Collusion by Exclusion in Public Procurement

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Motivation

- Public authorities in the EU spend around 14% of GDP on the purchase of services, works and supplies ($\approx$ € 2 trillion per year)
- Bid rigging is considered to be a major threat to an efficient procurement process
- Literature mostly considers single-stage (standard) auction formats
  - Open auctions are more prone to collusion than sealed-bid auctions [Athey et al., 2011]
  - Minimum prices make it harder to collude [Chassang and Ortner, 2019]
- In practice an "invitation to quote" often precedes the actual auction
- Opening bids submitted there are used for preselection of bidders

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Do opening bids affect strategy and profitability of cartels?

Contribution

Theory:

- Requesting opening bids results in a two-stage auction where a limited number of firms is allowed to proceed after the first stage
- In private value settings: auctioning off entry rights may increase efficiency, e.g. [Ye, 2007, Bhattacharya et al., 2014, Sweeting and Bhattacharya, 2015]
- In common value settings: a sealed-bid auction stage followed by an opening descending auction combines the best of two worlds, leads to aggressive price competition and low collusion incentives [Klemperer, 1998][3]

$\Rightarrow$ We consider a different (and widely used) auction format for the entry stage and show that cartels may achieve higher cartel profits with preselection

[3] See also [Maurer and Barroso, 2011].

Contribution

Empirics:

- Detection of bid-rigging via collusion markers informed by theory
  [Bajari and Ye, 2003, Kawai and Nakabayashi, 2022, Chassang et al., 2022]
- Comparing different auction format w.r.t. cartel's ability to rig them
  - Open vs. closed [Athey et al., 2011]
  - minimum price [Chassang and Ortner, 2019]

$\Rightarrow$ We use theory-informed collusion markers to make a new comparison both under competition and collusion

A reform in 2017 Slovakia allows us to observe outcomes for two-stage and standard auctions

Overview

Theory

Model Setup

- N risk-neutral firms $i \in \{1, ..., N\}$. $K \subset N$ coordinate their bids.
- Cost of providing a good to the procurer follows i.i.d. cumulative distribution function $F(c)$ on support $[\underline{c}, \overline{c}]$
- Timeline:
  - (0) Procurer announces preselection rule $n \in \{1, ..., N\}$ and reserve price $r > \overline{c}$.
  - (1) **Preselection stage:** Each firm i submits a sealed bid $b_i \leq r$. n firms with lowest b_i get preselected
  - (2) **Main auction:** Preselected firms are allowed to participate in a modified English auction with opening bid b_i as binding first bid. The firm with the lowest final bid q_i wins.

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- Hence, in the main auction *(Lemma 1)*:
  - The firm with the lowest cost among preselected will win the main auction.
  - Final price will be either lowest cost among non-colluding rival firms or own opening bid.

Predictions: Effect of the Reform on Competitive Auctions

Proposition 1

Under competition, changing the preselection rule from $n < N$ to N neither affects firm profits nor overall savings.

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Intuition:

- Bidding in the preselection stage is not restricting potential bids in the main auction, hence outcomes are the same
- Essentially: Revenue Equivalence since IPV setting with risk-neutral, symmetric and competitive agents, no entry cost.

Predictions: Effect of the Reform on Rigged Auctions

Proposition 2

Suppose there exists a cartel. If competitive rivals are not aware of it, changing the preselection rule from $n < N$ to N decreases cartel profits and increases savings.

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Intuition:

- *(Lemma 3)* In case with preselection rule $n < N$, at least n cartel members submit the same cartel bid in equilibrium.
- Cartel members have nothing to lose from this strategy because only the lowest cartel bid matters for the main auction
- But coordinating on the same bid has the huge potential of being jointly preselected

$\Rightarrow$ With preselection a cartel can, in addition to eliminating competition from within the cartel, also eliminate competition from outside the cartel!

What's the point of preselection?

