Corruption and the network structure of public contracting markets across government change

Appendices

Appendix A - Robustness checks with higher contracting threshold.

Table A1: Pooled OLS and buyer fixed-effects models for entropy of buyers issuing at least 10 contracts.

	Dependent Variable: Buyer Entropy, >=10 Contracts			
	Hungary		Czech Republic	
	(1)	(2)	(3)	(4)
CRI	-.003	.004	-.006	.007
	(.006)	(.007)	(.008)	(.008)
Election Year Dummy	-.015	.018	-.030*	-.005
	(.013)	(.012)	(.013)	(.012)
Buyer Number of Contracts (log)	.065***	.082***	.040***	.049***
	(.007)	(.009)	(.007)	(.008)
Buyer Contract Value (log)	-.074***	-.122***	-.046***	-.107***
	(.004)	(.005)	(.004)	(.005)
CRI, Election Year Interaction	.003	.012	-.003	-.031°
	(.013)	(.013)	(.018)	(.017)
Constant	1.551***		1.237***	
	(.055)		(.051)	
Model	Pooled OLS	Buyer, Year FE	Pooled OLS	Buyer, Year FE
Type, Location, Sector+ Dummies	Yes	-	Yes	-
Observations	1,806	1,806	1,491	1,491
R^2	.280	.362	.163	.286
F Statistic	23.035*** (df = 30; 1775)	107.624*** (df = 5; 948)	15.876*** (df = 18; 1472)	82.333*** (df = 5; 1030)
Note:				+Sector only available for Hungary
				°p<.1; *p<.05; **p<.01,***p<.001

Table A2: Pooled OLS and buyer fixed-effects models for competitive clustering of buyers issuing at least 10 contracts.

	Dependent Variable: Buyer Competitive Clustering, >=10 Contracts			
	Hungary		Czech Republic	
	(1)	(2)	(3)	(4)
CRI	-.069***	-.039***	-.023**	-.026***
	(.007)	(.007)	(.009)	(.008)
Election Year Dummy	.014	.039**	-.041**	-.052***
	(.016)	(.014)	(.013)	(.011)
Buyer Number of Contracts (log)	.131***	.110***	.145***	.132***
	(.009)	(.009)	(.009)	(.007)
Buyer Contract Value (log)	.002	-.002	.003	.004
	(.005)	(.005)	(.005)	(.005)
CRI, Election Year Interaction	-.018	.002	.027	.027°
	(.016)	(.015)	(.019)	(.016)
Constant	-.147*		-.110	
	(.075)		(.068)	
Model	Pooled OLS	Buyer FE	Pooled OLS	Buyer FE
Type, Location, Sector+ Dummies	Yes	-	Yes	-
Observations	1,806	1,806	1,491	1,491
R^2	.407	.180	.427	.289
F Statistic	40.660*** (df = 30; 1775)	41.569*** (df = 5; 948)	60.951*** (df = 18; 1472)	83.902*** (df = 5; 1030)

Note: +Sector only available for Hungary

°p<.1; *p<.05; **p<.01;***p<.001

Table A3: Pooled OLS and buyer fixed-effects models for weighted competitive clustering of buyers issuing at least 10 contracts.

	Dependent Variable: Buyer Weighted Competitive Clustering, >=10 Contracts			
	Hungary		Czech Republic	
	(1)	(2)	(3)	(4)
CRI	-.057***	-.034***	-.007	-.003
	(.006)	(.007)	(.008)	(.007)
Election Year Dummy	.008	.027°	-.00002	-.018°
	(.015)	(.014)	(.012)	(.010)
Buyer Number of Contracts (log)	.077***	.063***	.060***	.052***
	(.008)	(.009)	(.007)	(.007)
Buyer Contract Value (log)	.010*	.005	.018***	.021***
	(.004)	(.006)	(.004)	(.004)
CRI, Election Year Interaction	.008	.024	.004	-.002
	(.015)	(.016)	(.017)	(.015)
Constant	-.138*		-.141*	
	(.065)		(.057)	
Model	Pooled OLS	Buyer FE	Pooled OLS	Buyer FE
Type, Location, Sector+ Dummies	Yes	-	Yes	-
Observations	1,806	1,806	1,491	1,491
R^2	.279	.079	.249	.102
F Statistic	22.924*** (df = 30; 1775)	16.340*** (df = 5; 948)	27.157*** (df = 18; 1472)	23.362*** (df = 5; 1030)

