Number of Bidders and Final Price in Public Procurement of Construction Works in Poland

An Instrumental Variable Approach

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Economic importance of public procurement

Public procurement drives a large part of the economy.

- Public authorities in the EU spend around 14%–19% of GDP on public procurement
- This amounts to EUR 1.9–2.3 trillion (10^{12}) each year, or almost 5 times Poland's GDP
- How much can we gain by lowering barriers to entry?

Data

Source:

- barometrryzyka.pl
- Batory Foundation
- Creative Commons license

Scope:

- Poland
- 2010-2015

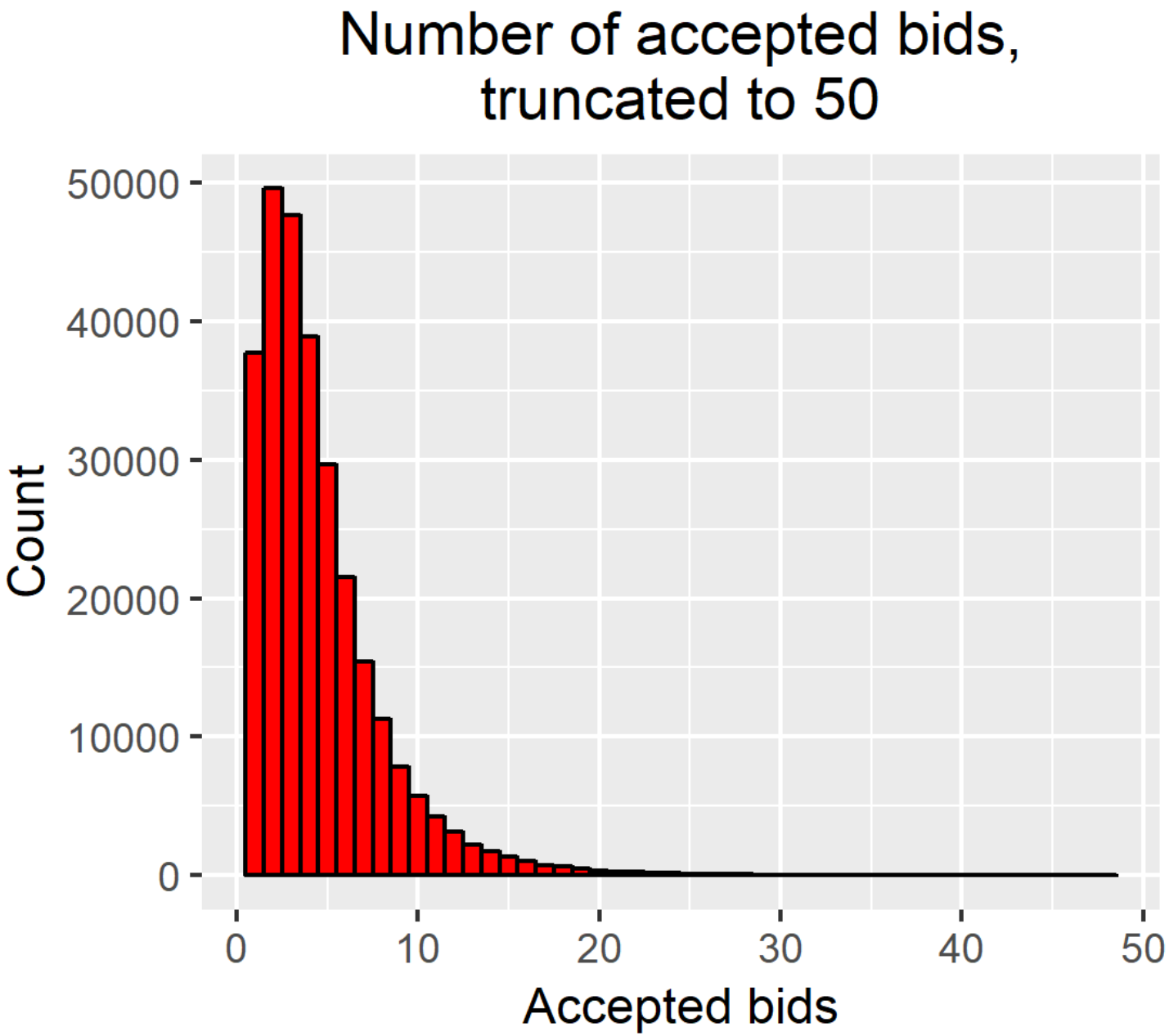
Ca. 1 900 000 records in raw data.