- The focus of the previous section is to show how cartels can exploit preselection
- But there is also a potential benefit of preselection in competitive settings
- Entry costs lead to endogenous entry into auctions
  - Then the number of bidders in the main auction is *random*:
    1. Too few bidders $\rightarrow$ little competition
    2. Too many bidders $\rightarrow$ not worth the total entry costs

$\Rightarrow$ Introducing preselection by an entry-rights auction may increase surplus as it ensures a more stable number of bidders

$\Rightarrow$ Under appropriate assumptions, our opening-bid format is revenue-equivalent to previously considered auction formats, but optimal collusive bidding strategy continues to hold

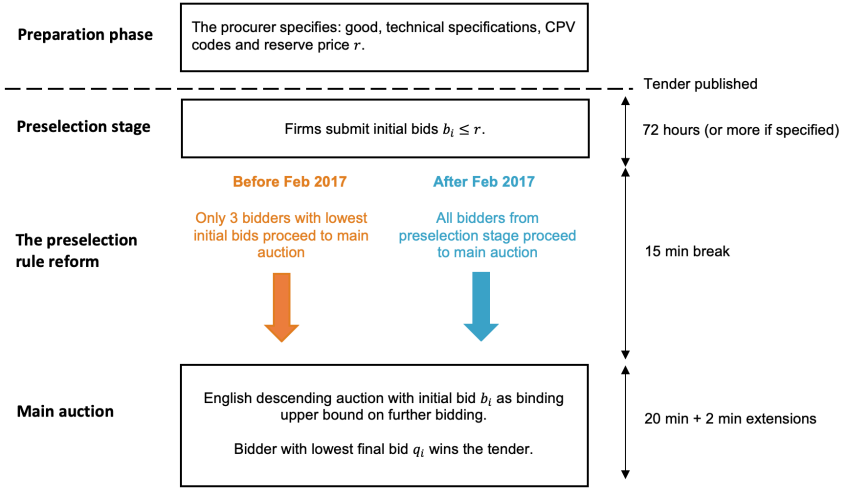
Theoretical predictions

Main predictions:

1. With preselection, frequent close bidding in the preselection stage is indicative of being a member of a partial bid-rigging cartel.
2. Joint participation of cartel firms is less likely without preselection compared to with preselection
3. Removing preselection is more beneficial for the procurement agency when a cartel is present

Auction rules and reform

E-Public Procurement Auctions and Reform in Slovakia



Empirical Analysis

Data

We have the universe of public procurement auctions published on ECS: More background

- Sample period is February 2016 - January 2020: 77.694 auctions worth €1.2 billion
- $>$ 6.000 distinct bidders, of which $\approx$ 4500 won at least one auction
- $>$ 3.000 procurement agencies from 1.300 different municipalities in Slovakia

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Collusive Markers exploit Suspicious Bid Pattern before the Reform

Step 1: With preselection, cartel members should bid closely to be able to exclude rivals

- **Close Bidding**: Identify auctions where at least 3 firms submit bids in a value range of 0.1% of the reserve price of each other in the selection stage
  [Robustness: consider 0.5% and 0.05%]

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Step 2: We are interested in colluders, not auctions per se

- **Potential Colluders**: Mark firms as potentially collusive, if they frequently participate in close bidding: more than 90% of firms in our sample
  [Robustness: consider 85% and 95%]

Distribution

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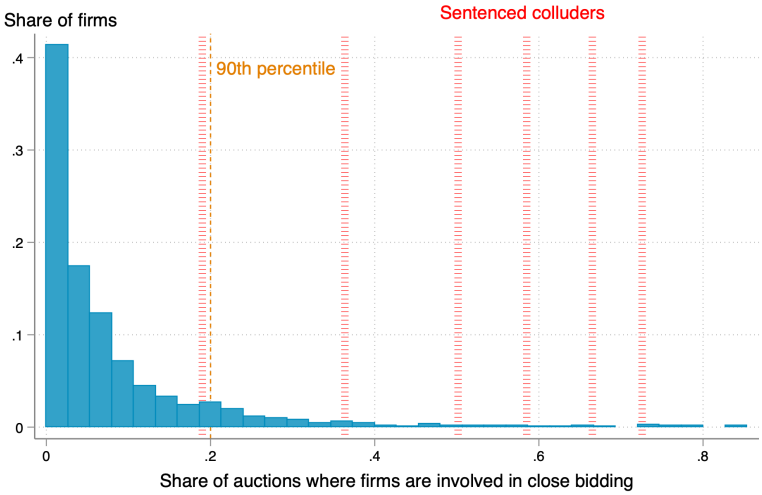
Distribution

