Imperfect Competition and Sanitation: Evidence from randomized auctions in Senegal[1]

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Desludging in Senegal

- Under-investment in public infrastructure: Almost 2 million people in peri-urban Dakar are not connected to the sewage system
- On average, every 6-12 months households need to *desludge* their private laterines
- Technologies:
  - *Mechanized:* Truck + Pump + Treatment center (?)
  - *Family:* Family member + Street or open water
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- Both manual options are *illegal* (rarely enforced)
- **Sanitation problem:** 47% of desludging in Dakar are performed with a truck, 27% by a family member, and 25% by a hired manual

Mechanized versus Manual Desludging



Mechanized versus Manual Desludging





Market failure: Collusion

- **Diffused ownership:**
  - Largest company controls 33 trucks
  - Most trucks are affiliated with a parking garage
- **Trade association (AAAS):**
  - *Official roles:*
    - ★ Allocate governmental contracts
    - ★ Operate main garages
    - ★ Coordinate procurement of truck parts
  - *Financing:* Membership fee and revenue sharing

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- **Regional differences in AAAS affiliation:**
  - Central neighborhoods (87% of trucks): 45% affiliated companies
  - Rufisque (13% of trucks): Unaffiliated
  - Rufisque vs Rest of Dakar: 15,000 CFA vs 25,000 CFA.

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- **Fun listen:** Planet Money, The Poop Cartel (episode 855)

Research Question

- To what extent are high mechanized prices and low take-up rates caused by tacit collusion between providers?

Intervention: Just in time auction platform

- Over 5,000 anonymous auctions b/w 2013-2016
- *Field experiment:* Random invitations and auction formats
  - Key: Bidders randomly invited to bid in *revisable* and sealed-bid auctions (50%)
- *Estimation:*
  - Test the null hypothesis of competitive bidding
  - Classify bidders between competitive and non-competitive types
- *Welfare Impacts:* Simulate invitations of more competitive bidders, calculate the impact on price, take-up and ultimately health.

Summary of results

- **Motivating evidence:** Rufisque vs Rest of Dakar
  - Sharp discontinuities in average mechanized prices and take-up
- **Auction experiments:** Sealed-bid vs revisable auction formats
  - Differences across formats reveal the existence of a group of competitive bidders who avoid dominated strategies
  - Revisable auctions are associated: (i) $\downarrow$ ties, and (ii) $\uparrow$ snipping
  - Bidder classification: 25% of active bidders avoid dominated strategies
- **Counter-factual simulations:** Partial equilibrium
  - Competitive-types would $\downarrow$ prices by up to 13% and $\uparrow$ take-up by 40%
  - Health impact: $\downarrow$ diarrhea cases between 9% and 14%

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Related literature

- Tests of collusion in Auctions
  - Test based on rejection *competitive benchmark* model
  - References: Hendricks and Porter (1989), Porter and Zona (1993,1999), Bajari and Ye (2003) Chassang et al (2022,2023)
- Imperfect competition in developing countries
  - References: Banerjee et al. (2019), Jack (2013) and Bergquist and Dinerstein (2020)
- Bounded rationality in market environments
  - References: DellaVigna (2009), Hortaçsu et al. (2019), DellaVigna and Gentzkow (2019)

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- **Companion paper:** Houde et al. (2025, wp)
  - Identify demand and cost parameters and simulate counter-factual platform with Bayes-Nash strategies and targeted invitations
  - *Takeaway:* Competitive platform could lower prices by 25%

Outline

1. Introduction
2. Market Structure
   - Motivating evidence
3. Field experiment: Auction Platform
   - Competition hypothesis test
   - Bidder classification
   - Validation
4. Measuring damages from collusion
5. Conclusion

How are prices set?

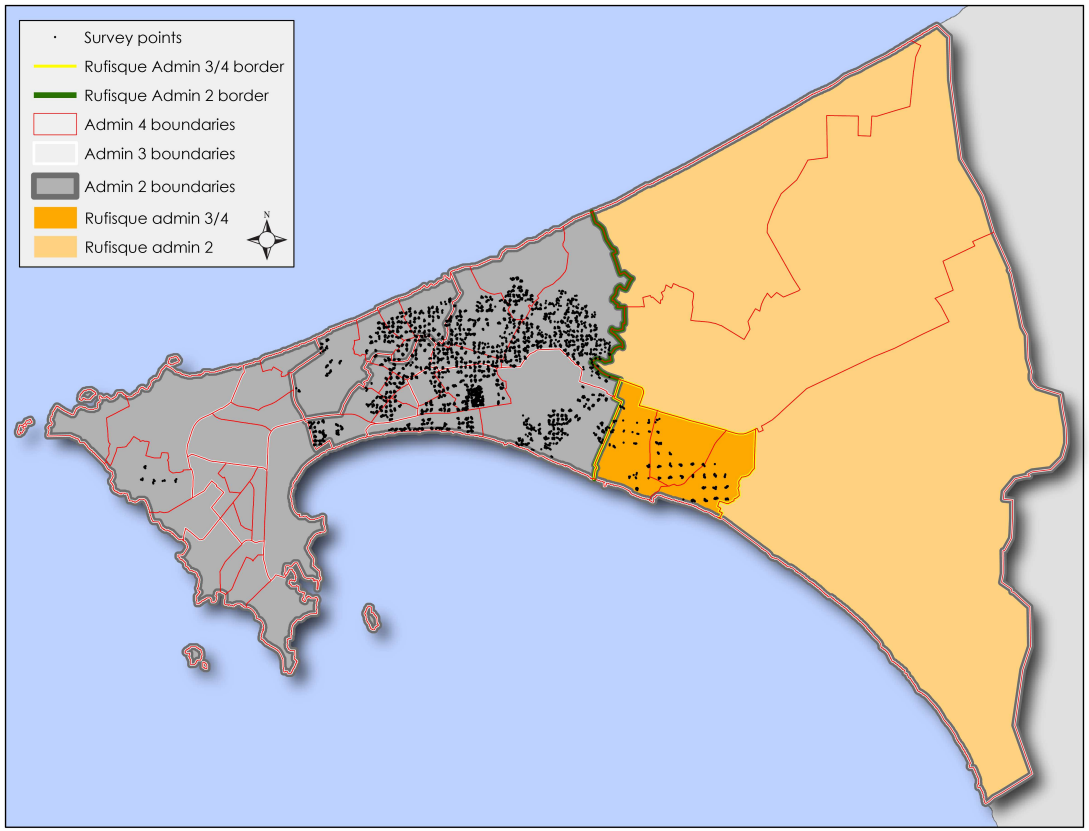
- **Price negotiation:**
  - *Affiliated garages:* Haggling with garage dispatchers (e.g. taxi stand)
  - *Independent truckers:* Street hailing/phone
- **Market structure:**
  - Garage operators determine "suggested" prices (e.g. floor)
  - No competition *within* garages
  - Limited competition *between* garages:
    - ★ Spatial differentiation
    - ★ Association: Largest garages controlled by AAAS
  - *Limited enforcement:* Trucks find clients outside of the garage system

