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Effect of Public Procurement Regulation on Competition and Cost-Effectiveness

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Abstract

This paper empirically investigates the impact of public procurement regulation quality on competition and cost-effectiveness. I employ the World Bank's Benchmarking Public Procurement quality scores. Using extensive data about public procurement in the European Economic Area, Switzerland, and Macedonia, the paper exhibits positive effects of improved regulation quality. Better quality scores are associated with higher levels of competition and cost-effectiveness. Improved regulation quality significantly increases number of bidders and the probability that procurement price is lower than estimated cost.

Keywords

Public Procurement; Regulation; Competition

JEL codes: H57; O12

1. Introduction

Effective public procurement (PP) is integral for productive use of public resources and economic growth. World Bank (2012) emphasizes that "... poor governance of public procurement systems can turn public investments into major political and economic liabilities, hinder development goals and outcomes, and result in additional costs and waste public funds." (Page 7) Accordingly, international organizations like the International Trade Centre UNCTAD/WTO (Wittig, 2002) and the OECD (2012) promote PP regulation. Wittig (2002) states that improved management of PP systems leads to benefits like enhanced competition, better administrative services and cost-effectiveness. Although policymakers and researchers (Campos et al., 2007 and Knack et al. 2017) promote improved PP regulation, empirical research about the effect of PP quality on PP outcomes is limited.

In this paper, I examine the impact of PP quality on competition and cost-effectiveness. Tenders Electronic Daily (TED) data set of the European Union (EU) contains information about 5,303,219 PP contracts for the European Economic Area, Switzerland, and the Former Yugoslav Republic of Macedonia for years 2006-2017. The cross-country structure of the TED data set allows identification of the effect of PP regulation quality. I employ the PP quality measures of the World Bank's Benchmarking Public Procurement database (BPP). Specifically, I investigate the effect of four PP quality measures on the level of competition, selection of procurement method and cost-effectiveness in EU PP. These measures are bid preparation score, bid and contract management score, payment of suppliers score and PP overall index. Empirical analysis of the paper concludes that number of bidders are significantly higher when a country has higher PP quality scores. Countries with higher PP quality are more likely to implement competitive (open) procurement procedure. Finally, cost-effectiveness improves substantially as the PP quality of a country rises. Accordingly, this paper provides empirical evidence about the positive effect of improved PP regulations on PP outcomes.

A closely related strand of literature investigates effect of public procurement practices on firm-level characteristics. Hoekman and Sanfilippo (2018) use a survey[1] for 6,700 firms based in 19 Sub-Saharan African countries to investigate the effect of "the share of total sales to the Government" on firm performance. They find that higher government demand enhances firm performance. Djankov et al. (2017) shows that better PP regulation promotes quality of trade and transport infrastructure. They employ the Logistics Performance Index of the World Bank based on a survey of 1,000 logistics professionals in 143 countries to measure road quality. Knack et al. (2017) examine the survey answers of 33,385 firms from the World Bank's Enterprise Surveys (WBES). They find that the probability that a firm participates in PP is higher in countries with more transparent procurement procedures. Additionally, percentage of kickbacks to officials are significantly lower in countries with better PP quality. Finally, Ghossein et al. (2018) combines BPP and WBES to examine PP quality on firm-level outcomes. They find that better PP quality is correlated with higher firm engagement, innovation and internet connectivity.

Several recent studies examine the TED data set. Kutlina-Dimitrova and Lakatos (2016) analyze the determinants of the probability of awarding public procurement contracts directly cross-border using a multivariate logit model. Gourdon and Messent (2017) show that a country's membership of the WTO Government Procurement Agreement (GPA) increases the probability of firms being awarded a procurement contract in the EU through the cross-border mode of supply. Herz and Varela-Irimia (2017) employ a gravity model to study cross-national border effects in the award of European Single Market (ESM) public contracts.

[1] The African Investor Survey (AIS) – administered by the United Nations Industrial Development Organization.

The remainder of this paper is organized as follows. Section 2 summarizes the EU TED and PP regulation quality data. Section 3 examines the effect of PP quality on level of competition, procurement procedure and PP cost-effectiveness. Finally, section 4 concludes.

2. European Union Public Procurement Regulation and Quality

Djankov et al. (2017) characterizes quality of public procurement regulation for 142 countries in 2016. They assess 3 aspects of PP: bidding process, the content and management of the bidding process and the contract, and the payment of suppliers involved in public procurement. Additionally, Djankov et al. (2017) calculate the Overall Public Procurement Score (PP Overall) by using the arithmetic mean of these scores. They collect data using expert surveys of more than 1,900 PP experts. Djankov et al. (2017) describe the questionnaire and the coding of the scores in detail. A higher score indicates that the country has higher PP quality.

In summary, bid preparation score gauges quality of the needs assessment and call for tender process. Bid and contract management score considers submission and evaluation of bids. Payment of suppliers score measures payment time frames and procedures to request payments.