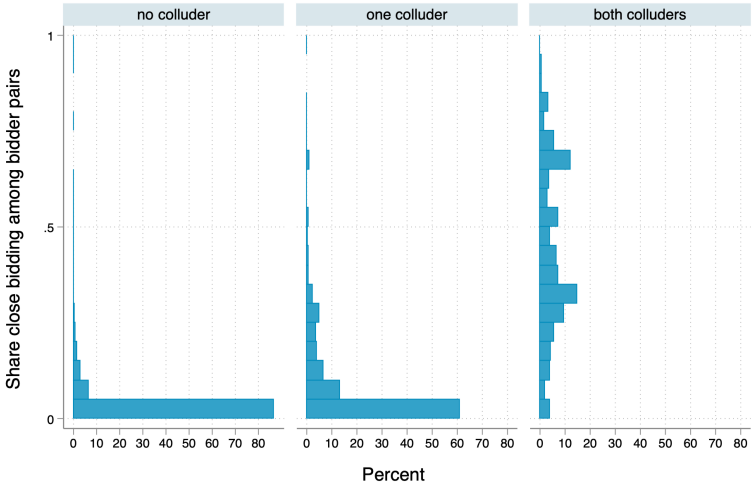
How well does this capture cartels?

Validation I: Overlap with convicted cartel

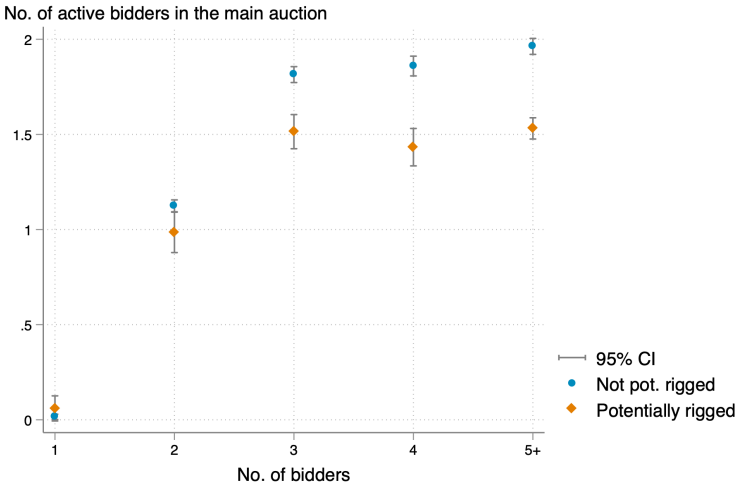


More on the cartel

Validation II: Close bidding in stable groups



Validation III: Little competition in main auction



The Effect of the Reform on Facing Colluder

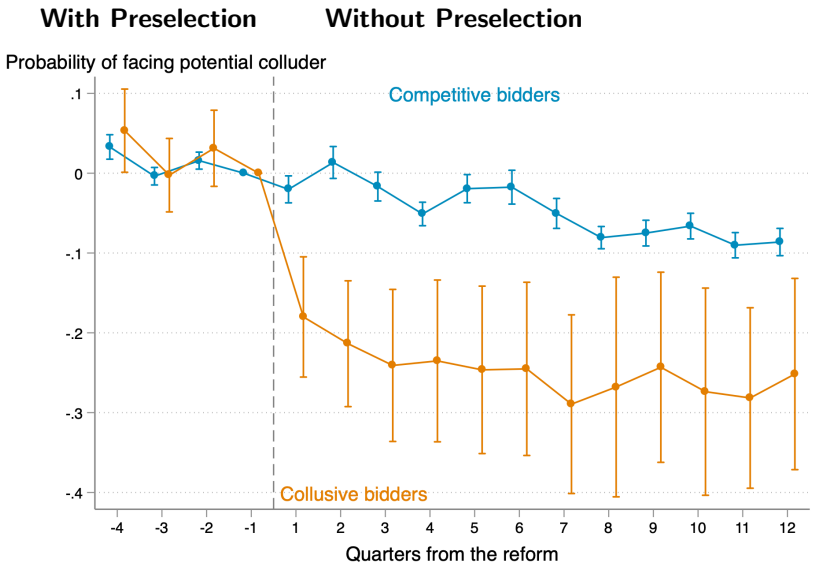
Regression specification:

$$CartelOpponent_{ia} = \alpha_0 + \alpha_1 Post + \alpha_2 PotentialColluder_i \times Post + \gamma_t + \delta_p + \theta_c + \omega_i + \epsilon_{ia}, \quad (1)$$