Desludging Market summary statistics

Based on 9800 Household surveys across Dakar from 2012-2015

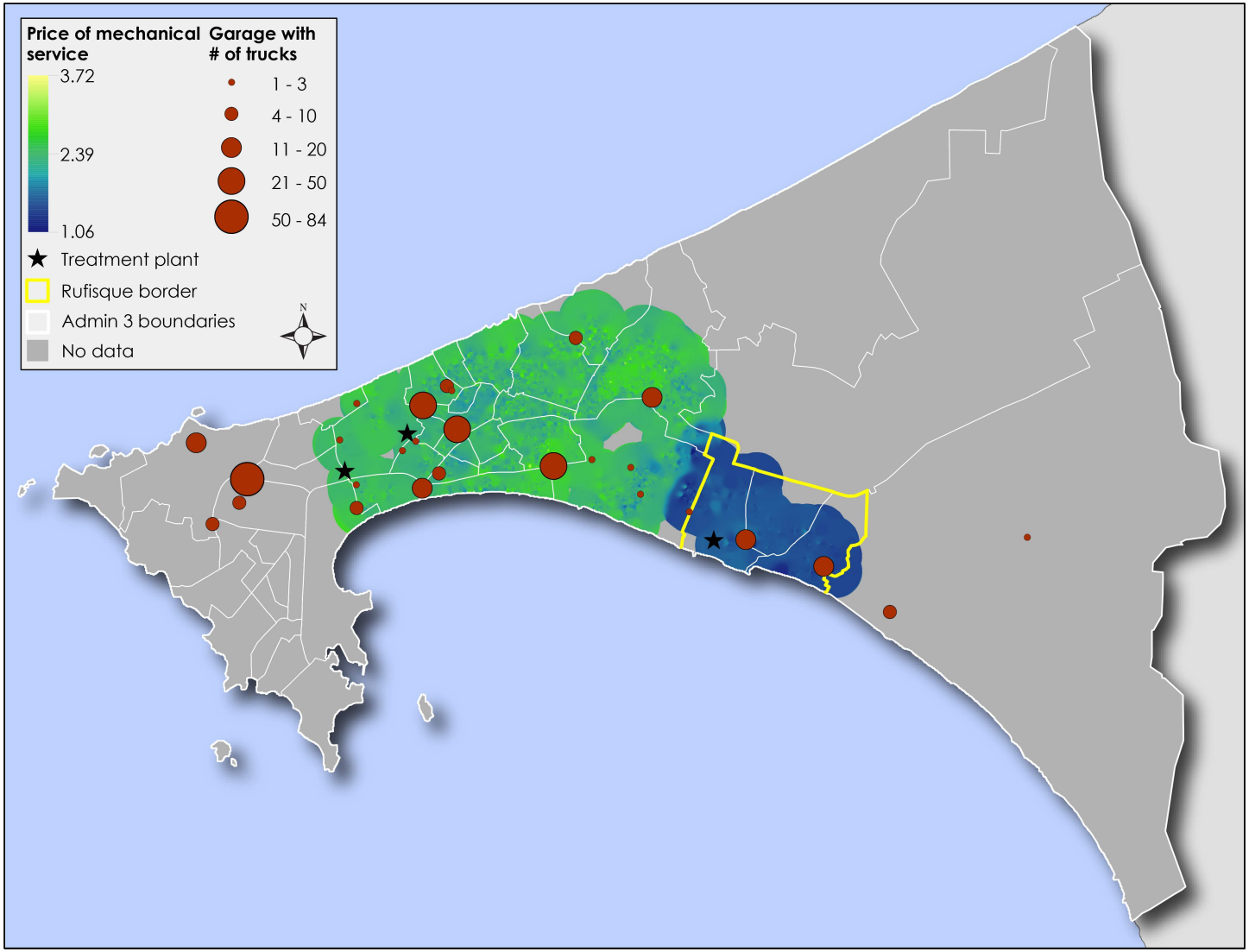
Variable	Mean	Std. Dev.	Min.	Max.	N
Mechanized price (x1K)	22.82	7.61	10	50	4865
Baay pell price (x1K)	14.28	6.5	5	40	2339
Family price (x1K)	0.53	2.54	0	25	2601
Choice: Mechanized	0.50	0.50	0	1	9805
Choice: Baay pell	0.24	0.43	0	1	9805
Choice: Family	0.27	0.44	0	1	9805
Truck find: Garage	0.22	0.42	0	1	4865
Truck find: Phone	0.19	0.40	0	1	4865
Truck find: Referral	0.43	0.49	0	1	4865
Truck find: Street	0.10	0.30	0	1	4865

