Public procurement in collusive institutional settings: evidence from Russian gasoline market

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Summary

- Public procurement framework, reverse auctions

- Each procurer has discretion in setting the reserve price, $R$, i.e., the maximum price he/she is willing to pay

- Model: reserve price manipulation (underpricing, $R_u$) to set/maintain a (tacit) collusive agreement between the procurer and a favored seller

- Empirical Analysis: Russian procurement data (gasoline)

- Very preliminary results!!!
Corrupt reserve price
- Manipulated reserve prices: higher $R$ leading to i) higher winning price; ii) private benefit for procurer (Atmaca, Schoors and Podkolzina, 2020).

Detection of corruption (and collusion)
- Tunneling around elections in exchange for procurement contracts (Mironov - Zhuravskaya, AEJep, 2016).
- Statistical test to detect coordinated entry and bidding choice (Conley - Decarolis, AEJmicro, 2015).
- Collusion from competition, when collusion not directly observed (Bajari - Ye, REStat, 2003, Aryal - Gabrielli, IJIO, 2013).

Manipulations of the awarding mechanism.
- ex-ante manipulation, in SRAs (Camboni, Valbonesi, Padova Wp 2018)
- ex-post manipulation (Prabal Goswami and Wettstein, IJIO, 2016; Burguet, AEJmicro2017; Huang - Xia, EER, 2019).
Our simple setting

- A local public procurer $P$ adopts auctions for repeated (and regular) purchases of an item (i.e. sugar, gasoline, etc.)
- Market structure, in each local market:
  - $n$ local small suppliers, $s_1\ldots s_n$
  - (at least) one efficient supplier $I$, i.e. the incumbent
- On average, $I$ is more efficient (i.e. lower marginal costs) than $s_1\ldots s_n$
- Having observed previous tenders, by $s_1\ldots s_n$, $P$ has a precise information about each local supplier’s marginal costs, $I$ has not, or not so precise
Underpricing in a nuthsell

- Underpricing of reserve price → P’s manipulation, i.e. P sets a $R_u$ which is lower than the average local price.

- Ratio:
  1. $P$ sets a reserve price $R_u$ to signal $I$ the marginal cost of the local most efficient small supplier $s_e$.
  2. Then, $I$ will bid $m$, with $m < \min \{ b^I, R_u \}$, and where $b^I = b(C(I))$ is the ”spontaneous” optimal bid by the incumbent.

- in presence of $R_u$, the $I$’s probability of victory is higher than the case without manipulation;

- such procurer-seller interaction could be repeated in the auctions which will follow, leading to a flow of collusive gains for both parts.
The model - Supply side

- Supply market

1. \( \theta \) is each bidder’s private cost (private information)
2. incumbent: type \( \theta^I \) \( \sim \) \( F^I(\theta^I) \) s.t. \( \theta^I \in \left[ \theta^I, \bar{\theta}^I \right] \).
3. \( n \) ”smaller” and local bidders of type \( \theta_i \) \( \sim \) \( F(\theta) \) s.t. \( \theta_i \in \left[ \theta, \bar{\theta} \right] \)
4. \( \underline{\theta} \) < \( \theta \) < \( \bar{\theta}^I \) < \( \bar{\theta} \)
The model - Supply side

Figure: the cost assumptions of type $\theta^I$ and type $\theta_i$
The model - Demand side

\( P \) receives a signal about the local suppliers’ costs, s.t. \( \tilde{\theta}_i^B = \theta_i + \varepsilon \), with \( \varepsilon \sim N(0, \sigma) \)

\( P \) adopts a FPA auction, and sets a reserve price (\( R \) or \( R_u \)).

**Underpricing.** Suppose \( \sigma = 0 \). Then, \( P \) sets \( R_u = \min \{ \tilde{\theta}_i^B \} = \min \{ \theta_i \} \).

Thus, either:

- If \( \theta^l > R_u \), a small bidder \( i \) wins, and buyer extracts all the surplus;
- If \( \theta^l < R_u \), then \( l \) bids \( m < R_u \), \( l \) wins and gets a weakly positive profit \( \pi^l (m) = m - \theta^l \)

RQ: In the underpricing setting, is \( m \) an equilibrium of an infinite horizon game?
The model - no underpricing

Standard FPA with asymmetric auction solved for a setting with two bidders, (Kaplan and Zamir, 2012), i.e. outside option.