The PP quality data set of Djankov et al. (2017) provides information about all 31 EU countries represented in the TED data set. Table 1 displays the summary statistics of EU PP quality scores.

Table 1: Summary Statistics of Public Procurement Regulation Scores

	Mean	Standard Dev.	Min.	Max
Bid Preparation	0.72	0.09	0.58	0.9
Bid and Contract Management	0.74	0.14	0.5	1
Payment of Suppliers	0.75	0.13	0.5	1
PP Overall Index	0.73	0.09	0.58	0.9

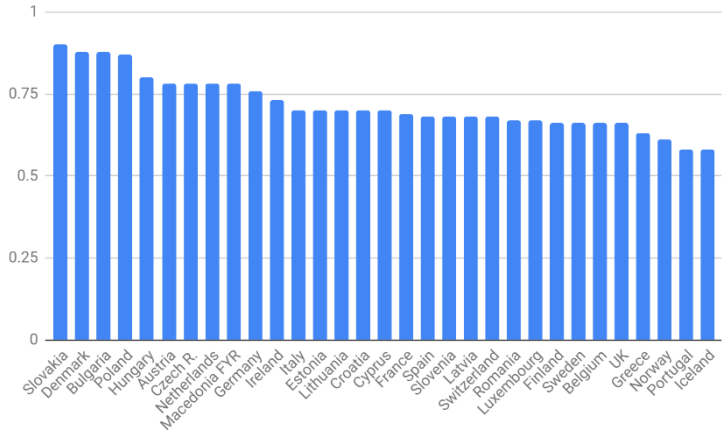
Table 2 below displays the pairwise correlations of PP scores of countries represented in the TED data set. Similar to the pairwise correlations of 142 economies presented in Djankov et al. (2017), different categories of PP quality of EU countries are not strongly correlated. Accordingly, each score contains particular information about PP quality.

Table 2: Pairwise Correlations of Public Procurement Scores of TED Countries

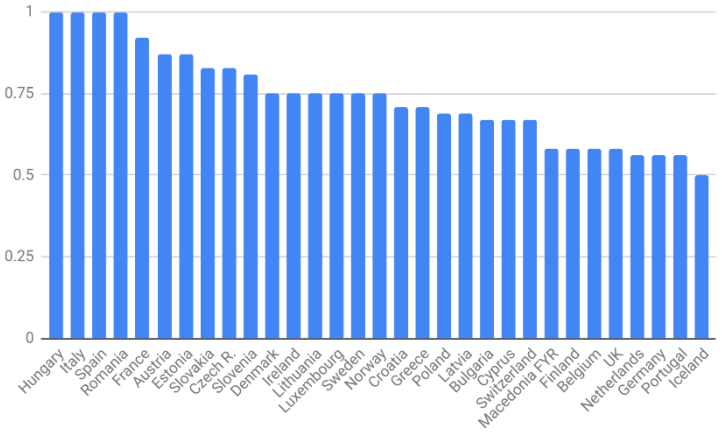
	Bid Preparation	Bid and Contract Management	Payment of Suppliers	PP Overall Index
Bid Preparation	1			
Bid and Contract Management	0.164	1		
Payment of Suppliers	0.267	0.334	1	
PP Overall Index	0.554	0.772	0.777	1

Figure 1 displays the PP quality scores of individual countries. Slovakia has the highest bid preparation score of 0.9 and Iceland and Portugal have the lowest score of 0.58. The scores of bid and contract management and payment of suppliers differ dramatically across EU countries. Several countries have perfect scores of 1 whereas Iceland has a score of 0.5. Finally, the overall PP index varies significantly across EU countries. The variation of PP quality scores across EU countries makes it possible to identify the effect of PP regulation quality on level of competition and cost-effectiveness. Table OA.4 in the online appendix display the Djankov et al. (2017) PP regulation quality scores.

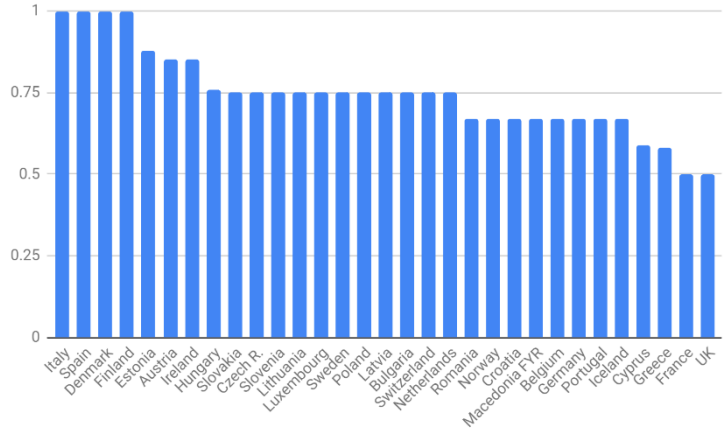
Figure 1: Public Procurement Scores of EU Countries