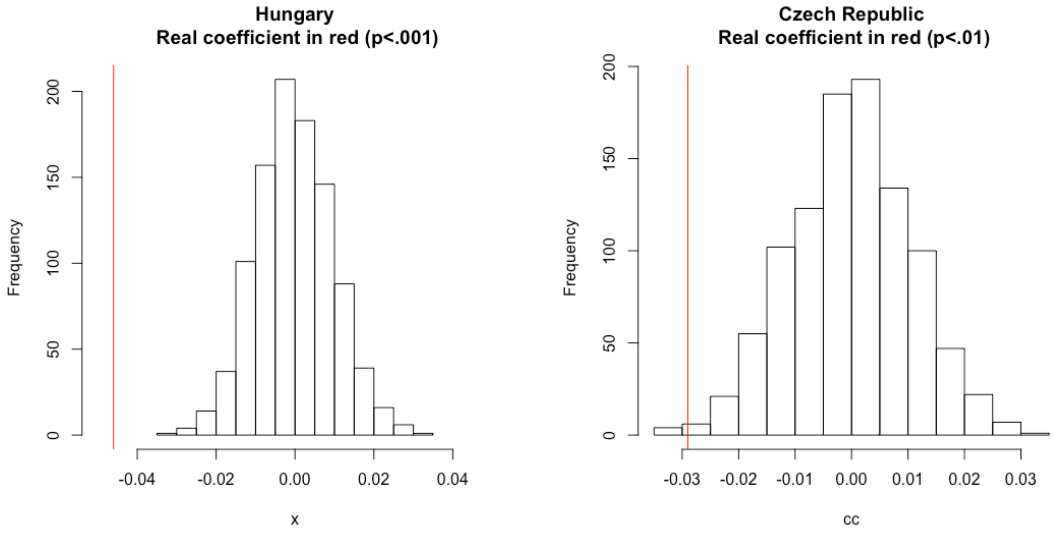
Note: +Sector only available for Hungary

°p<.1; *p<.05; **p<.01;***p<.001

Appendix B – Permutation tests of the regression results

In order to address concerns of non-independence of observations in the network, we permute the dependent variable (competitive clustering) and rerun the two fixed-effects regressions in Table 5, 1000 times. We count the number of times the observed coefficient on CRI is less than the randomized coefficient and generate a p-value. We plot the two distributions, for Hungary and Czech Republic, below. Results are the same as in the regressions reported in the main text.

Figure B1: Distributions of 1000 CRI coefficients from fixed-effect regressions with randomized dependent variable (competitive clustering). Observed coefficients marked in red.



Appendix C – Regressions with year dummies

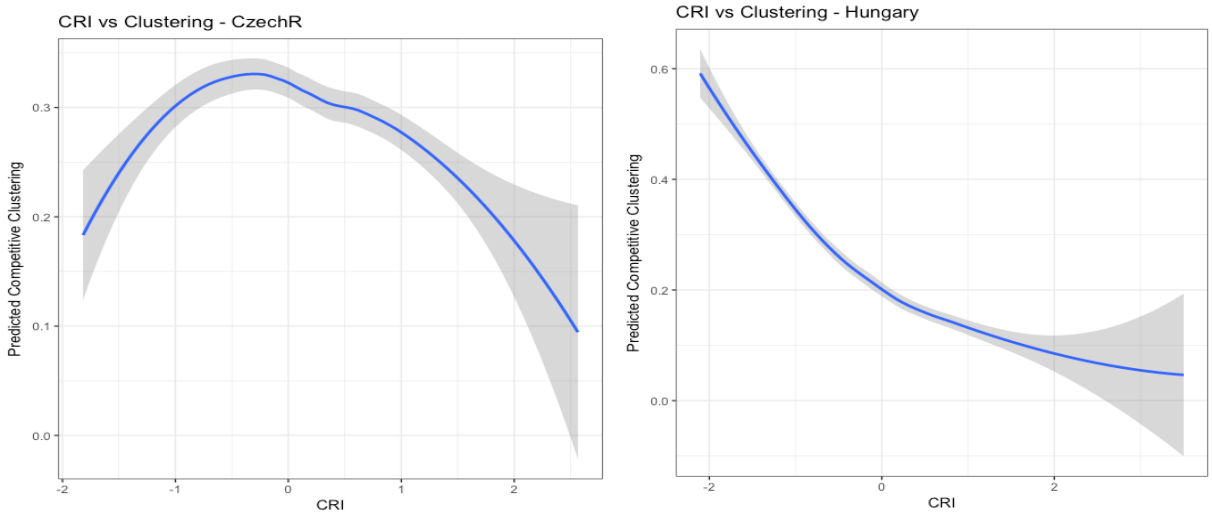
As an alternative model specification, we substitute year fixed effects for the election year dummy in the models in Table 5. We note that the coefficient on CRI in the Czech Republic is no longer significant. We investigate this in more detail below.

