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Effect of Public Procurement Regulation on  
Competition and Cost-Effectiveness

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European University Institute

**Robert Schuman Centre for Advanced Studies**

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## **Abstract**

This study empirically investigates the impact of public procurement regulation quality on the competition for tenders and the cost-effectiveness of awarded contracts, by employing the World Bank's Benchmarking Public Procurement and EuroPAM Public Procurement quality scores. Using extensive data on public procurement in the European Economic Area, Switzerland, and Macedonia, the analysis in this paper shows that higher quality public procurement regulatory regimes are associated with higher levels of competition and cost-effectiveness. Improved regulation quality significantly increases the number of bidders and the probability that the procurement price is lower than the estimated cost.

## **Keywords**

Public Procurement; Regulation; Competition

**JEL Codes:** H57; L51; O52





## 1. Introduction\*

Effective public procurement is essential for the productive use of public resources and economic growth. The 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). Wittig (2002) states that improved management of public procurement systems leads to benefits such as enhanced competition, better administrative services, and cost-effectiveness. Although policymakers and researchers (Campos et al., 2007 and Knack et al. 2017) promote improved public procurement regulation, empirical research about the effect of public procurement quality on economic outcomes is limited.

In this paper, I examine the impact of public procurement quality on competition for tenders and the cost-effectiveness of contracts awarded. The Tenders Electronic Daily (TED) dataset of the European Union (EU) contains information on 5,303,219 public procurement contracts for the European Economic Area, Switzerland, and the Former Yugoslav Republic of Macedonia during 2006–2017. The cross-country structure of the TED dataset allows identification of the effect of public procurement regulation quality. I employ measures of public procurement regulation quality compiled by the World Bank in its Benchmarking Public Procurement (BPP) database, and by EuroPAM, a data collection effort that assesses the transparency of public administration. Specifically, I investigate the effect of public procurement quality measures on the level of competition, the procurement method used, and the cost-effectiveness of procurement contract awards in European public procurement processes. The measures of regulatory quality used from the BPP dataset are the bid preparation score, the bid and contract management score, an indicator of the timeliness of payment of suppliers, and the overall BPP index. EuroPAM reports the procurement evaluation, open competition, institutional arrangements, and overall country scores. The empirical analyses find that the number of bidders is significantly higher for countries with higher public procurement quality scores; countries with better procurement regulation are more likely to implement the competitive (open) procurement procedure; and cost effectiveness improves substantially as the public procurement score of a country rises.

A closely related strand of literature investigates the effect of public procurement practices on firm-level characteristics. Hoekman and Sanfilippo (2018) use a survey<sup>1</sup> of 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) show that better public procurement regulation promotes the 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 Enterprise Survey (WBES). They find that the probability that a firm participates in public procurement is higher in countries with more transparent procurement procedures. Additionally, the percentage of kickbacks to officials is significantly lower in countries with better regulation quality. Finally, Ghossein et al. (2018) combine BPP and WBES to examine public procurement quality on firm-level outcomes. They find that better quality is correlated with higher firm engagement, innovation, and internet connectivity.

Several studies use the cross-country dimension of the TED dataset to study cross-border procurement. Kutlina-Dimitrova and Lakatos (2016) analyze the determinants of the probability of directly awarding cross-border public procurement contracts by using a multivariate logit model. Gourdon and Messent (2017) show that a country's membership of the WTO Government Procurement

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\* An early version of the paper is circulated as Robert Schuman Centre for Advanced Studies Research Paper No. RSCAS 2019/22.

<sup>1</sup> The African Investor Survey (AIS), which is administered by the United Nations Industrial Development Organization.

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.

The remainder of this paper is organized as follows. Section 2 describes the theoretical motivation. Section 3 summarizes the EU TED and public procurement regulation data. Section 4 examines the effect of public procurement quality on the level of competition, procurement procedure, and cost-effectiveness. Finally, section 5 concludes the paper.

## **2. Literature and Motivation**

World Bank BPP and EuroPAM regulation quality scores have several dimensions. The existing literature delineates the link between public procurement process and procurement outcomes. An extensive literature shows that the publicity requirements, discriminatory policies, electronic procurement mechanisms, procurement procedures, buyers' discretion, and payment process have significant effects on entry and procurement price. The scoring sheets of BPP shows that the bid preparation score depends on questions about publicity requirements. Bid and contract management score is based on questions about foreign participation, procurement procedures, and buyers' discretion in selecting bidders and tenderers. BPP payment of suppliers score is based on questions about the time it will take the bidder to make the payment and whether the payment can be made online.

Similarly, the EuroPAM scores are based on questions<sup>2</sup> about evaluation, open competition, and institutional arrangements. Specifically, the EuroPAM evaluation score contains information about preferential treatment (discriminatory policies) in, and publication of, the bid evaluation process. The questionnaire for open competition score measures the procurement procedures. The institutional arrangements score evaluates the buyers' discretion.