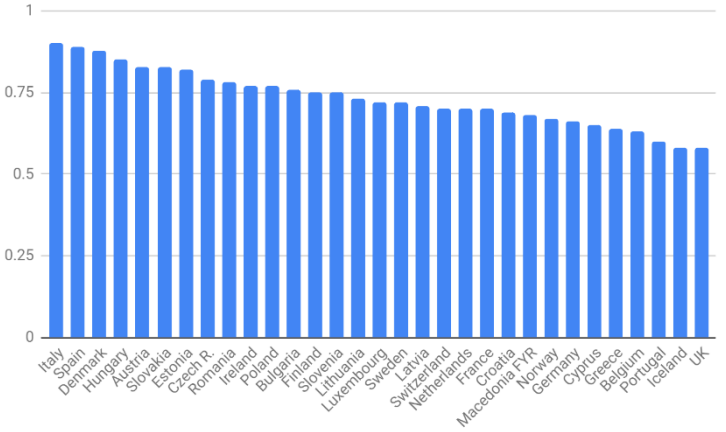
Bid Preparation



Bid and Contract Management



Payment of Suppliers



Overall Public Procurement Index

The TED data is available online in CSV format for years 2006-2017.[2] The EU extracts the data from the contract notice and contract award notice standard forms filled in by the authorities.[3] The original data set contains information about 5,303,219 PP contracts for the European Economic Area, Switzerland, and the Former Yugoslav Republic of Macedonia. For each contract, the TED data includes variables about estimated and contract price, detailed CPV code[4] of the subject of procurement, procurement method, types of contracting authorities and detailed names and locations of procuring agencies and winning firms. I identify the sector of each contract using the first two digits of the CPV code noting that there are 72 major sectors.

PP regulation scores of Djankov et al. (2017) are based on surveys conducted in 2016. Accordingly, I examine 412,491 EU PP contracts conducted in year 2016. Tables OA.1 – OA.3 in the online appendix display number of contacts with respect to countries, procurement procedures and contracting authority types.

3. Results

I analyze the effect of PP regulation quality on three PP outcomes: level of competition, procurement procedure and PP cost-effectiveness.

3.1 Competition

This section empirically examines the effect of PP regulation quality on level of competition in EU PP. I measure the level of competition using the number of bidders participating to the procurement as Branzoli and Decarolis (2015). Figure 2 displays the histogram of number of bidders for year 2016.[5] The mean of number of bidders is 12.75 with a maximum of 999.[6]

[2] I use the contact award notices csv files. The files are available at https://data.europa.eu/euodp/data/dataset/ted-csv.

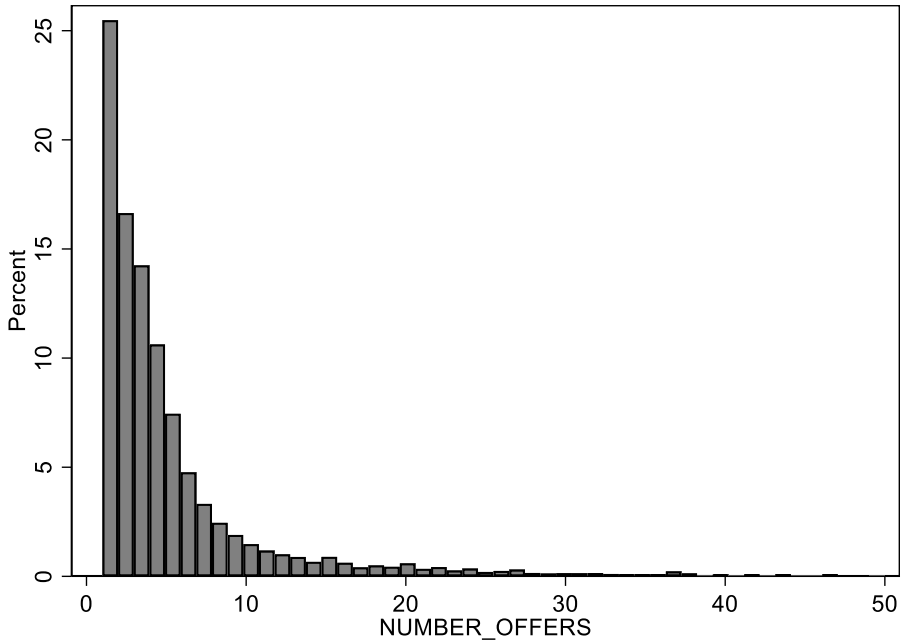
[3] The standard forms of the EU are available at "http://simap.ted.europa.eu/web/simap/standard-forms-for-public-procurement. Public authorities are obliged to publish their tender invitations on TED for all contracts exceeding EU public procurement thresholds. However, as emphasized by Kulina-Dimitrova and Lakatos (2016), contract awards below the threshold are also reported on TED since authorities are in general not prevented from announcing the tender on TED even if the tender's value is below the threshold.

[4] Common Procurement Vocabulary (CPV) establishes a single classification system for public procurement aimed at standardizing the references used by contracting authorities and entities to describe the subject of procurement contracts.