Table C1: Pooled OLS and Buyer, Year Fixed Effects models predicting buyer competitive clustering in Hungary and Czech Republic.

	Dependent Variable: Buyer Competitive Clustering, >=5 Contracts			
	Hungary		Czech Republic	
	(1)	(2)	(3)	(4)
CRI	-.073***	-.049***	-.017**	-.005
	(.005)	(.005)	(.006)	(.006)
Buyer Number of Contracts (log)	.139***	.106***	.156***	.128***
	(.006)	(.007)	(.006)	(.006)
Buyer Contract Value (log)	-.016***	.002	.004	.010**
	(.003)	(.004)	(.003)	(.004)
Constant	.027		-.133**	
	(.050)		(.047)	
Model	Pooled OLS	Buyer, Year FE	Pooled OLS	Buyer, Year FE
Type, Location, Sector+ Dummies	Yes	-	Yes	-
Observations	3,657	3,657	2,704	2,704
R^2	.436	.199	.466	.335
F Statistic	84.938*** (df = 33; 3623)	57.049*** (df = 8; 1835)	97.489*** (df = 24; 2679)	90.876*** (df = 10; 1808)
Note:				+Sector only available for Hungary
				°p<.1; *p<.05; **p<.01;***p<.001

As in Figure 8 we plot the LOESS smoothed model prediction for competitive closure as a function of CRI for the fixed-effects models in Table C1.

Figure C1: Model visualizations, Czech and Hungarian CRI vs competitive closure.



Given the suggested inverse quadratic relationship between CRI and competitive clustering in the Czech Republic, we rerun the models with a quadratic term for CRI. We argue that our substantive findings are preserved: in the above average CRI regime, there is a clear negative relationship between CRI and competitive closure, especially at the upper half of the CRI distribution where complete capture is more likely to be present.

Table C2: Pooled OLS and buyer, year fixed-effects models predicting competitive closure, including a quadratic term for CRI.

	Dependent Variable: Buyer Competitive Clustering, >=5 Contracts			
	Hungary		Czech Republic	
	(1)	(2)	(3)	(4)
CRI	-.073***	-.049***	-.010	.004
	(.005)	(.005)	(.006)	(.007)
CRI Squared	.019***	-.004	-.018***	-.017**
	(.004)	(.004)	(.005)	(.005)
Buyer Number of Contracts (log)	.137***	.106***	.156***	.129***
	(.006)	(.007)	(.006)	(.006)
Buyer Contract Value (log)	-.012***	.002	.003	.009*
	(.003)	(.004)	(.003)	(.004)
Constant	-.028		-.098*	
	(.050)		(.049)	
Model	Pooled OLS	Buyer, Year FE	Pooled OLS	Buyer, Year FE
Type, Location, Sector+ Dummies	Yes	-	Yes	-
Observations	3,657	3,657	2,704	2,704
R^2	.441	.200	.469	.338
F Statistic	84.012*** (df = 34; 3622)	50.810*** (df = 9; 1834)	94.699*** (df = 25; 2678)	83.822*** (df = 11; 1807)
Note:				+Sector only available for Hungary
				°p<.1; *p<.05; **p<.01;***p<.001

Appendix D – Yearly persistence graphs

Below we plot the distributions of persistences among captured and non-captured buyers for both countries across all years. When the intervening year saw a change in the central government (2010 for both countries), we shade the period yellow.

Figure D1: Persistence of captured and non-captured yellow.Hungarian buyer persistence. Persistence across years with change of government shaded yellow.