Motivating evidence: The Case of Rufisque

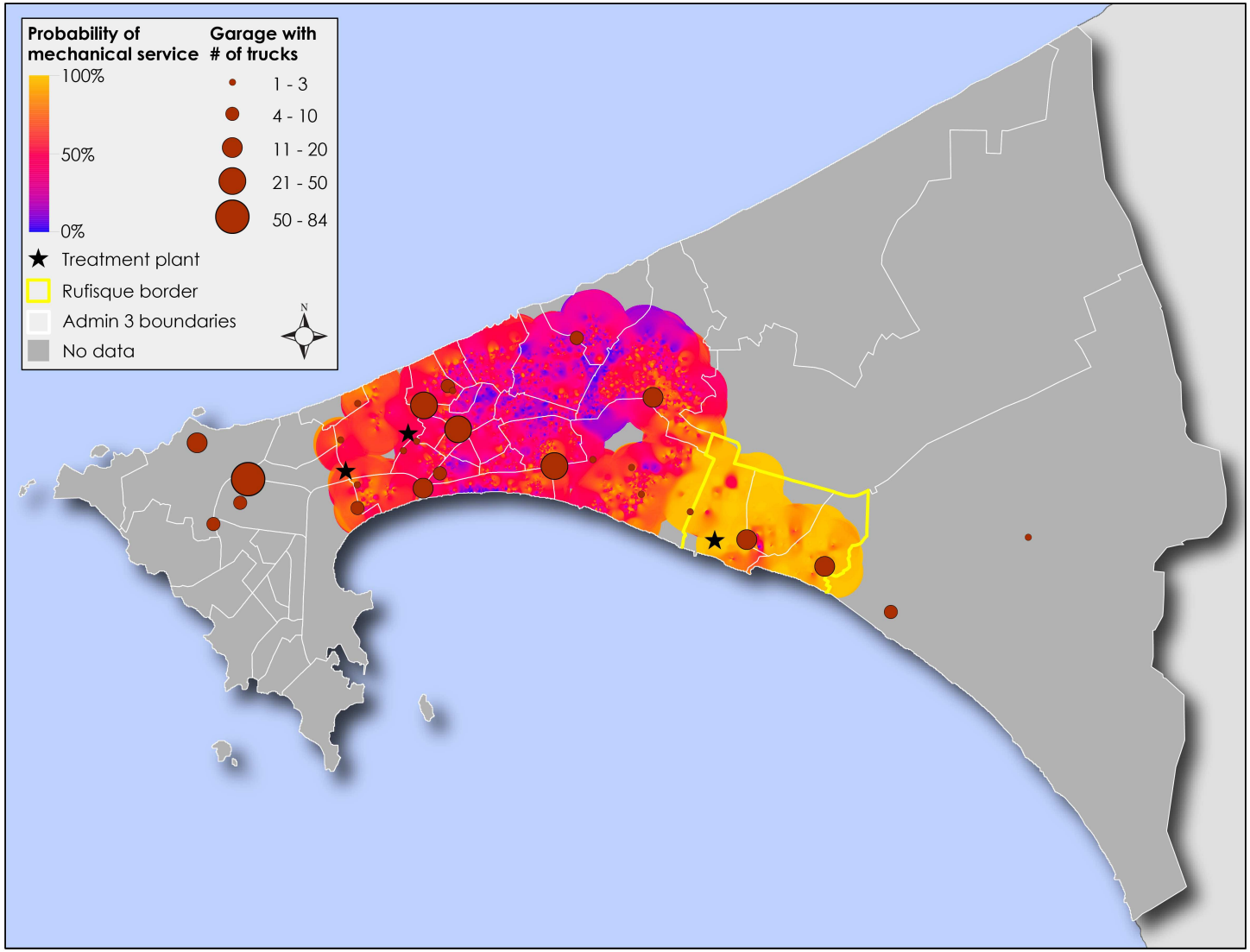


- Main provider: UPAMA
  - Fish factory cleaning + residential desludging
  - Disband from the association $\approx$ 15 years ago
- Limited capacity and price posting

Distribution of prices in Rufisque and the rest of the market



Demand for mechanized desludging in Rufisque and the rest of the market

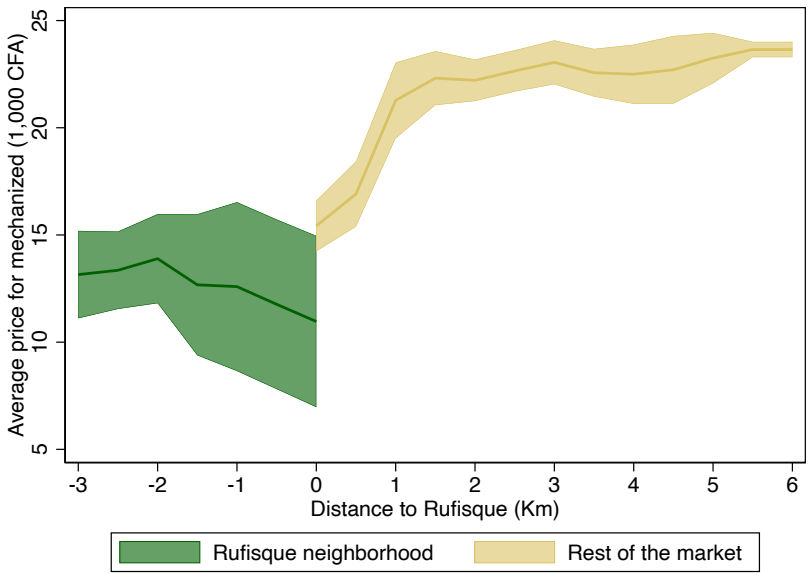


Neighborhood differences: Cost or Conduct?

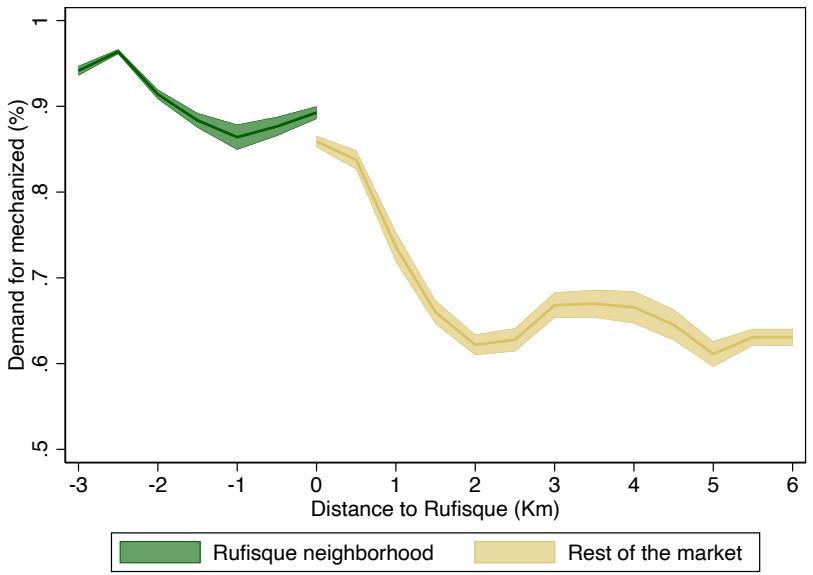
Expected price/demand evaluated at 1km distances

Regression: $y_i = X_i\beta^k + g^k(\text{Dist. to boundary}_i) + \epsilon_i, k \in \{\text{Rufisque}, \text{Dakar}\}$

Mechanical Desludging



p(mechanical)



- Additional results:
  - Price dispersion
  - Capacity utilization

Field experiment: Auction Platform

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Field experiment: Auction Platform

- The previous analysis provides suggestive evidence consistent with collusion, but we cannot rule out other explanations (e.g. different business models, costs, demands, etc.)
- Next, we use data from an experimental marketplace to quantify the fraction of sellers are willing to submit competitive quotes
- Dual objectives of the intermediation platform:
  - Improve access to competitive prices across all neighborhoods of Dakar
  - Learn firm conduct by randomizing the list of sellers and the mechanism

Auction Experiment

1. Client t calls the platform
2. Randomization
   - Nb. Bidders: $n \sim U[8, 22]$
   - **Sealed-bid auction (50%):**
     - ★ *Reminders (minutes):* 15, 30, 40, and 50
     - ★ *Information:* Minutes left
   - **Revisable auction (50%):**
     - ★ *Reminders (minutes):* 15, 30, 40, and 50
     - ★ *Information:* Lowest bid + Minutes left
     - ★ *Hard-close:* No new information after 50
3. Client is offered the lowest bid, and decides to accept or reject.
4. Bidders are notified of the winning bid (not the identity)



Testing for collusion

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- Why not testing for collusion directly instead?
  - Lack of theoretical foundation on what collusion "looks" like (Hendricks & Porter, 1989)
- **Assumptions:**
  - Private/independent values (cost)
  - Continuous cost distribution (no mass points)
  - No *within* auction coordination. Why?
    - ★ Random/anonymous invitations + short window
  - Rational expectation about the distribution of rival bids
    - ★ Why? Invited bidders are informed about the winning bid + "bid-to-beat" in revisable auctions.
  - Exogenous entry

Identification strategy

Ref's: Porter & Zona (1993, 1999), Bajari & Ye (2003), Chassang et al. (2022, 2023,...)