Data selection

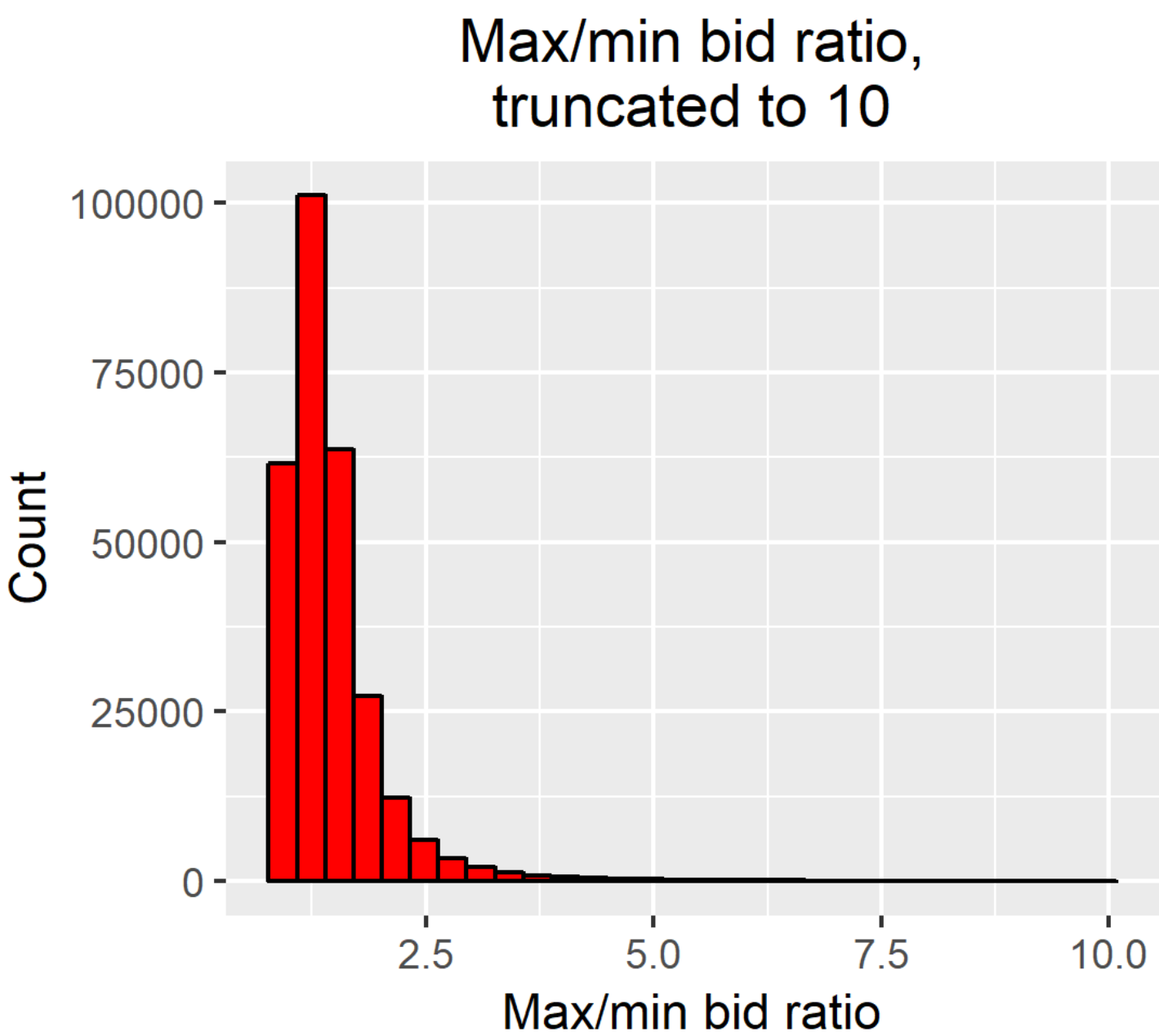
- CPV division: Construction work
- Procedure type: open tender
- Number of bids < 50
- Max to min bid ratio < 10, max bid $>$ min bid
- All financial values > 0
- Final to estimated value ratio: 0.1–10

Ca. 280 000 observations fitting the above criteria.