[5] Values larger than 50 (2%) are not displayed for brevity.

[6] 44 contracts have 999 bidders.

Figure 2: Histogram of Number of Bidders



I estimate the following regression equation using negative binomial model following Li and Perrigre (2003).

$$N_c = \beta_1 PPQ_c^i + \sum_{k=1}^{5} \beta_{k+1} PM_c^k + \sum_{z=1}^{9} \beta_{z+6} PA_c^z + \theta FE + \varepsilon_c \qquad (1)$$

where N_c is the number of bids submitted for each contract. PPQ_c^i is the public procurement quality; PM_c^k is the dummy variable for procurement method *k* and PA_c^z denotes the type of public procurement authority. Additionally, FE is the vector of 71 sector and 30 country fixed effects variables.[7] All estimations use robust standard errors. First four columns of Table 3 show the estimation results of equation 5 with alternative PP quality measures, PPQ_c^i. All quality measures have statistically significant positive coefficients. Accordingly, PP regulation promotes the level of competition in EU PP markets. Countries with better scores are able to attract more bidders.

[7] Djankov et al. (2017) does not have public procurement regulation scores for Liechtenstein and Malta. The TED data set contains 311 contracts for Liechtenstein and 2,518 for Malta.

Table 3: Effect of Public Procurement Regulation Quality on Competition

	Negative-Binomial				**HB-IV GMM**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bid Preparation	1.87				6.92			
	(68.19)**				(3.05)**			
Management		2.03				6.98		
		(68.17)**				(6.87)**		
Payment			2.24				8.99	
			(68.17)**				(9.27)**	
PP Overall				2.03				8.44
				(68.17)**				(4.57)**
Observations	412,491	412,491	412,491	412,491	412,491	412,491	412,491	412,491
Procedure Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: * $p<0.05$; ** $p<0.01$. Robust z-statistics in parentheses.

Table 3 also considers the case that the BBP quality scores might be endogenous. There might be unobserved factors that affect both number of bidders and quality scores. In that case, the error term of the regression equation, ε_c, will contain these unobserved factors. The quality scores will be correlated with the error term and this endogeneity problem will distort the empirical results. I employ an instrumental variable (IV) GMM methodology to consider possible endogeneity of PP quality score variables. Lewbel (2012) develops a heteroscedasticity-based (HB) identification approach that identifies structural parameters when valid IVs do not exist.[8] Lewbel (2012) constructs valid IVs that are independent of the error term using the heteroscedasticity structure of the error term.[9] I implement the HB-IV methodology to assess whether potential endogeneity of PP quality scores affect the empirical results of the paper. Columns 5-8 of Table 3 display the HB-IV GMM estimation results of equation 1. The results do not change when the empirical methodology factors in potential endogeneity of PP quality scores. Countries with higher levels of PP regulation quality attract significantly more bidders and achieve higher levels of competition.

3.2 Procurement Procedure

In this sub-section, I study whether authorities in countries with higher PP regulation quality use the competitive open (first price auction) procedure compared to direct purchase and negotiation. I estimate the following logit regression specification:

$$Prob(Open_c = 1|\mathrm{x}) = F(x'_{irt}\beta) \tag{2}$$

where $Open_c$ is a dummy variable, that is, 1 if authorities employ the open procedure and 0 otherwise. $F(x'_{irt}\beta)$ is a logit probability function of $x'_{irt}\beta$. x'_{irt} and X' contains the explanatory variables described in the previous section. The coefficient of PPQ_c^i gauges the impact of PP regulation quality on the probability that authorities use a competitive procedure. Empirical analysis also considers that the quality scores may be endogenous. Lewbel (2018) shows that a linear probability model can be estimated using heteroscedasticity based instrumental variables (IV) of Lewbel (2012) when the dependent variable is binary and an explanatory variable is potentially endogenous. Accordingly, we correct for possible endogeneity of the PPQ_c^i variables by implementing the IV GMM methodology of Lewbel (2012) to the following linear probability model.

$$Open_c = \beta_1 PPQ_c^i + \sum_{k=1}^{5} \beta_{k+1}\, PM_c^k + \sum_{z=1}^{9} \beta_{z+6}\, PA_c^z + \theta FE + \varepsilon_c \tag{3}$$

Table 4 displays the logit and HB-IV GMM estimation of regression specifications of equations 2 and 3. The coefficients of all quality scores are significant with a positive coefficient. Accordingly, table 4 concludes that the likelihood that an authority will implement a competitive open procedure is significantly higher when a country has better PP regulation quality.

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[8] Rigobon and Sack (2003) used a similar identification technique to assess the reaction of monetary policy to the stock market. Lewbel (2012) generalizes this identification technique. Accordingly, it can be applied to data sets with different structures like the TED data set. The method developed by Lewbel (2012) identifies structural parameters by constructing instruments as functions of the model's data when valid instrumental variables do not exist. This approach provides an unbiased and consistent estimate of parameters when the regression model contains endogenous or mismeasured regressors, or when the model suffers from the omitted-variable bias. The Monte Carlo results and numerous empirical applications presented in Lewbel (2012) show that the estimator works very well compared to the two-stage least squares method and to GMM when good instrumental variables are not available. The methodology uses the heteroscedasticity of the errors to construct valid IVs and consistent and unbiased parameters of the empirical model can be estimated by employing these IVs in an IV-GMM setting.