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- **Challenge:** Bidders' costs are privately observed
- **Solution:** Identify *robust predictions* that are valid for all cost realizations
  - *Non-competitive types:* Use dominated strategies that soften price competition
  - *Competitive types:* Best-respond to the distribution of rival bids

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- **Drawback:** Non-competitive bidding can also be due to "mistakes"

Competitive and non-competitive strategies

1. **Focal prices**
   - Tie-breaking rule: earliest bidder wins
   - Example of focal prices: 25K and 30K CFA
   - This is not optimal in the sealed-bid auction due to ties
     - ⋆ If $G(b_{-i})$ has a mass-point at 25, submitting $b = 24.5 \uparrow$ win prob.
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2. **Sniping**
   - Roth and Ockenfels (2002): Late bidding is a best response to incremental early bidding (irrational)
   - Snipping definition: Bid time $>$ Last time interval (50)
   - Why?
     - ⋆ Minimal risk of being rejected (10 minutes + grace period)
     - ⋆ Limit detections + undercutting
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   - Caveat: Early bidding to deter entry by signaling "strength" (more on this later)

Implementation

- Rationality? Rejection of the competition hypothesis does not necessarily imply that bidders are not competing
- For instance:
  - Biased believes about $\Pr(\text{Win}|b)$
  - Inattention
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- Interpretation:
  - Rejection of H1 and H2 is consistent with the collusion hypothesis
  - Failure to reject H1 and H2 implies that a positive fraction bids are placed "competitively"

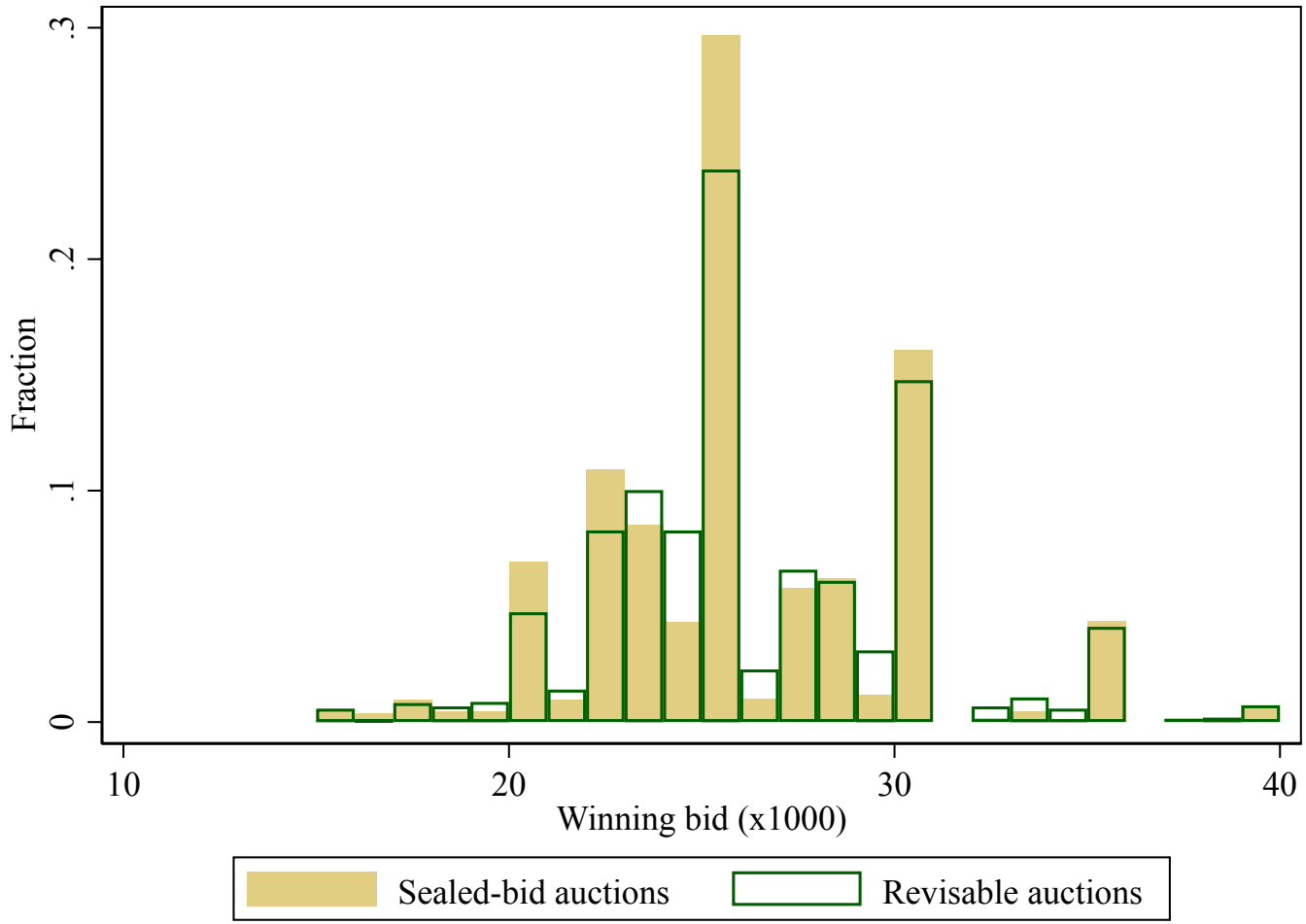
Roadmap for the empirical analysis

1. Test two predictions of competitive model: H1 and H2.
2. Measure the fraction of bidders behaving competitively
3. Damage calculation: What is the effect of inviting only competitive bidders on take-up?

Summary Statistics: Auction platform

VARIABLES	mean	min	max
Revisable auction indicator	0.497	0	1
Number of invited bidders per auction	12.79	5	21
Zero bids indicator	0.191	0	1
Number of valid bids (at least one bid)	2.437	1	11
Bidder participation probability	0.104	0	0.569
Active bidder participation probability	0.246	0.0691	0.535
Number of auction invitations per bidder	524.0	15	1,693
Number of auction invitations per active bidder	886.4	414	1,693

