Heterogeneity of Cost Deviations

A Panel Analysis of Public Procurement of Construction Works in Poland

Michał Kaftanowicz

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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

Research question

How to explain and lower the differences between final and estimated project price?

Data

Source:

- barometrryzyka.pl
- Batory Foundation
- Creative Commons license

Scope:

- Poland
- 2010-2015

Ca. 1 900 000 records in raw data.

Data selection

- 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
- Aggregating to mean values by a $\{$buyer id, call for tender date$\}$ pairs

Ca. 207 000 observations in the resulting table.

Model

$$final\_to\_est\_ratio \sim ca\_est\_value\_pln + ca\_bids + cft\_duration + tguarantee + max\_to\_min\_bid\_ratio$$

Estimating the relationship between the final to estimated price ratio (price deviation) and:

- estimated value (ca_est_value_pln)
- number of bids (ca_bids)
- call for tender duration (cft_duration)
- existence of bid bond (tguarantee)
- ratio between the biggest and the smallest bid (max_to_min_bid_ratio)

Pooled model

Table 1: Pooled model

	Dependent variable:
	final_to_est_ratio
ca_est_value_pln	−0.000***
	(0.000)
ca_bids	−0.017***
	(0.0002)
cft_duration	−0.0003***
	(0.0001)
tguarantee	−0.005***
	(0.001)
max_to_min_bid_ratio	−0.079***
	(0.001)
Constant	1.096***
	(0.002)
Observations	206,800
R^2	0.085
Adjusted R^2	0.085
F Statistic	3,842.381*** (df = 5; 206794)
Note:	*p<0.1; **p<0.05; ***p<0.01

Wooldridge's test for unobserved effects (individual)

Wooldridge's test for unobserved individual effects

data: formula

$z = 9.5198$, p-value < 0.00000000000000022

alternative hypothesis: unobserved effect

Wooldridge's test for unobserved effects (time)

Wooldridge's test for unobserved time effects

data: formula

$z = 14.181$, p-value < 0.00000000000000022

alternative hypothesis: unobserved effect

Fixed Effects model

Table 2: FE model

	Dependent variable:
	final_to_est_ratio
ca_est_value_pln	-0.000^{***}
	(0.000)
ca_bids	-0.017^{***}
	(0.0002)
cft_duration	-0.0002^{***}
	(0.0001)
tguarantee	-0.005^{***}
	(0.001)
max_to_min_bid_ratio	-0.077^{***}
	(0.001)
Observations	206,800
R^2	0.087
Adjusted R^2	0.017
F Statistic	$3{,}644.508^{***}$ (df = 5; 192249)
Note:	*p<0.1; **p<0.05; ***p<0.01

Fixed Effects model - Lagrange multiplier test for individual effects

Lagrange Multiplier Test - (Honda) for unbalanced panels

data: final_to_est_ratio ~ ca_est_value_pln + ca_bids + cft_duration + ...

normal = 321.54, p-value < 0.00000000000000022

alternative hypothesis: significant effects

Fixed Effects model - Lagrange multiplier test for time effects

Lagrange Multiplier Test - time effects (Honda) for unbalanced panels

data: final_to_est_ratio ~ ca_est_value_pln + ca_bids + cft_duration + ...

normal = 43.477, p-value < 0.00000000000000022

alternative hypothesis: significant effects

Random Effects model

Table 3: RE model

	Dependent variable:
	final_to_est_ratio
ca_est_value_pln	−0.000***
	(0.000)
ca_bids	−0.017***
	(0.0002)
cft_duration	−0.0002***
	(0.0001)
tguarantee	−0.005***
	(0.001)
max_to_min_bid_ratio	−0.077***
	(0.001)
Constant	1.108***
	(0.002)
Observations	206,800
R^2	0.359
Adjusted R^2	0.359
F Statistic	115,706.700***
Note:	*p<0.1; **p<0.05; ***p<0.01

Random Effects model - Lagrange multiplier test for individual effects

Lagrange Multiplier Test - (Honda) for unbalanced panels

data: final_to_est_ratio ~ ca_est_value_pln + ca_bids + cft_duration + ...

normal = 321.54, p-value < 0.00000000000000022

alternative hypothesis: significant effects

Random Effects model - Lagrange multiplier test for time effects

Lagrange Multiplier Test - time effects (Honda) for unbalanced panels

data: final_to_est_ratio $\sim$ ca_est_value_pln + ca_bids + cft_duration + ...

normal = 43.477, p-value $<$ 0.00000000000000022

alternative hypothesis: significant effects

Hausman test

data: final_to_est_ratio ~ ca_est_value_pln + ca_bids + cft_duration + ...

chisq = 24.806, df = 5, p-value = 0.0001519

alternative hypothesis: one model is inconsistent

Summary

- All models suggest statistical significance of explanatory variables and negative signs for their effects; as expected for the number of bids and call for tender duration, contrary to expectations for the estimated value, existence of bid bond and the ratio between the biggest and the smallest bid
- Wooldridge's test on pooled model suggests both individual and time unobserved effects
- Lagrange multiplier tests on both FE and RE model confirm that both individual and time effects are significant
- Hausman test implies that RE model is inconsistent, suggesting the choice of FE model

Thank you for your attention!