realized revenue AMSA: 34.3

- provides a possible explanation of the result that in FP a moderately higher level of collusion is observed

Explaining the results: part 3

Part 3	profit transaction winner collusion	price paid by designated bidder	% cases designated bidder buys product
FPA	49.6 (19.3) n=56	50.3 (5.6) n=52	92.9%; n=56
EN	61.8 (26.5) n=53	40.9 (19.6) n=51	96.2%; n=53
AMSA	42.3 (26.1) n=40	51.6 (17.9) n=33	82.5%; n=40

Conclusion

- Collusion in case of symmetric bidders
  - Theory: auctions provide identical incentives to collude
  - Experiment: FP triggers (moderately) more collusion than EN and AMSA

- Collusion in case of asymmetric bidders
  - Theory: FP better than EN; ranking AMSA depends on equilibrium
  - Experiment: AMSA beats EN and FP; EN and FP equally unsuccessful in fighting collusion
  - Explanation: unattractive prospects designated bidder AMSA; low level of uncertainty encourages collusion in FP