Winning bid distribution across formats

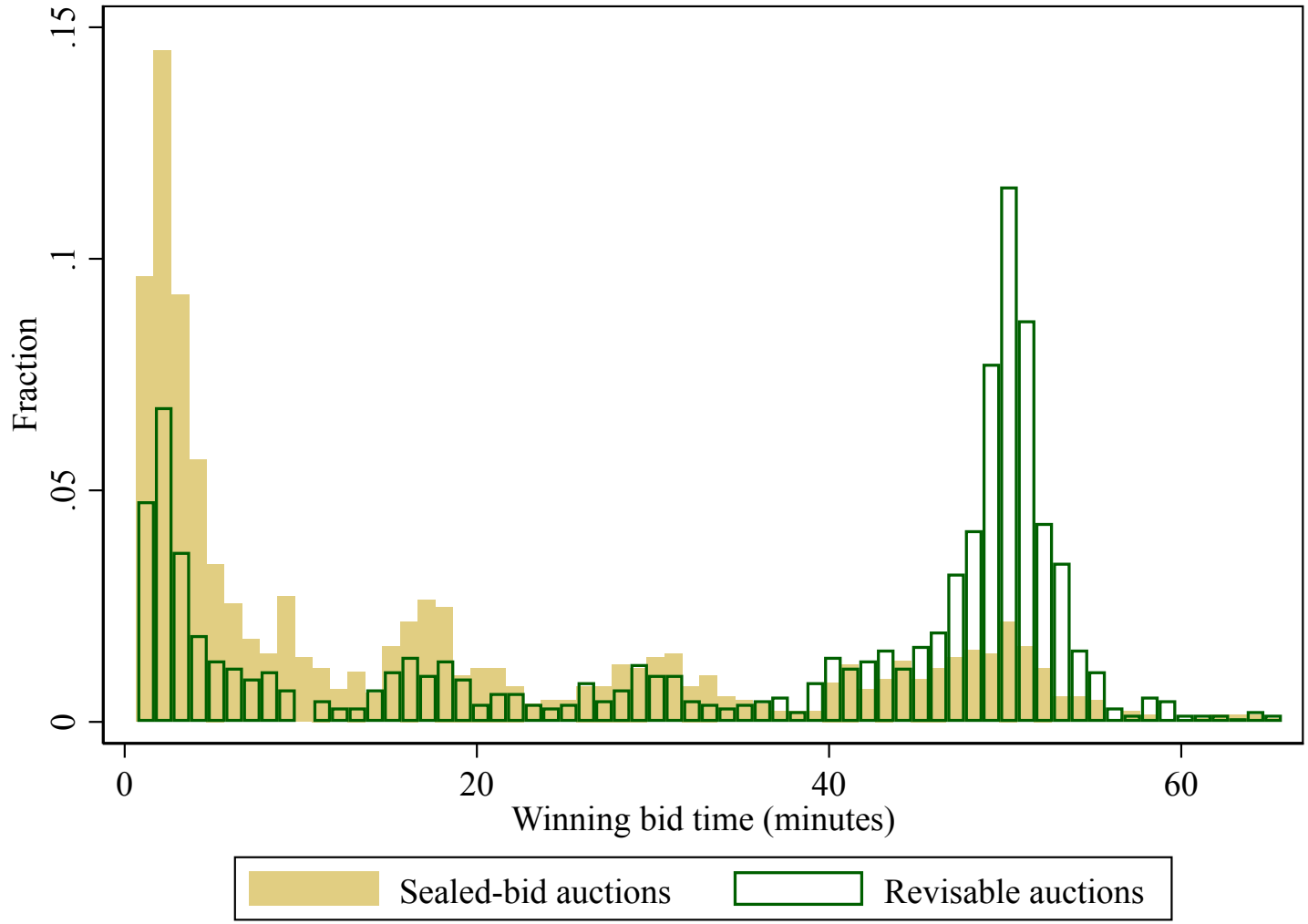


- Common prices: 25, 30, 22, etc.
- Missing density (sealed): 24, 29, 21, etc.

Effect of auction format on bidding strategies (H1)

VARIABLES	Winning bid	1(Ties)	1(Round)
1(Revisable)	0.29**	-0.090***	-0.094***
	(0.12)	(0.015)	(0.015)
Observations	4,177	2,865	4,177
Unit of observation	Auctions	Auctions	Auctions
Mean dep. variable	25.8	0.19	0.53

Timing of winning bid across formats



Evolution over time

Effect of auction format on the timing of bids (H2)

VARIABLES	1(Last message)	First bid (min.)
1(Revisable)	0.29***	3.29***
	(0.013)	(0.59)
Observations	4,177	4,177
Unit of observation	Auctions	Auctions
Mean dep. variable	0.28	17.3

Step 1: Summary of competition test results

- Causal effect of the revisable auction format:
  - Higher prices (weak)
  - Fewer ties and round bids
  - Snipping
- Implications for competition:
  - Differences across formats reveal the existence of a group of competitive auctions
  - However, many auctions failed to attract competitive bids (i.e. ties, early bidding)

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  - However, many auctions failed to attract competitive bids (i.e. ties, early bidding)
- Next question: What causes heterogeneity in conduct? Differences across auctions or across bidders?

Step 2: Detection strategy

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- **Empirical analysis:** Exploit repeated invitations
  1. Define non-competitive strategies across formats
  2. Form groups based on the frequency of non-competitive strategies using K-means clustering.
  3. Validate classification by measuring the effect of (randomly) inviting *competitive type* on auction outcomes

Bidder classification

Reference: Bonhomme, Lamadon and Manresa (2022)

- Bidder i's grouping variable: x_i
  - Summarize bidders' timing and bid coarseness across all invited auctions
- K-means clustering algorithm:
  1. Pick K observations x_j, $j = 1, 2, ..., K$, at random. Initialize the group average of group j as $\mu_j = x_j$, $j = 1, 2, ..., K$.
  2. Assign each observation i to the group $G_j \subset \{1, 2, ..., N\}$ whose group average μ_j is closest to x_i in terms of Euclidean distance.
  3. For each of the K current group assignments, compute the average characteristics $\mu'_j = \frac{1}{|G_j|} \sum_{i \in G_j} x_i$.
  4. Repeat steps 2 and 3 until convergence of assignment or a maximum number of iterations is reached.
- Final classification: $K = 3$

Grouping variables

1. **Round, Sealed-Bid:** % bids placed by bidder i in the sealed-bid format taking the values $25K$ or $30K$
2. **Snipe, Revisable-Bid:** % *undercutting* bids placed by i after the final message.
3. **Early, Revisable-Bid:** % bids placed by i in the revisable-bid format in the first 15 minutes of the auction.

- Recall: (1-3) are markers of non-competitive conduct, (2) is consistent with competitive bidding

Finding 1: Persistence in competitive/non-competitive conducts

	1(Bid)	Bid Amt.	Round, S	Snipe, R	Early, R
1(Bid)	1.00				
Bid Amt.	-0.04	1.00			
Round, S	-0.00	**0.35****	1.00		
Snipe, R	0.18	-0.18***	**-0.45*****	1.00	
Early, R	0.12	0.08***	0.38***	**-0.82****	1.00

Finding 2: 25% of active bidders are classified as "competitive"

	N.	Bid Placed	Bid Amt	Round, S	Snipe, R	Early, R
Competitive	10	0.25	**26.30**	**0.34**	**0.54**	0.11
Non-comp.: Early	19	0.26	27.12	0.57	0.07	0.47
Non-comp.: Late	10	0.22	28.41	0.68	0.25	0.21

Note: The distinction between the two groups of non-competitive bidders is based on the timing of bids in revisable auctions

- **Takeaway 1:** "Competitive types" are more likely to snipe, less likely to tie, and place lower bids

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- **Takeaway 2:** Tacit collusion or Irrational bidders? We cannot formally rule out either interpretations. But...
  - Analysis focus only on active bidders
  - Lots of information about the "bid to beat"
  - Bidders can use fairly fine bids

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- **Takeaway 3:** "Non-competitive early" types rely heavily on focal prices in sealed-bid auctions
  - Early bids in revisable auctions are placed by bidders who are more likely colluding
  - Inconsistent with entry deterrence strategy (competitive strategy)

Finding 3: Early bidding in revisable auctions leads to higher offers for consumers

VARIABLES	First bid amount	Winning bid amount
1(Early bid received)		-1.02***
		(0.17)
1(Revisable)	0.88***	-0.16
	(0.13)	(0.16)
1(Revisable)x1(Early bid received)		0.89***
		(0.26)
Observations	4,177	4,177
Unit of observation	Auctions	Auctions
Mean dependent variable	27.7	25.8

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Mean dependent variable	27.7	25.8

- **Interpretation:** Early bids are used to facilitate coordination

Finding 4: Inviting more competitive bidders leads to lower prices and higher take-up