- γ_t: Year and Months FE
- δ_p: Procurer FE
- θ_c: CPV category FE
- ω_i: Bidder FE
- Standard errors clustered at the bidder level

regression table

The Effect of the Reform on Facing Colluder



The Effect of the Reform on Savings

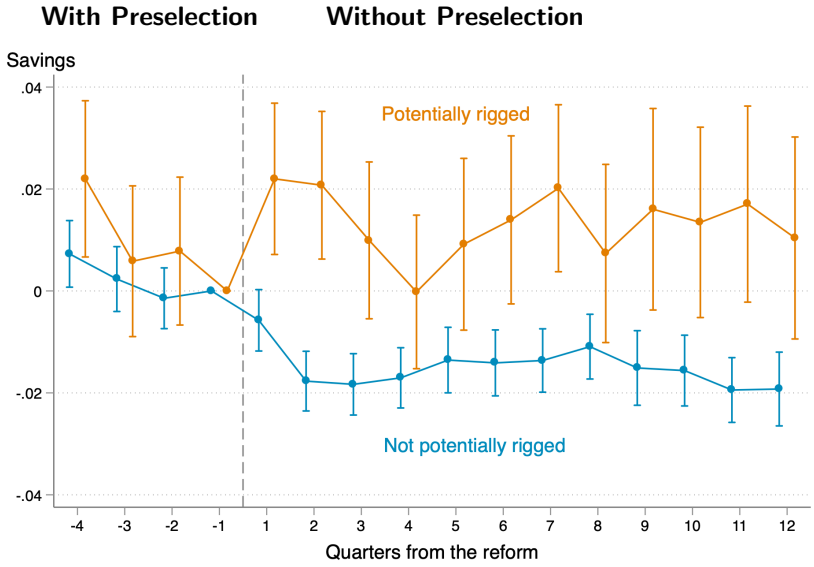
Auction is Potentially rigged if at least one colluder participates

Regression specification:

$$\begin{aligned} Savings_a = {} & \alpha_0 + \alpha_1 Post + \alpha_2 PotentiallyRigged_a \times Post \\ & + \alpha_3 PotentiallyRigged_a + \beta_1 Bidder\#2_a + \beta_2 Bidder\#2_a \times Post_t \\ & + \beta_3 Bidder\#3_a + \beta_4 Bidder\#3_a \times Post_t \\ & + \beta_5 Bidder\#4_a + \beta_6 Bidder\#4_a \times Post_t \\ & + \beta_7 Bidder\#5_a + \beta_8 Bidder\#5_a \times Post_t + \gamma_t + \delta_p + \theta_c + \epsilon_i, \end{aligned} \tag{2}$$

regression table

The Effect of the Reform on Savings



The Effect of the Reform on Savings

So how much did bid rigging cost the procurement authorities?

- In the year before the reform, contracts with a total value of €256 million were published on the platform
- Auctions where a collusive bidder participated were worth €73.1 million
- Procurement agencies ended up paying €63.6 million: Savings of €9.5 million
- Their savings could have been **14.7% higher** on these contracts had they introduced post-reform rules one year earlier

Conclusion

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- The profitability of selective procedures, among others, depends on the prevalence of cartels in the bidder population
- Procurement agents need to strike the right balance

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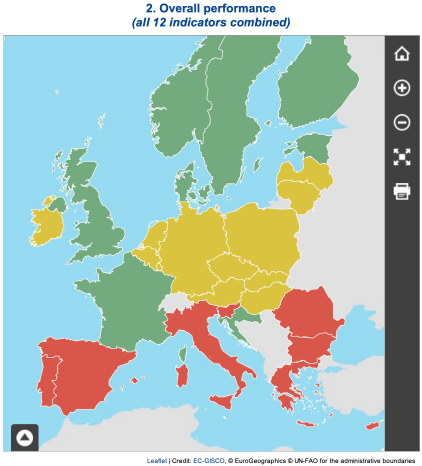
Some Background on Slovakia

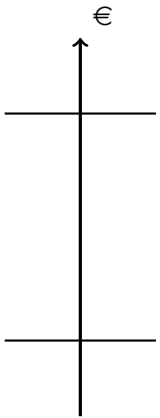
- Attractive data: the system reliably tracks the identity of procurer and bidder and is one of the most transparent
- Comparable to other European countries according to indicators based on different public procurement aspects (competitiveness, transparency, SME inclusion)



[4]

[4] https://ec.europa.eu/internal_market/scoreboard/_docs/2019/performance_per_policy_area/public_procurement_en.pdf

Slovakia: Institutional Background



Over-the-threshold contracts (OTC): governed by EU law

Under-the-threshold contracts (UTC): Slovak rules apply: tenders are required to use the electronic contracting system (EKS) for standardized goods and services