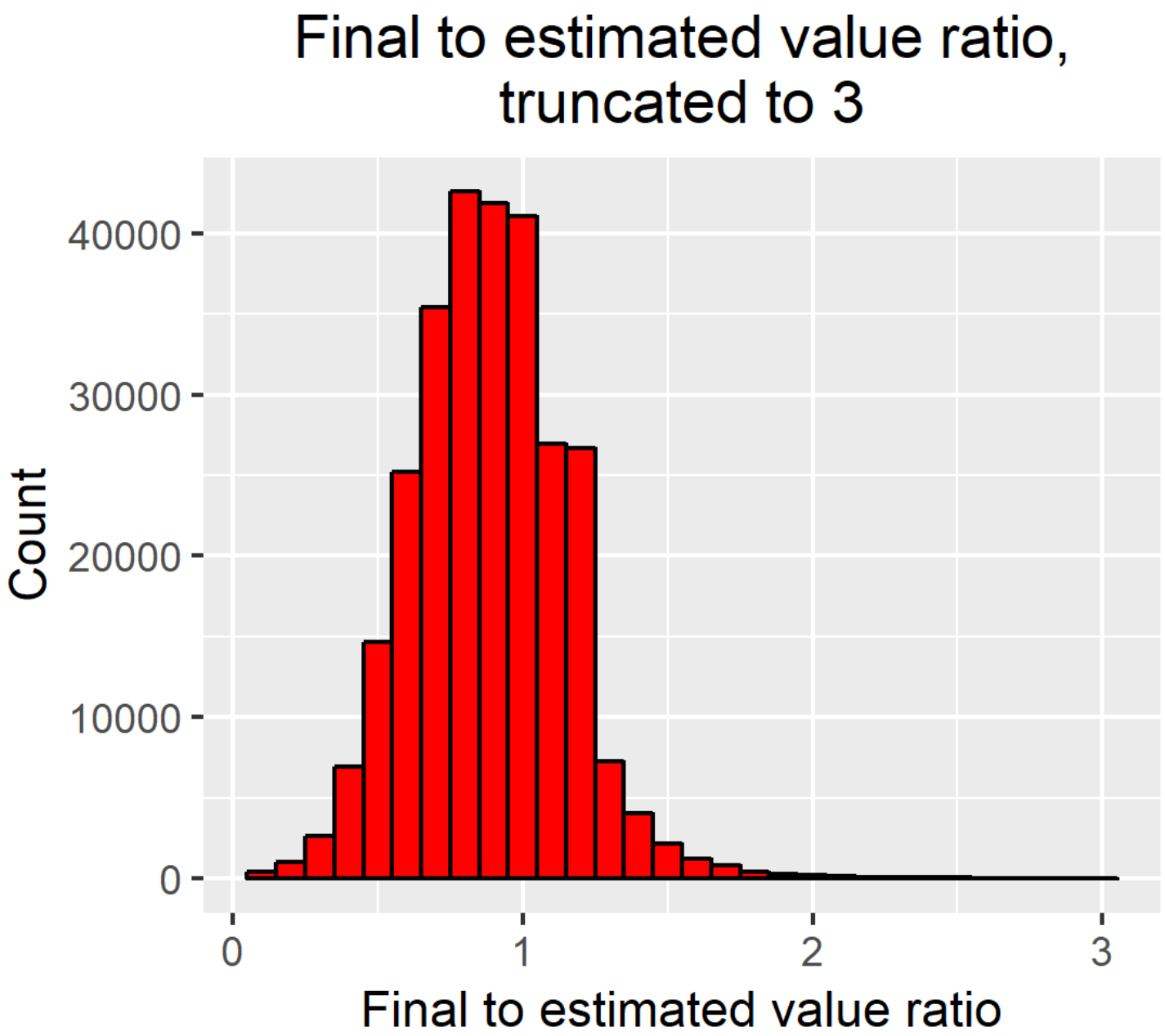
Number of bids



Max to min bid ratio



Final to estimated value



Model

Estimating the impact of the number of bidders (ca_bids) on the final price (ca_contract_value_pl):

$$ln(ca\_contract\_value\_pl)_i = ca\_bids_i\beta_1 + X_i'\beta + \mu_i$$

Controlling for:

- estimated value (ca_est_value_pln)
- selling group dummy (w_consortium)
- seasonal dummies for call for tender date (cft_autumn, cft_winter)

OLS - R code

```
ols <- lm(log(ca_contract_value_pl) ~ ca_bids +
            log(ca_est_value_pln) +
            w_consortium +
            cft_autumn +
            cft_winter,
          data = dt)
```

OLS - results

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.1652	0.0051	32.2005	0.0000
ca_bids	-0.0260	0.0002	-143.5430	0.0000
log(ca_est_value_pln)	0.9796	0.0004	2409.4711	0.0000
w_consortium	0.0266	0.0022	12.2902	0.0000
cft_autumn	0.0328	0.0015	22.0362	0.0000
cft_winter	0.0024	0.0019	1.2750	0.2023

Endogeneity in auctions

"(. . .) bidding is a costly activity; even with no participation fee, the opportunity cost of participation are likely to be significant, and to vary considerably across potential bidders.

(. . .) a concern with using OLS (. . .) is that unobserved characteristics of potential bidders might influence their decision to participate in the bidding process, and might simultaneously be correlated with the winning bids."

– Velamuri, Malathi and Onur, Ilke, Competition, Endogeneity and the Winning Bid: An Empirical Analysis of Ebay Auctions (October 1, 2011).

Instrumental variable approach

Using the call for tender duration (cft_duration) as an instrument for the number of bidders.

2SLS - R code

```
first_stage <- lm(ca_bids ~ log(ca_est_value_pln) +
                    w_consortium + cft_autumn +
                    cft_winter + cft_duration,
                  data = dt)
dt[, fit_ca_bids := first_stage$fitted.values]
second_stage <- lm(log(ca_contract_value_pl) ~
                     fit_ca_bids +
                     log(ca_est_value_pln) +
                     w_consortium + cft_autumn +
                     cft_winter,
                   data = dt)
```

2SLS - results

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.1650	0.0053	31.0493	0.0000
fit_ca_bids	-0.0565	0.0095	-5.9208	0.0000
log(ca_est_value_pln)	0.9915	0.0038	264.3670	0.0000
w_consortium	0.0102	0.0056	1.8058	0.0709
cft_autumn	0.0300	0.0018	16.7615	0.0000
cft_winter	0.0838	0.0256	3.2797	0.0010

IV - R code

```
iv <- ivreg(log(ca_contract_value_pl) ~ ca_bids +
              log(ca_est_value_pln) +
              w_consortium + cft_autumn + cft_winter |
              cft_duration + log(ca_est_value_pln) +
              w_consortium + cft_autumn + cft_winter,
            data = dt)
```

IV - results

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.1650	0.0054	30.6616	0.0000
ca_bids	-0.0565	0.0097	-5.8469	0.0000
log(ca_est_value_pln)	0.9915	0.0038	261.0659	0.0000
w_consortium	0.0102	0.0057	1.7833	0.0745
cft_autumn	0.0300	0.0018	16.5522	0.0000
cft_winter	0.0838	0.0259	3.2388	0.0012

IV - diagnostics

	df1	df2	statistic	p-value
Weak instruments	1	282398	109.3575	0.0000
Wu-Hausman	1	282397	10.9506	0.0009
Sargan	0	NA	NA	NA

- Weak instruments test rejects the null - the instrument is strong
- Wu-Hausman test for endogeneity rejects the null - the number of bidders is endogenous

Summary

- The number of bidders is endogenous
- There is a downward bias in the (absolute) OLS estimate
- We risk underestimating the potential savings from lowering the barriers for participation in public tenders

Thank you for your attention!