- *I*'s profits: $E[\pi^I] = (b(\theta^I) - \theta^I) \cdot \Pr(\theta^I < \min\{\theta_i\})$

- *P*'s utility:
  1. $V - b(\theta^I)$, if $\theta^I < \min\{\theta_i\}$
  2. $V - \min\{\theta_i\}$, if $\theta^I > \min\{\theta_i\}$
Equilibrium, underpricing setting

1. Is the Buyer better off?
   - YES, if $m < b(\theta^l)$

2. Is the winner (i.e. Incumbent) better off?
   - YES, conditional on bid $m$.
   - In equilibrium: $m < b(\theta^l)$, and $Pr(\theta^l < min \{\theta_i\}) = 1$
   - Intuitively: $I$ has a richer information set and therefore a higher likelihood of winning the auction (even getting lower profit in each auction, but collusive agreement sustains repeated winnings).

3. Incentive compatibility constraint
   - In a single shot game, $I$’s best response in underpricing is to place a bid equal to $R_u$.
   - In a repeated game, assume $\delta$ is bidder’s discount rate of the future.
   - Then, ICC is: $(m - \theta^l) \frac{\delta}{1-\delta} > (R_u - \theta^l) + \frac{\delta^2}{1-\delta} \cdot E[\pi^l]$
Testable predictions

to highlight if evidence in our dataset can be explained with the above underpricing strategy:

1. **Stable pair:**
   \[ R_u \] is a strategy employed by a stable \((P, I)\) pair.

2. **Effect on competition:**
   in auctions with \( R_u \), less than average number of bidders, and higher probability of having just one bidder (the Incumbent).

3. **Effect on auctions' outcome:**
   in auctions with \( R_u \), the winning price is on average lower than the market price.
Unified procurement system (Federal Law No.94 of 21/07/2005)

Federal, provincial and municipal levels

In 2011 e-auctions introduced. Sealed bid auctions can be used only for $R < 500,000 RUB$

In 2014 replaced by Federal Law No.44

$R$: Tender notice/documentation contains information on level and rationale.
Our data

- Russian data on gasoline, varying octane rating (a largely homogeneous good)
- Purchases through gas stations
- No outsourcing
- Lowest price as award criterion (FPA)
- 83 Russian regions, for the period 2011 – 2013
- 81,750 auctions (72% sealed bid and 28% e-auctions)
- Monthly regional market prices of gasoline types (Rosstat)
Underpricing as a stable pair

\[ r_{ijt} = X_{ijt} \beta + \gamma_{year_{ijt}} + \mu_{ij} + \epsilon_{ijt} \]  \hspace{1cm} (1)

\[ \mu_i = \frac{1}{k} \sum_{j=1}^{k} \mu_{ij} \]  \hspace{1cm} (2)

**Underpricing if**

\[ \mu_{ij} - \mu_i < 0 \]  \hspace{1cm} (3)

- \( r_{ijt} \): reserve price per liter of gasoline
- \( X_{ijt} \): market price, volume and govt level of procurer
- \( \gamma_{year_{ijt}} \): year effects
- \( \mu_{ij} \): procurer-seller fixed effects on reserve price
- \( i \): procurer, \( j \): seller, \( t \): time
Empirical definition of Underpricing

**Definition**

A Procurer $P$ and a Seller $I$ adopts an underpricing strategy iff reserve price set by $P$ in contracts won by $I$ is systematically lower than the average reserve price for auctions of similar characteristics. Underpricing = 1 if $\mu_{ij} - \mu_i < 0$, and 0 otherwise.

<table>
<thead>
<tr>
<th>Underpricing</th>
<th>Observations</th>
<th>Pairs $(P, I)$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$N$</td>
<td>%</td>
</tr>
<tr>
<td>0</td>
<td>44729</td>
<td>78</td>
</tr>
<tr>
<td>1</td>
<td>12613</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>57343</td>
<td>100</td>
</tr>
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## Effect on Competition

<table>
<thead>
<tr>
<th></th>
<th>(N^\circ) bidders</th>
<th>(Prob(n = 1))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Underpricing pair</td>
<td>-0.0289***</td>
<td>-0.031***</td>
</tr>
<tr>
<td>E-auction</td>
<td>-0.419***</td>
<td>-0.420***</td>
</tr>
<tr>
<td>Underpricing pair * e-auction</td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td>Log(volume)</td>
<td>0.038***</td>
<td>0.038***</td>
</tr>
<tr>
<td>Reserve price</td>
<td>0.004***</td>
<td>0.004***</td>
</tr>
<tr>
<td>Sorting</td>
<td>0.017**</td>
<td>0.017**</td>
</tr>
<tr>
<td>Voluntary e-auction</td>
<td>0.019**</td>
<td>0.018**</td>
</tr>
<tr>
<td>Minimal application period</td>
<td>0.007</td>
<td>0.007</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.235***</td>
<td>-0.235***</td>
</tr>
<tr>
<td>Region FE</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Year FE</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Obs.</td>
<td>50767</td>
<td>50767</td>
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</table>
## Effect on auction price