Low-value contracts (LV): Use of ECS optional

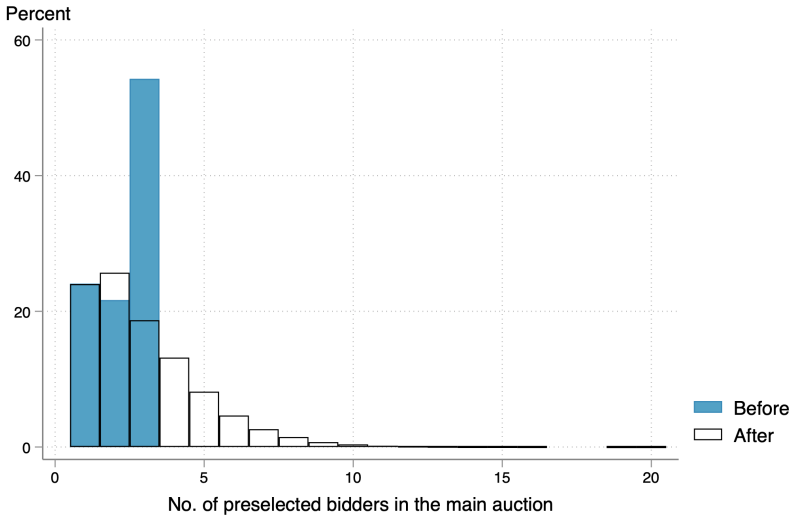
Summary Statistics

Table: Summary statistics

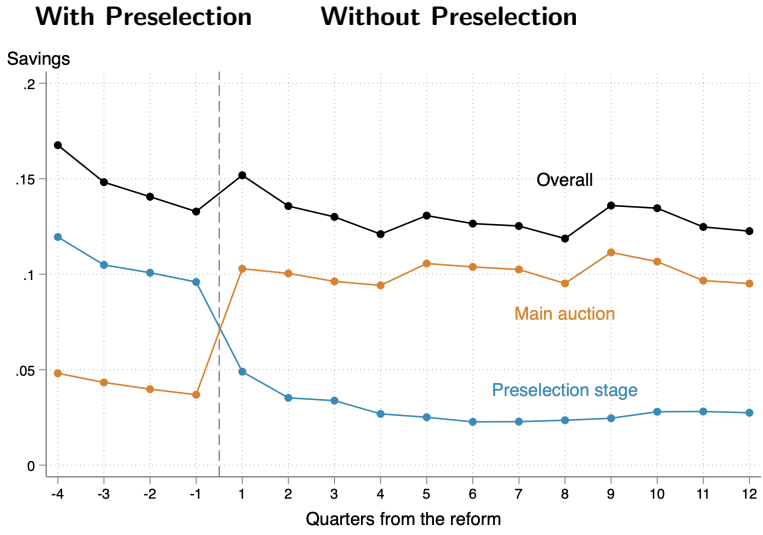
	(1) Full Sample				(2) Before Feb 2017		(3) After Feb 2017		(4) Difference (2) − (3)
	Mean	SD	min	max	Mean	SD	Mean	SD	b
Savings	0.14	0.17	0.00	1.00	0.15	0.17	0.13	0.17	0.01***
Savings realized in Stage 1	0.05	0.11	0.00	1.00	0.10	0.15	0.03	0.08	0.07***
Reserve price (k€)	15.50	37.37	0	1860.00	10.80	30.27	17.56	39.92	-6.76***
Final bid (k€)	14.33	35.224	0	1855.00	9.93	28.72	16.26	37.60	-6.33***
Notified contractors	418.09	209.20	0.00	2396.00	432.96	217.04	411.56	205.32	21.40***
No. of bidders	3.10	2.09	1.00	24.00	3.37	2.44	2.99	1.91	0.39***
No. of bidders in Stage 2	1.57	1.46	0.00	11.00	1.20	1.16	1.73	1.55	-0.52***
No. of bids in Stage 2	26.12	55.80	0.00	2185.00	17.94	42.67	29.70	60.32	-11.76***
Observations	77694				23701		53993		77694

Notes: The table summarizes auction-level variables for the sample used in our analysis, covering auctions on the EKS platform from February 2016 to January 2020. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Mechanical Effect of the Reform