[9] Baldi et al. (2016) implement the HB-IV methodology of Lewbel (2012) in a linear probability model regression setting. They study the effect of project complexity and corruption on selection of procurement procedure in 11,400 public procurement contracts in Italy over the period 2007-2012.

Table 4: Effect of Public Procurement Regulation Quality on Procurement Procedure

	Logit				**HB-IV GMM**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bid Preparation	2.84				1.14			
	(31.20)**				(87.85)**			
Management		2.57				1.20		
		(31.20)**				(68.27)**		
Payment			2.84				0.59	
			(31.20)**				(97.53)**	
PP Overall				2.57				0.78
				(31.20)**				(101.53)**
Observations	412,491	412,491	412,491	412,491	412,491	412,491	412,491	412,491
Procedure Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: * $p<0.05$; ** $p<0.01$. Robust z-statistics in parentheses.

3.3 Cost-Effectiveness

Finally, I examine the impact of the WTO GPA on the cost-effectiveness of government procurement. I measure cost-effectiveness by assessing whether procurement price is lower than the authority's estimated cost. Article 5-1 of the 2014/24/EU directive describes estimated cost as: "The calculation of the estimated value of a procurement shall be based on the total amount payable, net of VAT, as estimated by the contracting authority, including any form of option and any renewals of the contracts as explicitly set out in the procurement documents."

The estimated cost is available in 170,112 observations for year 2016. Furthermore, I check consistencies of the reported contract prices and estimated costs. Following Bajari et al. (2014), I calculate the ratio of contract price and estimated cost. Table OA.5 in the online appendix display the summary statistics of contract price, estimated cost and the ratio for 2016 and 2006-2017. Then, I implement Billor et al.'s (2000) BACON methodology (blocked adaptive computationally efficient outlier nominators) to identify the outliers. The BACON method identifies contracts with ratios lower than 0.25 and higher than 1.87 as outliers, 11,649 contracts. I remove these observations with unrealistic values. Table OA.5 in the online appendix display the summary statistics with and without outliers. On average, the ratio is 0.91 indicating that the contract price is 91% of the estimated cost. Conley and Decarolis (2016) find that on average the contract price (winning bid) is 13.4 percent lower than the estimated cost in simple roadworks contracts in Northern Italy. Similarly, Ishii (2009) shows that the ratio of winning bid to estimated cost is between 0.80 and 0.95 in Okinawa Prefecture road construction auctions in Japan.

I follow the description of OECD (2012) to identify cost-ineffective procurements. As stated by OECD (2012) "value for money" can be assessed by comparing the procurement price and estimated costs. Specifically, procurement prices that are higher than the engineering cost estimates are not cost-effective. OECD (2012) suggests that public authorities should investigate these procurements. I determine the tenders with procurement prices lower than estimated costs (ratio of price and estimate is smaller than one). Contract prices are below their estimated costs in 95,278 (60.1%) contracts. I label these contracts as cost-effective.

$$Prob(Cost\ Effective_c = 1|\mathrm{x}) = F(x'_{irt}\beta) \quad (4)$$

where $Cost\ Effective_c$ is a dummy variable, that is, 1 if contract price is lower than estimated cost and 0 otherwise. $F(x'_{irt}\beta)$ is a logit probability function of $x'_{irt}\beta$. x'_{irt} and X' contain the explanatory variables described in section 3.1. Additionally, I estimate the following linear probability model using HB-IV GMM to consider potential endogeneity of PP quality scores.

$$Cost\ Effective_c = \beta_1 PPQ_c^i + \sum_{k=1}^{5} \beta_{k+1}\, PM_c^k + \sum_{z=1}^{9} \beta_{z+6}\, PA_c^z + \theta FE + \varepsilon_c \quad (5)$$

Table 5 presents the estimation results of the logit and HB-IV GMM linear probability models of equations 4 and 5. Both models conclude that PP regulation quality has a significant positive effect on the probability that the contract is cost-effective. Countries with better PP regulation quality are more likely to have cost-effective contracts with lower procurement prices compared to estimated costs.