VARIABLES	(1) N Bids	(2) 1(N Bids > 0)	(3) Winning bid	(4) 1(Accept)	(5) 1(Trans.)
N Invited, Comp.	0.21***	0.028***	-0.36***	0.021***	0.026***
	(0.019)	(0.0046)	(0.048)	(0.0073)	(0.0063)
N Invited, NC (early)	0.22***	0.034***	-0.085**	-0.0013	0.0097**
	(0.014)	(0.0036)	(0.040)	(0.0055)	(0.0047)
N Invited, NC (late)	0.16***	0.023***	-0.041	0.0017	0.011*
	(0.018)	(0.0047)	(0.048)	(0.0072)	(0.0060)
N Invited, Total	0.027***	0.0069**	-0.093***	-0.0043	-0.0018
	(0.010)	(0.0028)	(0.030)	(0.0041)	(0.0035)
Observations	5,162	5,162	4,177	3,621	4,491
R-squared	0.341	0.191	0.318	0.057	0.056
Comp.=NC (early)	0.67	0.20	4.7e-07	0.0057	0.018
Comp.=NC (late)	0.027	0.41	1.9e-07	0.041	0.054
NC early = NC late	0.0023	0.029	0.43	0.71	0.89
Mean dep. variable	1.97	0.81	25.8	0.30	0.24

Measuring economic damages from collusion

- **Question:** What is the effect of inviting only competitive types?
- How?
  - Estimate the policy function of competitive bidders (10): (i) participation, and (ii) bid
  - Estimate distribution of clients' willingess-to-pay: Accept/reject
  - Simulate auction outcomes assuming all bidder use competitive policy function
- Two scenarios:
  - *Conservative:* Only active bidders bid competitively
  - *Maximal:* All bidders bid competitively
- **Caveat:** Simulation exercise does not account for equilibrium response to the change in conduct

Estimated bidder strategies and client willingness-to-pay

VARIABLES	1(Participate)	Bid (log)	1(Accept)
Winning bid (x1000)			-0.13***
			(0.043)
log(dist): Garage–client	0.11***	0.061***	
	(0.031)	(0.0068)	
log(dist): Client–treatment	0.15**	0.092***	0.17
	(0.072)	(0.016)	(0.11)
log(N. Invited)	0.18	-0.045	
	(0.19)	(0.040)	
Observations	4,440	1,362	3,620
Unit of observation	Bidders	Bidders	Auctions
Auction sample	Sealed-bid	Sealed-bid	All
Bidders	Competitive	Competitive	All
Mean dep. variable	0.31	3.24	0.30
Control function?			Yes
First-stage (F)			44.3
Exog. test (P-value)			0.58
Avg. demand elasticity			-3.52

Simulation results

	(1) Num. bids Average	(2) Bid Average	(3) Winning bid Average	(4) Accepted bid Average	(5) Acceptance Probability
Panel A: Observed auctions					
Rest of market	2.04	27.55	25.77	24.87	0.30
Rufisque	0.81	26.56	24.84	17.14	0.06
Panel B: All invited bidders scenario					
Rest of market	3.88	26.26	22.60	21.64	0.42
Rufisque	2.13	23.22	21.17	19.68	0.18
Panel C: Only active bidders scenario					
Rest of market	2.28	26.37	23.88	22.55	0.37
Rufisque	1.22	23.34	21.95	19.99	0.16

Note: The observed and simulation samples correspond to all sealed-bid auctions for non-subsidized households (2,598 auctions). Bids are measured in 1,000 CFA.

Back-of-the-envelope effect of collusion on health

Finding the effect of collusion on diarrhea

- Based on prior work, a 1% increase in desludging leads to a 0.58% decrease in diarrhea

$$\frac{\Delta H_i}{\Delta Q_i}\frac{\bar{Q}}{\bar{H}} = \frac{\Delta H_i}{\Delta \text{Subsidy}_i}\left(\frac{\Delta Q_i}{\Delta \text{Subsidy}_i}\right)^{-1}\frac{\bar{Q}}{\bar{H}} = \frac{-0.028}{0.029}\frac{0.295}{0.49} = -0.58,$$

- Replacing naive and collusive bidders with competitive bidders would increase take-up by 23% (most competitive scenario).
- Increasing competition on the platform would decrease the number of diarrhea cases by 14%.
- A more conservative elasticity of mechanical desludging -2.2 based on Deutschmann et al 2024, would lead to a reduction in diarrhea rates of 9%.

Conclusion

- Large potential gains from eliminating collusion:
  - Making the active bidders behave competitively on the platform, prices would go down 9%.
  - CS in the platform is currently 1,570 CFA (about 7% of transaction price), potential to increase by 45% to 2,280 if collusive and naive bidders are made competitive.
  - The potential health impacts are significant: Potential for decreases in diarrhea of 9-23%

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  - CS in the platform is currently 1,570 CFA (about 7% of transaction price), potential to increase by 45% to 2,280 if collusive and naive bidders are made competitive.
  - The potential health impacts are significant: Potential for decreases in diarrhea of 9-23%
- Preview of companion paper:
  - Use the auctions to identify demand and cost parameters (structural estimation)
  - Measure the equilibrium effect of increasing competition on take-up
  - **Key result**: Competitive platform would increase take-up by 45%

Desludging Cost Estimation

- **Expected profits:** Bidder i's expected profits from submitting a bid b with cost c_{it} with information set I_{it}:

$$\pi_i(b, c_{it}, I_{it}) = \underbrace{\Pr[\text{Win}|b, I_{it}]}_{\Pr(\text{Winning})} \underbrace{D[b|I_{it}]}_{\text{Demand}} \underbrace{(b - c_{it})}_{\text{Margin}} = G(b|I_{it})(b - c_{it})$$

- **Probability of winning:** Let $\tilde{A}_{-i}$ be the number of active bidders besides i, so

$$\Pr[\text{Win}|b, I_{it}] = \underbrace{\Pr[\tilde{A}_{-i} = 0|I_{it}]}_{\text{Monopolist}} + \underbrace{(1 - \Pr[\tilde{A}_{-i} = 0|I_{it}])}_{\text{Contested auction}} \underbrace{\Pr[\min b_{-i} \geq b|\tilde{A}_{-i} > 0, I_{it}]}_{\text{Lowest bidder (accounting for ties)}}$$

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- Traditional approach (Guerre, Perrigne and Vuong, 2000):

$$\frac{b_{it} - \hat{c}_{it}}{b_{it}} = -\left[\frac{d\text{Prob. Transaction}}{d\text{Bid}}\right]^{-1} \frac{\widehat{\Pr}[\text{Win}|b_{it}, I_{it}]\hat{D}[b_{it}|I_{it}]}{b_{it}}$$

Cost Estimation: Revealed Preference Inequalities

- Profit maximization implies:

$$\begin{aligned}\hat{G}(b_{it}|I_t)(b_{it}-c_{it}) &= \widehat{\Pr}[\text{Win}|b_{it},I_t]\hat{D}[b_{it}|I_t](b_{it}-c_{it}) \\ &\geq \widehat{\Pr}[\text{Win}|b',I_t]\hat{D}[b'|I_t](b'-c_{it}) = \hat{G}(b'|I_t)(b'-c_{it}), b' \in \mathcal{B}_i\end{aligned}$$

- **Round bids and ties:** If consideration set is very rich (e.g. $\mathcal{B}_i = \Re_+$), some bids b_{it} are *dominated* for any $c_{it} \geq 0$ (e.g. $b_{it} = 25K$).
- **Solution:** Use bidder-specific consideration-sets to
  - Estimate robust bounds on marginal cost (c_{it})
  - Account for differences in conduct and/or attentiveness across bidders