First look at the reform: Huge shift in Competition



Back

Fined firms

- In May 2021, the competition authority convicted 6 companies of rigging EKS auctions
- Court case describes derived strategy: cartel members bid in groups of 3 with close opening bids, inactive afterwards
- Case was supported by hard evidence: bidding from the same IP address
- We correctly predict 5 out of 6 colluding firms
- 276 auctions investigated (251 pre-reform, 23 post-reform)
- 6 firms, highly asymmetric in size
- Biggest firm ca. 200 employes, revenue €10 million, manufacturing of workwear, shoes, gloves
- The rest much smaller $<$ 15 employees, retail
- 2 most active won contracts worth of ca. €1.5 million EUR, fined only €162.000 and €8.600
- Largest firm participated in 10 and won 1 contract (€5.900) but fined €0.9 million

Investigated auctions

	(1)		(2)		(3)		(4)	
	No rivals present		Rivals excluded		Rivals not excluded		Rivals not excluded	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Savings	0.03	0.04	0.12	0.12	0.28	0.13	0.20	0.18
Preselection savings	0.03	0.04	0.12	0.12	0.24	0.14	0.14	0.15
Reserve price	7.53	6.66	12.14	22.35	10.24	15.44	11.92	18.36
Winning bid	7.32	6.61	11.90	22.24	9.83	14.59	11.55	17.58
Main auction bidders	0.19	0.54	0.05	0.37	1.57	1.15	1.66	1.06
Preselection bidders	2.53	0.77	5.67	2.32	6.02	2.50	4.66	2.54
Total bids	2.90	1.28	8.37	6.60	19.16	19.60	31.05	48.76
Cartel bidder	2.53	0.77	3.01	0.12	3.02	0.15	1.31	0.47
Cartel winner	1.00	0.00	1.00	0.00	0.27	0.45	0.72	0.45
Observations	73		73		44		61	

Back

The Effect of the Reform on Facing Colluder

Back

	(1) OLS	(2) OLS	(3) OLS	(4) OLS
Post	-0.031**	-0.009	0.006	0.033*
	(0.012)	(0.012)	(0.014)	(0.014)
Pot. Colluder × Post		-0.219***		-0.195***
		(0.045)		(0.050)
Constant	0.258***	0.256***	0.252***	0.250***
	(0.006)	(0.006)	(0.006)	(0.006)
Bidder FE	yes	yes	yes	yes
Month FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Procurer FE	yes	yes	yes	yes
CPV Category FE (2-digit)	yes	yes	no	no
CPV Category FE (full)	no	no	yes	yes
Adj. R2	0.34	0.34	0.44	0.44
Avg. Outcome	0.21	0.21	0.21	0.21
N	182724	182724	112944	112944

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The Effect of the Reform on Savings

Back

	(1) OLS	(2) OLS	(3) OLS	(4) OLS
Post	-0.018**	-0.018**	-0.007	-0.007
	(0.006)	(0.006)	(0.008)	(0.008)
Potentially rigged		-0.053***		-0.032***
		(0.003)		(0.004)
Pot. rigged × Post		0.018***		0.019***
		(0.004)		(0.005)
Bidder #2	0.087***	0.090***	0.090***	0.092***
	(0.002)	(0.003)	(0.003)	(0.003)
Bidder #3	0.067***	0.072***	0.064***	0.067***
	(0.004)	(0.004)	(0.004)	(0.004)
Bidder #4	0.044***	0.046***	0.037***	0.039***
	(0.005)	(0.004)	(0.005)	(0.005)
Bidder #5	0.067***	0.075***	0.061***	0.067***
	(0.004)	(0.004)	(0.005)	(0.005)
Bidder #2 × Post	-0.006*	-0.007**	-0.012**	-0.013***
	(0.003)	(0.003)	(0.004)	(0.004)
Bidder #3 × Post	0.011**	0.008	0.015**	0.012*
	(0.004)	(0.004)	(0.005)	(0.005)
Bidder #4 × Post	0.001	0.000	0.006	0.005
	(0.005)	(0.005)	(0.006)	(0.006)
Bidder #5 × Post	0.019***	0.013*	0.015*	0.012
	(0.005)	(0.005)	(0.006)	(0.006)
Constant	0.022***	0.024***	0.021***	0.023***
	(0.002)	(0.002)	(0.003)	(0.003)
Month FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Procurer FE	yes	yes	yes	yes
CPV Category FE (2-digit)	yes	yes	no	no
CPV Category FE (full)	no	no	yes	yes
Adj. R2	0.38	0.39	0.45	0.46
Avg. Outcome	0.14	0.14	0.14	0.14
N	59101	59101	37046	37046

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$