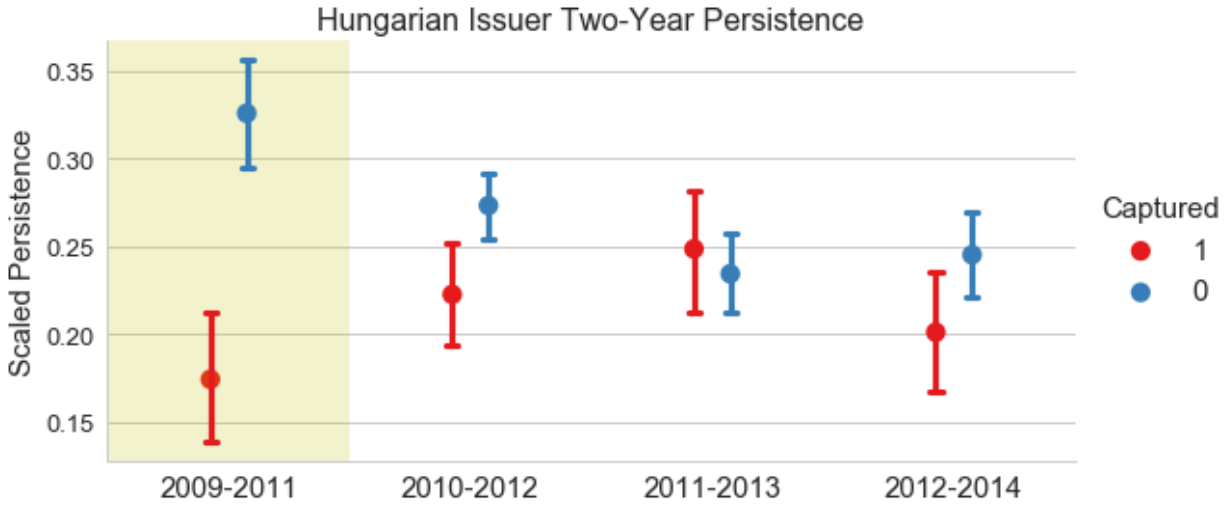
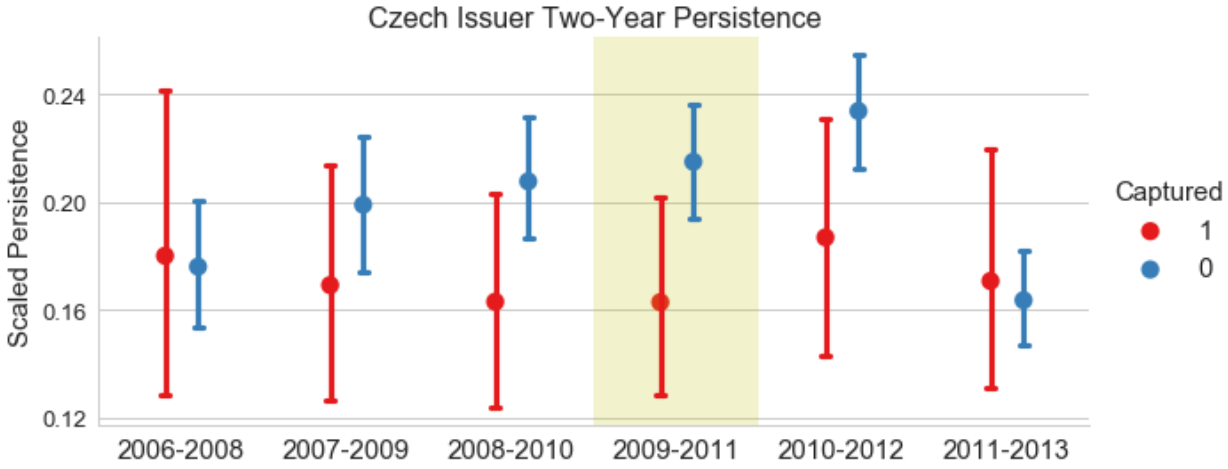


Figure D2: Persistence of captured and non-captured yellow.Czech buyer persistence. Persistence across years with change of government shaded yellow.



Appendix E: Histograms of Capture Persistence Randomized vs Actual

Figure E1: The distribution of 1000 instances of Hungarian captured issuer persistence with the captured label randomly permuted. The red line indicates the true value of captured issuer persistence.