Cost Estimation: Revealed Preference Inequalities

- For each chosen bid b_{it}:

$$\hat{G}(b_{it}|I_t)(b_{it} - c_{it}) \geq \hat{G}(b'|I_t)(b' - c_{it}), b' \in \mathcal{B}_i$$

$$\rightarrow c_{it} \leq \frac{\hat{G}(b_{it}|I_t)b_{it} - \hat{G}(b'|I_t)b'}{\hat{G}(b_{it}|I_t) - \hat{G}(b'|I_t)} = \mu_{it}(b_{it}, b'), \forall b' > b_{it}$$

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Return

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- If $c_{it} = x_{it}\beta + \gamma_{it}$, the likelihood can be formed as follows:

$$\Pr(b_{it} = b_k|I_t, x_{it}) = F(\mu_{it,k} - x_{it}\beta) - F(\mu_{it,k-1} - x_{it}\beta)$$

where $\mathcal{B}_{it} = \{b_1 < \cdots < b_k < \cdots < b_{K_i}\}$ is the sorted set excl. b_{it}, and $\mu_{it,k} = \mu_{it}(b_k, b_{k+1})$.

  - *Semi-parametric approach:* In practice, we use a mixture-of-normals to approximate $F(\gamma)$ (Coppenjans, JoE, 2001).

Return

Result 1: What is the effect of eliminating non-competitive conduct?

	Dist. (km)	1(Bid)		Price		1(Trans.)	
	(1)	(2) Obs.	(3) CF	(4) Obs.	(5) CF	(6) Obs.	(7) CF
Downtown	16.96	0.22	0.42	2.22	1.95	0.39	0.49
Guediawaye	14.96	0.19	0.48	2.36	2.03	0.22	0.37
Niayes	21.91	0.16	0.40	2.69	2.33	0.15	0.26
Pikine	11.03	0.21	0.45	2.00	1.88	0.24	0.34
Thiaroye	18.37	0.20	0.50	2.39	2.02	0.32	0.41
Total	18.02	0.19	0.45	2.37	2.10	0.26	0.36

Number of simulations: 5,000 auctions and 5,000 invitation lists.

Transaction prices are expressed in 10,000 CFA.

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	Uniform	Inverse distance weights			Full list
	(1)	(2)	(3)	(4)	(5)
	$\bar{N} = 10$	$N = 10$	$N = 15$	$N = 20$	$N = 39$
	Mean	Mean	Mean	Mean	Mean
Total distance (km)	17.121	15.349	15.516	15.676	17.120
1(Transaction)	0.359	0.371	0.401	0.420	0.457
Transaction price	2.096	2.073	2.014	1.975	1.896
Winning bid	2.322	2.271	2.165	2.107	2.005
1(Zero bids)	0.007	0.004	0.001	0.000	0.000
1(Participation)	0.454	0.466	0.405	0.364	0.275
Observations	2636	2636	2636	2636	2636

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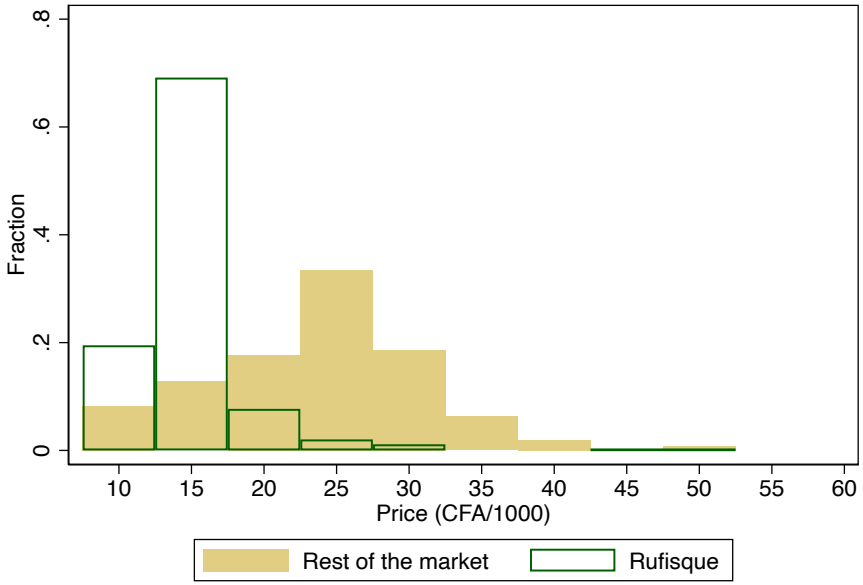
Simulation: 5,000 auctions and 5,000 invitation lists.

Prices are expressed in 10,000 CFA.

Return

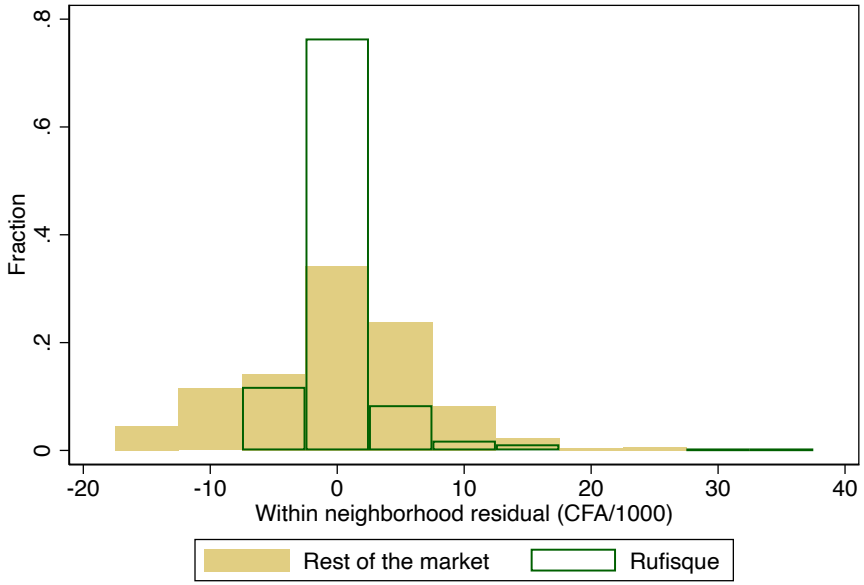
Price dispersion across and within neighborhoods