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underpricing pair</td>
<td>-0.009***</td>
<td>-0.012***</td>
</tr>
<tr>
<td>E-auction</td>
<td>0.003***</td>
<td>0.056***</td>
</tr>
<tr>
<td>Underpricing pair * E-auction</td>
<td>-0.007**</td>
<td></td>
</tr>
<tr>
<td>Log(volume)</td>
<td>0.0001</td>
<td>0.0003</td>
</tr>
<tr>
<td>Reserve price</td>
<td>0.016***</td>
<td>0.016***</td>
</tr>
<tr>
<td>Sorting to avoid e-auction</td>
<td>0.008***</td>
<td>0.007***</td>
</tr>
<tr>
<td>Voluntary e-auction</td>
<td>0.002***</td>
<td>0.001***</td>
</tr>
<tr>
<td>N° bidders</td>
<td>-0.021***</td>
<td>-0.014***</td>
</tr>
<tr>
<td>Underpricing pair * N° bidders</td>
<td></td>
<td>0.003***</td>
</tr>
<tr>
<td>E-auction * N° bidders</td>
<td></td>
<td>-0.037***</td>
</tr>
<tr>
<td>Underpricing pair * N° bidders * E-auction</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.455***</td>
<td>0.466***</td>
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</tbody>
</table>

Region & year FE | \( \times \) | \( \times \)

Obs. | 49836 | 49836
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underpricing pair</td>
<td>0.275***</td>
<td>0.386***</td>
<td>0.224***</td>
<td>0.452***</td>
</tr>
<tr>
<td>E-auction</td>
<td>-0.196***</td>
<td>-0.065</td>
<td>-0.267***</td>
<td>-0.131**</td>
</tr>
<tr>
<td>N° bidders</td>
<td>-1.312***</td>
<td>-1.372***</td>
<td>-1.461***</td>
<td>-1.493***</td>
</tr>
<tr>
<td>Sorting to avoid e-auction</td>
<td>0.174***</td>
<td>0.109*</td>
<td>0.162***</td>
<td>0.098</td>
</tr>
<tr>
<td>Voluntary e-auction</td>
<td>-0.069</td>
<td>0.051</td>
<td>-0.074</td>
<td>0.050</td>
</tr>
<tr>
<td>Constant</td>
<td>4.098***</td>
<td></td>
<td>4.298***</td>
<td></td>
</tr>
<tr>
<td>Region FE</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Year FE</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Procurer FE</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Obs.</td>
<td>68764</td>
<td>52645</td>
<td>52929</td>
<td>40087</td>
</tr>
<tr>
<td>n° of different procurers</td>
<td>3220</td>
<td></td>
<td></td>
<td>2647</td>
</tr>
</tbody>
</table>

Sample is restricted to firms that have won at least 1 contract of given procurers. Column 3 is restricted to firms that have won at least 45 contracts. The last column contains firms that have at least 1 corrupt relation.
Suppose $I$ pays a bribe to $P$ in exchange of the information about marginal cost of the most efficient local supplier. Then $I$ will play $R$.

If Underpricing AND $b(\theta^I) = R$, then a bribe is required to justify the result of our model/empirical analysis.

If Underpricing AND $b(\theta^I) < R$, then underpricing may be used to maintain a long term relation.
Winning rebate in underpricing pairs

Table: Winning rebate if underpricing

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of auctions with rebate =0 (bribe required)</td>
<td>7,283</td>
</tr>
<tr>
<td>number of auctions with rebate &gt;0 (no bribe required)</td>
<td>5,385</td>
</tr>
</tbody>
</table>

Note: Sample restricted to underpricing pairs.
Conclusions

- A strategy of $R_u$ can be used to maintain a long-term relation between a procurer and a favored bidder (i.e. Incumbent).
- This strategy leads to the reduction of competition and blocks entry of new/small firms in public procurement.
- This form of favoritism may be implicit and does not require a bribe.
- Our preliminary empirical analysis suggests that this strategy of exists.
- Neither model, nor data allow to disentangle good and bad relations: relational contract (+) or favoritism (-)?
Comments, questions, doubts, suggestions ...

... .... .....
THANK YOU!!!