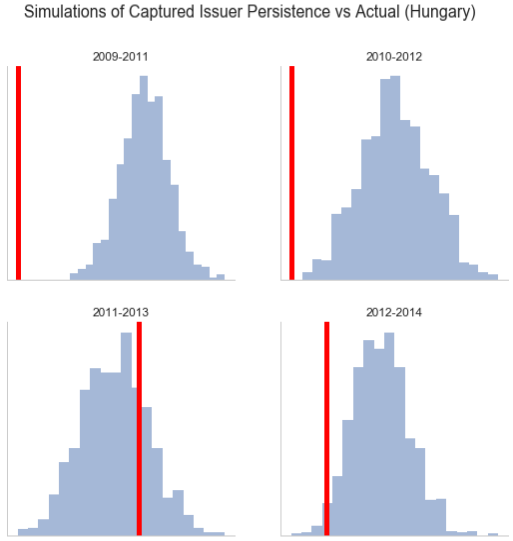
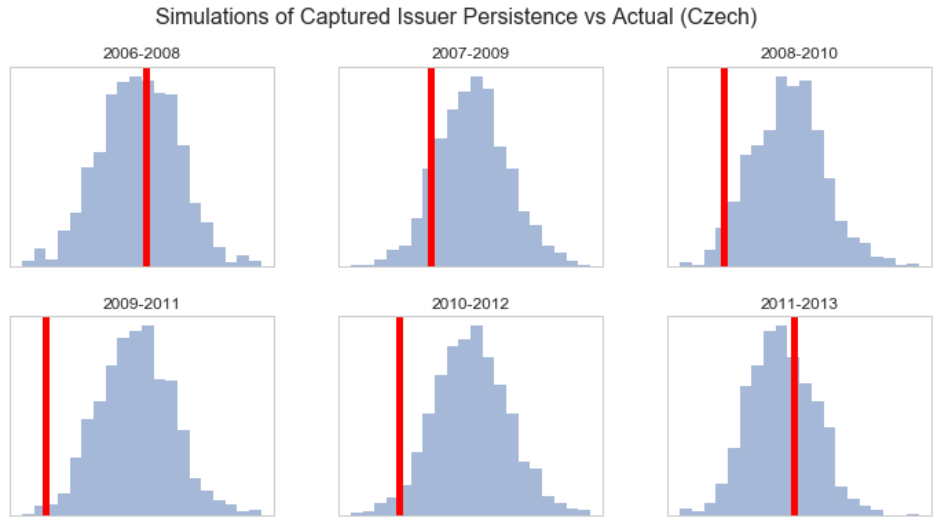


Figure E2: The distribution of 1000 instances of Czech captured issuer persistence with the captured label randomly permuted. The red line indicates the true value of captured issuer persistence.



Appendix F: Data, statistics, examples

Table F1: Primary sources of public procurement data and minimum thresholds

Country	Data Source	URL	Threshold (EUR)
Czech Republic	Ministerstvo pro místní rozvoj ČR	http://www.isvzus.cz/usisvz/	39,000
Hungary	Közbeszerzési Értesítő	http://www.kozbeszerzes.hu/	27,300

Table F2: Summary Statistics

	Number of Contracts	Unique suppliers	Unique buyers	Total Contract Value (EUR)	Mean Contract Value	Std. Dev. Contract Value	Mean CRI	Std. Dev. CRI	Share Single Bidder
Czech Republic	92,511	13,178	6,892	71,154,784,414	769,149	7,044,414	0.288	0.168	0.246
Hungary	73,883	17,084	3,106	11,733,786,615	158,816	1,888,193	0.315	0.205	0.307

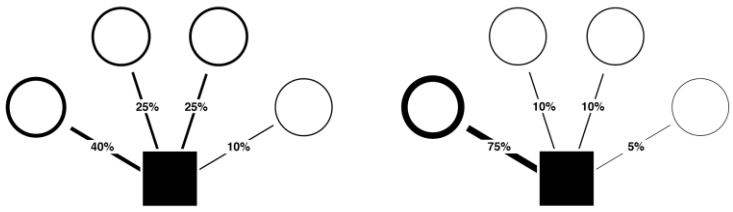


Figure F1: Two hypothetical distributions of contract value from an buyer, represented by a black square to four suppliers, represented by circles. The first buyer has normalized entropy 0.32, and the second, reflecting a less equal distribution, has normalized entropy 0.21.

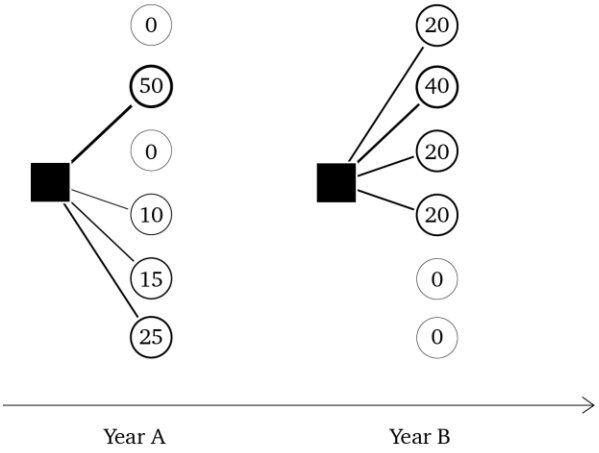


Figure F2: A buyer's persistence from Year A to Year B is measured by the Pearson correlation of its issuances in the two years. The black square again represents the focal buyer at two years. Each circle represents a supplier, and relative positions are fixed across the years. The number represents the percent of the buyer's spending going to that supplier in the specific year. For instance, The first supplier in the list receives 0% of the buyer's contract value in year A, and then 20% in year B. In this case, the buyer's (A,B)-persistence is ρ((0,50,0,10,15,25),(20,40,20,20,0,0)) = 0.38.