Table 5: Effect of Public Procurement Regulation Quality on Cost-Effectiveness

	Logit				**HB-IV GMM**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bid Preparation	0.97				0.69			
	(15.63)**				(40.50)**			
Management		1.06				0.79		
		(15.62)**				(56.32)**		
Payment			1.17				0.71	
			(15.62)**				(61.66)**	
PP Overall				1.06				0.97
				(15.62)**				(57.28)**
Observations	158,355	158,355	158,355	158,355	158,355	158,355	158,355	158,355
Procedure Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

3.4 Robustness

In this sub-section, I study the robustness of the empirical results presented in tables 3 and 5. Almost 1 % of the contracts have very large number of bidders. To assess the robustness of the results about competition, I eliminate contracts with more than 100 bidders and rerun the estimations of section 3.1. Additionally, I conduct the empirical analyses using the complete TED data set for years 2006-2017, 3,507,656 contracts.[10] Table OA.6 in the online appendix display the robustness analysis for section 3.1. All analysis confirm the robustness of the results of table 3. The coefficients of PP quality scores are positive and significant.

Table OA.7 examines the impact of regulation quality on cost-effectiveness using the complete TED data set. After eliminating outliers, I study 1,331,066 contracts that have data about estimated costs and contract prices. Both logit and HB-IV GMM estimations validate the results of table 5. Regulation quality improves cost-effectiveness of EU PP when empirical analysis considers the complete TED data set.

4. Conclusion

I empirically analyze the effect of public procurement regulation quality on competition and cost-effectiveness. I examine 412,491 contracts for 31 European Single Market countries. I find that tenders in countries with high public procurement quality have higher levels of competition. Countries with good quality scores are more likely to implement competitive procurement procedures. Finally, improved regulation quality significantly increases the probability that procurement price is lower than estimated costs. The paper provides empirical evidence about favorable effects of proper public procurement regulation.

[10] I employ year fixed effects for these regressions.

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Online Appendix:

Table OA.1
Number of Contracts by Authority Country

Country	Number of Contracts
Austria	3,302
Belgium	3,552
Bulgaria	11,530
Croatia	6,339
Cyprus	667
Czech Republic	9,449
Denmark	4,982
Estonia	2,572
Finland	4,521
France	70,168
Germany	36,788
Greece	3,774
Hungary	6,339
Iceland	86
Ireland	3,034
Italy	12,869
Latvia	10,506
Lithuania	9,261
Luxembourg	655
Macedonia	1,127
Malta	417
Netherlands	9,410
Norway	3,280
Poland	95,971
Portugal	1,207
Romania	26,112
Slovakia	2,214
Slovenia	7,975
Spain	10,027
Sweden	11,362
Switzerland	2,526
United Kingdom	41,754

Table OA.2
Number of Contracts by Procurement Procedure

Procedure Type	Number of Contracts
award without prior publication of a contract notice	10,723
competitive dialogue	532
negotiated without a call for competition	9,350
negotiated with a call for competition	17,578
Open	358,065
Restricted	16,675

Table OA.3
Number of Contracts by Type of Contracting Authority

Procedure Type	Number of Contracts
Ministry or any other national or federal authority	40,769
Regional or local authority	100,931
Water, energy, transportation and telecommunication	24,915
European Union institution	1,876
Other international institution	6
Body governed by public law	133,060
Other	88,240
National or federal Agency	6,619
Regional or local agency	8,722
Not specified	7,785

Table OA.4: Public Procurement Performance Rankings of EU Countries

Country	Bid Preparation	Bid and Contract Management	Payment of Suppliers	PP Overall Index
Italy	0.7	1	1	0.9
Spain	0.68	1	1	0.89
Denmark	0.88	0.75	1	0.88
Hungary	0.8	1	0.76	0.85
Austria	0.78	0.87	0.85	0.83
Slovakia	0.9	0.83	0.75	0.83
Estonia	0.7	0.87	0.88	0.82
Czech R.	0.78	0.83	0.75	0.79
Romania	0.67	1	0.67	0.78
Ireland	0.73	0.75	0.85	0.77
Poland	0.87	0.69	0.75	0.77
Bulgaria	0.88	0.67	0.75	0.76
Finland	0.66	0.58	1	0.75
Slovenia	0.68	0.81	0.75	0.75
Lithuania	0.7	0.75	0.75	0.73

Luxembourg	0.67	0.75	0.75	0.72
Sweden	0.66	0.75	0.75	0.72
Latvia	0.68	0.69	0.75	0.71
Switzerland	0.68	0.67	0.75	0.7
Netherlands	0.78	0.56	0.75	0.7
France	0.69	0.92	0.5	0.7
Croatia	0.7	0.71	0.67	0.69
Macedonia FYR	0.78	0.58	0.67	0.68
Norway	0.61	0.75	0.67	0.67
Germany	0.76	0.56	0.67	0.66
Cyprus	0.7	0.67	0.59	0.65
Greece	0.63	0.71	0.58	0.64
Belgium	0.66	0.58	0.67	0.63
Portugal	0.58	0.56	0.67	0.6
Iceland	0.58	0.5	0.67	0.58
UK	0.66	0.58	0.5	0.58