Nominal prices



Note: Width = 5,000 CFA

Within neighborhood dispersion

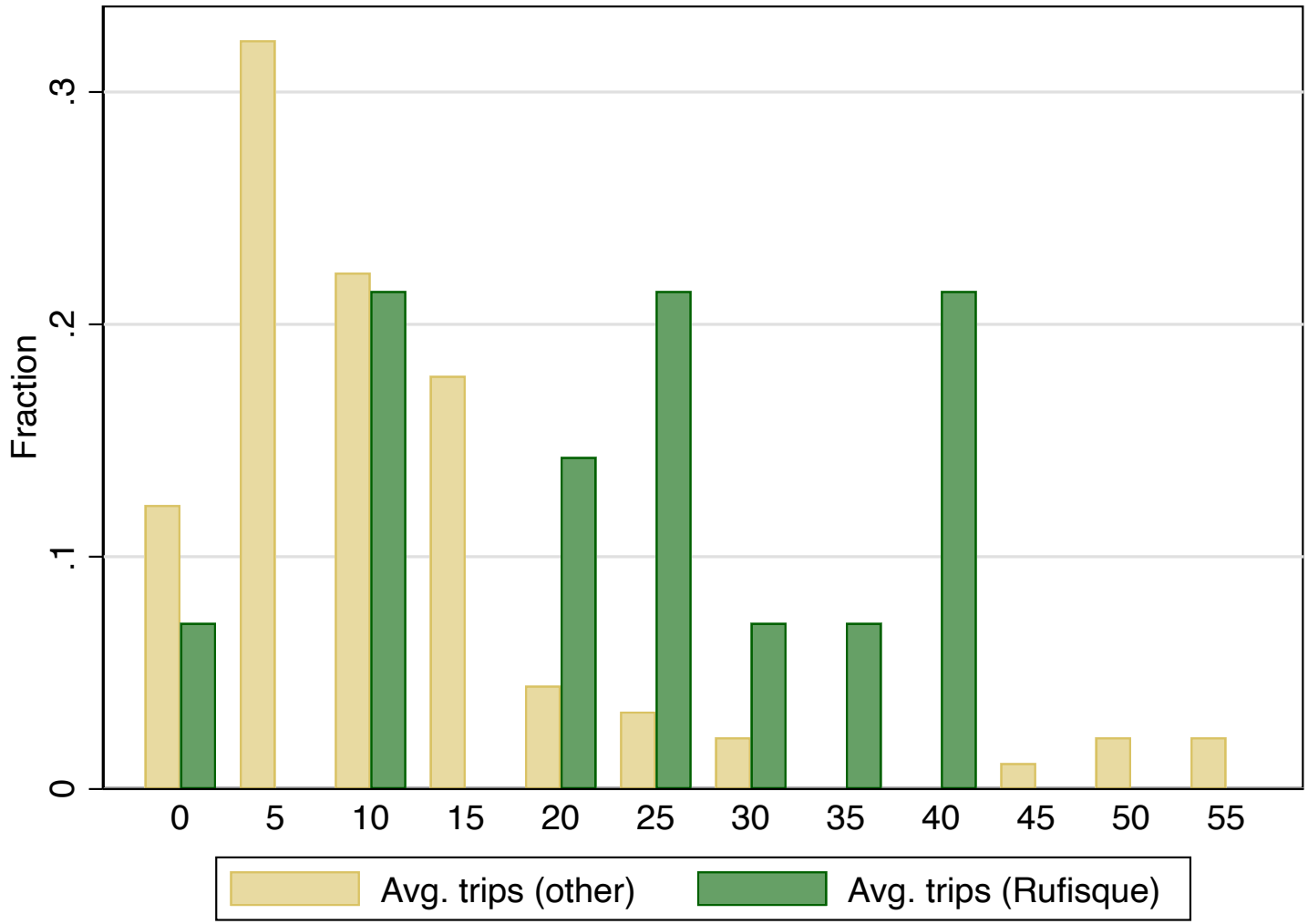


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Return

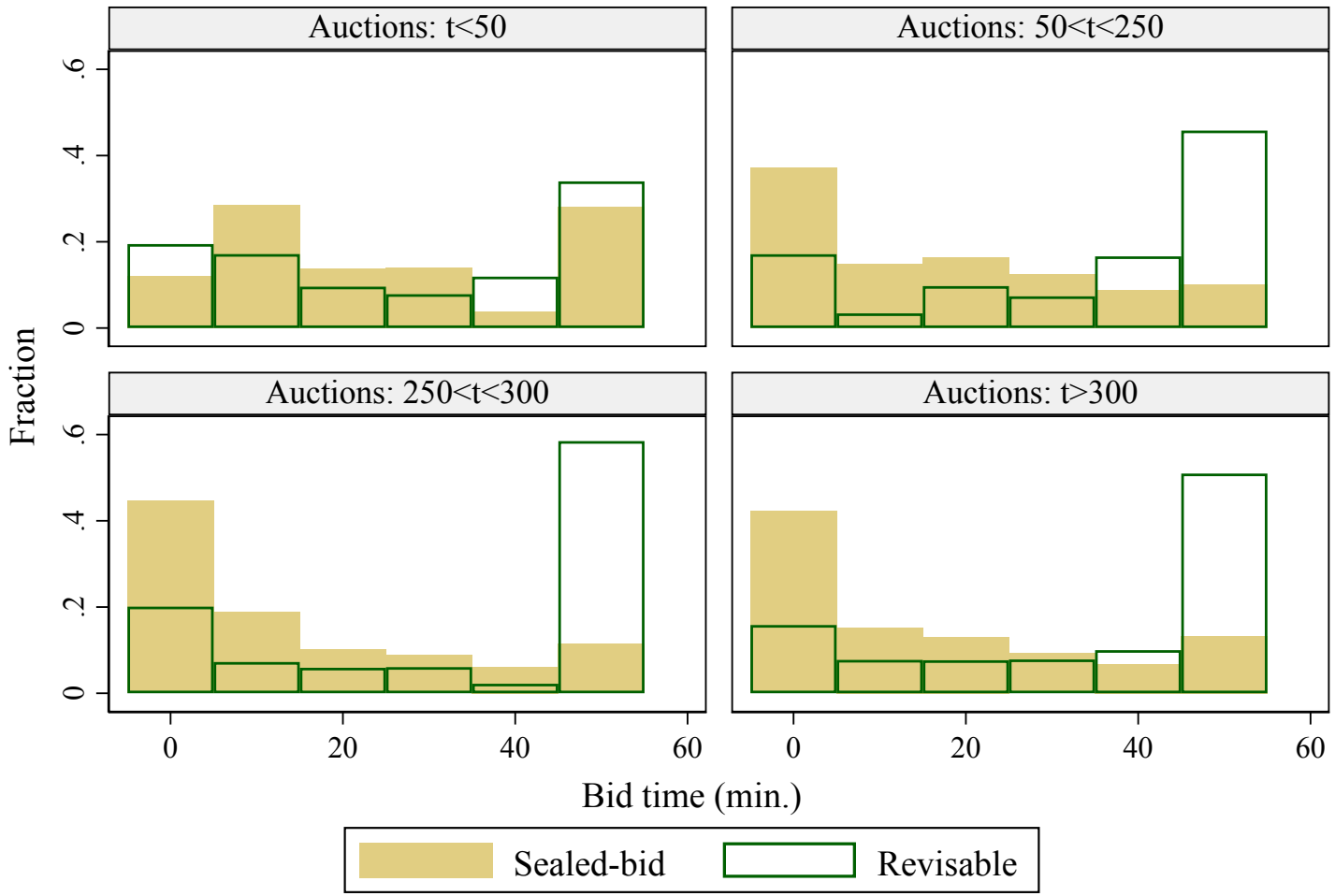
Capacity utilization

Number of potential trips per truck $\approx$ 50 over 10 days (or $<$ 2hrs/trip)



Return

Evolution of the timing of winning bid across formats



Graphs by Auction count

Return