Table OA.5
Summary Statistics of Contract Prices and Estimated Costs

Variable	Number of Observations	Mean	Standard Deviation	Min	Max
		Without Outliers in Year 2016			
Contract Price (Euros)	158,463	1,663,194	4.33e+07	0.01	5.51e+09
Estimated Cost (Euros)	158,463	1,801,556	4.49e+07	0.01	5.51e+09
Ratio[11]	158,463	0.91	0.21	0.25	1.87
		With Outliers in Year 2016			
Contract Price (Euros)	170,112	1,698,895	4.91e+07	0	1.00e+10
Estimated Cost (Euros)	170,112	2,496,133	1.36e+08	0.01	4.54e+10
Ratio	170,112	1,944.83	343,679.8	0	1.16e+08
		Without Outliers in Years 2006-2017			
Contract Price (Euros)	1,653,255	1.06 e+09	1.34 e+12	0.01	1.73 e+15
Estimated Cost (Euros)	1,653,255	1.06 e+09	1.34 e+12	0.01	1.73 e+15
Ratio	1,653,255	0.9	0.22	0.25	1.87

Table OA.6
Effect of Public Procurement Regulation Quality on Competition
Negative-Binomial Regression, Tenders without Outliers
(Number of Bidders <100, 99% of Procurements)

	Year 2016				**Years 2006-2017**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bid Preparation	1.82				2.23			
	(78.67)**				(298.85)**			
Management		1.97				2.42		
		(78.64)**				(298.88)**		
Payment			2.18				2.68	
			(78.64)**				(298.88)**	
PP Overall				1.97				2.42
				(78.64)**				(298.88)**

[11] Contract price over estimated cost.

accelerated negotiated					-0.35	-0.35	-0.35	-0.35
					(30.17)**	(30.17)**	(30.17)**	(30.17)**
accelerated restricted					-0.22	-0.22	-0.22	-0.22
					(33.59)**	(33.58)**	(33.58)**	(33.58)**
award w. publication	0.29	0.29	0.29	0.29	0.11	0.11	0.11	0.11
	(30.28)**	(30.30)**	(30.30)**	(30.30)**	(30.38)**	(30.43)**	(30.43)**	(30.43)**
competitive dialogue	-0.53	-0.53	-0.53	-0.53	-0.45	-0.45	-0.45	-0.45
	(12.29)**	(12.34)**	(12.34)**	(12.34)**	(35.88)**	(35.88)**	(35.88)**	(35.88)**
negotiated comp.	-0.12	-0.12	-0.12	-0.12	-0.23	-0.23	-0.23	-0.23
	(14.21)**	(14.21)**	(14.21)**	(14.21)**	(79.11)**	(79.16)**	(79.16)**	(79.16)**
Neg. without comp.	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89
	(78.93)**	(78.88)**	(78.88)**	(78.88)**	(255.18)**	(255.15)**	(255.15)**	(255.15)**
restricted	0.16	0.16	0.16	0.16	-0.04	-0.04	-0.04	-0.04
	(20.89)**	(20.91)**	(20.91)**	(20.91)**	(15.44)**	(15.40)**	(15.40)**	(15.40)**
Central government	-0.02	-0.02	-0.02	-0.02	0.03	0.03	0.03	0.03
	(2.86)**	(2.78)**	(2.78)**	(2.78)**	(15.86)**	(15.85)**	(15.85)**	(15.85)**
Water, energy, transport	0.21	0.21	0.21	0.21	0.25	0.25	0.25	0.25
	(26.59)**	(26.63)**	(26.63)**	(26.63)**	(91.27)**	(91.43)**	(91.43)**	(91.43)**
EU institution	0.04	0.04	0.04	0.04	-0.09	-0.09	-0.09	-0.09
	(1.45)	(1.50)	(1.50)	(1.50)	(10.39)**	(10.31)**	(10.31)**	(10.31)**
other inter. org.	-0.27	-0.27	-0.27	-0.27	-0.40	-0.40	-0.40	-0.40
	(0.70)	(0.70)	(0.70)	(0.70)	(9.80)**	(9.78)**	(9.78)**	(9.78)**
Gov. by public law	0.11	0.11	0.11	0.11	0.08	0.08	0.08	0.08
	(23.05)**	(22.99)**	(22.99)**	(22.99)**	(48.51)**	(48.40)**	(48.40)**	(48.40)**
Other	0.16	0.16	0.16	0.16	0.09	0.09	0.09	0.09
	(32.32)**	(32.22)**	(32.22)**	(32.22)**	(53.74)**	(53.63)**	(53.63)**	(53.63)**
National Agency	0.10	0.10	0.10	0.10	0.29	0.29	0.29	0.29
	(8.37)**	(8.36)**	(8.36)**	(8.36)**	(72.92)**	(72.88)**	(72.88)**	(72.88)**
Local Agency	-0.09	-0.09	-0.09	-0.09	0.03	0.03	0.03	0.03
	(7.83)**	(7.83)**	(7.83)**	(7.83)**	(7.78)**	(7.78)**	(7.78)**	(7.78)**
Not specified	0.01	0.01	0.01	0.01	0.08	0.08	0.08	0.08
	(1.30)	(1.29)	(1.29)	(1.29)	(25.38)**	(25.45)**	(25.45)**	(25.45)**
Observations	407,041	407,041	407,041	407,041	3,507,656	3,507,656	3,507,656	3,507,656
Sectoral Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes

Table OA.7
Effect of Public Procurement Regulation Quality on Cost-Effectiveness
Logit and Heteroscedasticity-Based Instrumental Variable GMM
Years 2006-2017

	Logit				**HB-IV GMM**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bid Preparation	0.79				0.71			
	(34.10)**				(136.28)**			
Management		0.85				0.73		
		(34.09)**				(137.00)**		
Payment			0.95				0.24	
			(34.09)**				(21.52)**	
PP Overall				0.85				0.84
				(34.09)**				(58.69)**
accelerated negotiated	-1.13	-1.13	-1.13	-1.13	-0.26	-0.26	-0.25	-0.26
	(25.34)**	(25.34)**	(25.34)**	(25.34)**	(27.22)**	(27.08)**	(25.54)**	(27.23)**
accelerated restricted	-0.10	-0.10	-0.10	-0.10	-0.02	-0.02	-0.01	-0.02
	(4.04)**	(4.03)**	(4.03)**	(4.03)**	(4.02)**	(3.93)**	(2.98)**	(4.20)**
award w. publication	-0.48	-0.48	-0.48	-0.48	-0.09	-0.09	-0.08	-0.09
	(29.17)**	(29.17)**	(29.17)**	(29.17)**	(27.08)**	(26.93)**	(25.09)**	(27.36)**
competitive dialogue	-0.17	-0.17	-0.17	-0.17	-0.03	-0.03	-0.03	-0.04
	(2.53)*	(2.53)*	(2.53)*	(2.53)*	(2.54)*	(2.49)*	(1.96)	(2.62)**
negotiated comp.	-0.50	-0.50	-0.50	-0.50	-0.11	-0.11	-0.10	-0.10
	(36.40)**	(36.37)**	(36.37)**	(36.37)**	(37.18)**	(37.03)**	(35.56)**	(35.79)**
Neg. without comp.	-0.95	-0.95	-0.95	-0.95	-0.21	-0.20	-0.19	-0.21
	(90.04)**	(90.01)**	(90.01)**	(90.01)**	(92.52)**	(91.87)**	(83.78)**	(91.91)**
restricted	-0.08	-0.08	-0.08	-0.08	-0.02	-0.02	-0.01	-0.02
	(6.11)**	(6.10)**	(6.10)**	(6.10)**	(6.42)**	(6.18)**	(3.53)**	(6.55)**
Central government	-0.03	-0.03	-0.03	-0.03	-0.00	-0.00	0.03	-0.01
	(2.83)**	(2.89)**	(2.89)**	(2.89)**	(2.14)*	(0.44)	(17.96)**	(3.47)**
Water, energy, transport	-0.27	-0.27	-0.27	-0.27	-0.05	-0.05	-0.02	-0.06
	(26.45)**	(26.50)**	(26.50)**	(26.50)**	(25.57)**	(24.49)**	(11.32)**	(25.20)**
EU institution	-0.52	-0.50	-0.50	-0.50	-0.11	-0.10	-0.08	-0.03
	(15.64)**	(15.11)**	(15.11)**	(15.11)**	(15.96)**	(15.15)**	(12.19)**	(4.15)**
other inter. org.	-0.20	-0.20	-0.20	-0.20	-0.04	-0.04	-0.02	-0.03
	(1.24)	(1.24)	(1.24)	(1.24)	(1.15)	(1.09)	(0.49)	(1.02)

Gov. by public law	-0.15	-0.15	-0.15	-0.15	-0.03	-0.02	0.01	-0.03
	(21.38)**	(21.38)**	(21.38)**	(21.38)**	(19.58)**	(17.42)**	(6.86)**	(18.01)**
Other	-0.10	-0.10	-0.10	-0.10	-0.02	-0.02	0.01	-0.02
	(14.69)**	(14.70)**	(14.70)**	(14.70)**	(13.03)**	(11.19)**	(9.18)**	(12.54)**
National Agency	-0.22	-0.22	-0.22	-0.22	-0.04	-0.03	-0.00	-0.04
	(12.00)**	(12.01)**	(12.01)**	(12.01)**	(10.93)**	(10.10)**	(0.68)	(11.59)**
Local Agency	0.03	0.03	0.03	0.03	0.01	0.01	0.04	0.00
	(2.28)*	(2.27)*	(2.27)*	(2.27)*	(1.89)	(2.77)**	(12.23)**	(1.05)
Not specified	-0.20	-0.20	-0.20	-0.20	-0.04	-0.04	-0.02	-0.04
	(8.88)**	(8.88)**	(8.88)**	(8.88)**	(8.43)**	(8.10)**	(4.32)**	(7.66)**
Observations	1,331,066	1,331,066	1,331,066	1,331,066	1,331,066	1,331,066	1,331,066	1,331,066
Sectoral Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: * $p<0.05$; ** $p<0.01$

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