The theoretical auction literature states that the public release of information about the valuation of an object causes more aggressive bidding behavior. (Milgrom and Weber, 1982; Harstad, 1990; Campbell and Levin, 2000) Empirical analysis by De Silva et al. (2008) validates these theoretical results. They show that the more stringent publicity requirements laid down by Oklahoma Department of Transportation led to a significant decrease in procurement prices. Ohashi (2009) states that greater transparency in Japanese public procurement increased competition and reduced procurement costs by up to 8%. Coviello and Mariniello (2014) analyze Italian public procurement auctions. They conclude that a more stringent publicity requirement induces greater participation and promotes competition. The cost of procurement decreases significantly (a reduction equivalent to 0.7% of the GDP) when procurements are publicized more widely.

McAfee and McMillan (1989) provide theoretical results about the impact of a price-preference policy in government procurement. Krasnokutskaya and Seim (2011) provide theoretical and empirical arguments about the impact of bid preference programs on participation and procurement prices. They find that SME preference programs improve firms' bidding and participation decisions. SME participation increases, whereas the number of bids submitted by SMEs and SME profits rise. Nakabayashi (2013) finds similar results for Japanese public construction projects. He shows that SME participation would decrease 40% if SME set-asides were removed. A strand of literature states that discriminatory policies have significant effects on public procurement.

Several studies investigate the impact of the procurement procedure on public procurement. Decarolis (2018) shows theoretically and empirically that first price auctions are more efficient in public procurement. Bajari et al. (2009) argue that negotiations may be preferred when construction projects

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<sup>2</sup> EuroPAM questionnaire about public procurement is available at <http://europam.eu/data/in-law%20indicators/EuroPAM%20Public%20Procurement%20indicator%20list.pdf>.

are complex. The level of buyer's discretion has a significant impact on public procurement. Coviello et al. (2017) show that the probability of the same firm winning repeatedly is higher when the procuring authority has more discretion. Palguta and Pertold (2017) show that authorities can manipulate procurements to ensure that they are below a certain threshold. They document that when authorities have more authority to preselect bidders, the probability that contracts are given to anonymous firms increases significantly. Authorities avoid the open auction procurement mechanism when they have more discretion. The studies summarized above provide evidence about the impact of different dimensions of regulation and public procurement.

### **3. European Union Public Procurement Regulation and Quality Scores**

Djankov et al. (2017) characterizes the quality of public procurement regulation for 142 countries in 2016. They assess the following 3 aspects of public procurement: 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 from surveys that cover more than 1,900 public procurement experts. Djankov et al. (2017) describe the BPP questionnaire and the coding of its scores in detail. A higher score indicates that the country has higher public procurement quality.

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

The EuroPAM initiative provides an alternative measure of public procurement regulation quality for all European countries during 2015-2017. It is part of an EU-funded DIGIWHIST project. The project produces datasets to improve efficiency of public spending in Europe. EuroPAM employs lawyers and public procurement experts to examine the legal framework and practical aspects of public procurement in each European country. Specifically, they evaluate the following dimensions: evaluation, open competition, and institutional arrangements. Lawyers and experts assess scores for 64 questions related to these dimensions.<sup>3</sup> Additionally, EuroPAM calculates country scores using the arithmetic mean of these scores. Compared to the BPP dataset, EuroPAM allows investigation of European public procurement during 2015-2017.

The BPP data set of Djankov et al. (2017) and EuroPAM provide information about 31 European countries represented in the TED dataset.<sup>4</sup> Table 1 displays the summary statistics of BPP and EuroPAM public procurement quality scores for the European countries.

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<sup>3</sup> EuroPAM public procurement indicator list is available online at <http://europam.eu/data/in-law%20indicators/EuroPAM%20Public%20Procurement%20indicator%20list.pdf>. The details of the scoring methodology are available online at <http://europam.eu/data/in-law%20indicators/EuroPAM%20scoring%20for%20Public%20Procurement.pdf>.

<sup>4</sup> The BPP does not calculate public procurement scores for Malta. Whereas, EuroPAM does not calculate public procurement scores for Macedonia FYR. Tables OA.4 and OA.5 in the Online Appendix display the BPP and EuroPAM scores for each country.

**Table 1: Summary Statistics of Public Procurement Regulation Scores**

	Mean	Standard Dev.	Min.	Max
World Bank BPP				
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
EuroPAM				
Evaluation	76.54	12.66	31	100
Open Competition	69.73	16.62	11	89
Institutional Arrangement	36.84	18	14	100
Country Score	61.9	10.5	34.68	88

Table 2 below displays the pairwise correlations of the public procurement scores of countries represented in the TED dataset. As in the pairwise correlations of 142 economies presented in Djankov et al. (2017), different categories of public procurement quality of European countries are not strongly correlated. Accordingly, each score contains particular information about the public procurement quality. The correlation of the overall BPP index and EuroPAM country score is 0.26. The difference might be because of the strong emphasis of the EuroPAM on suitable legal structure in public procurement.

**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

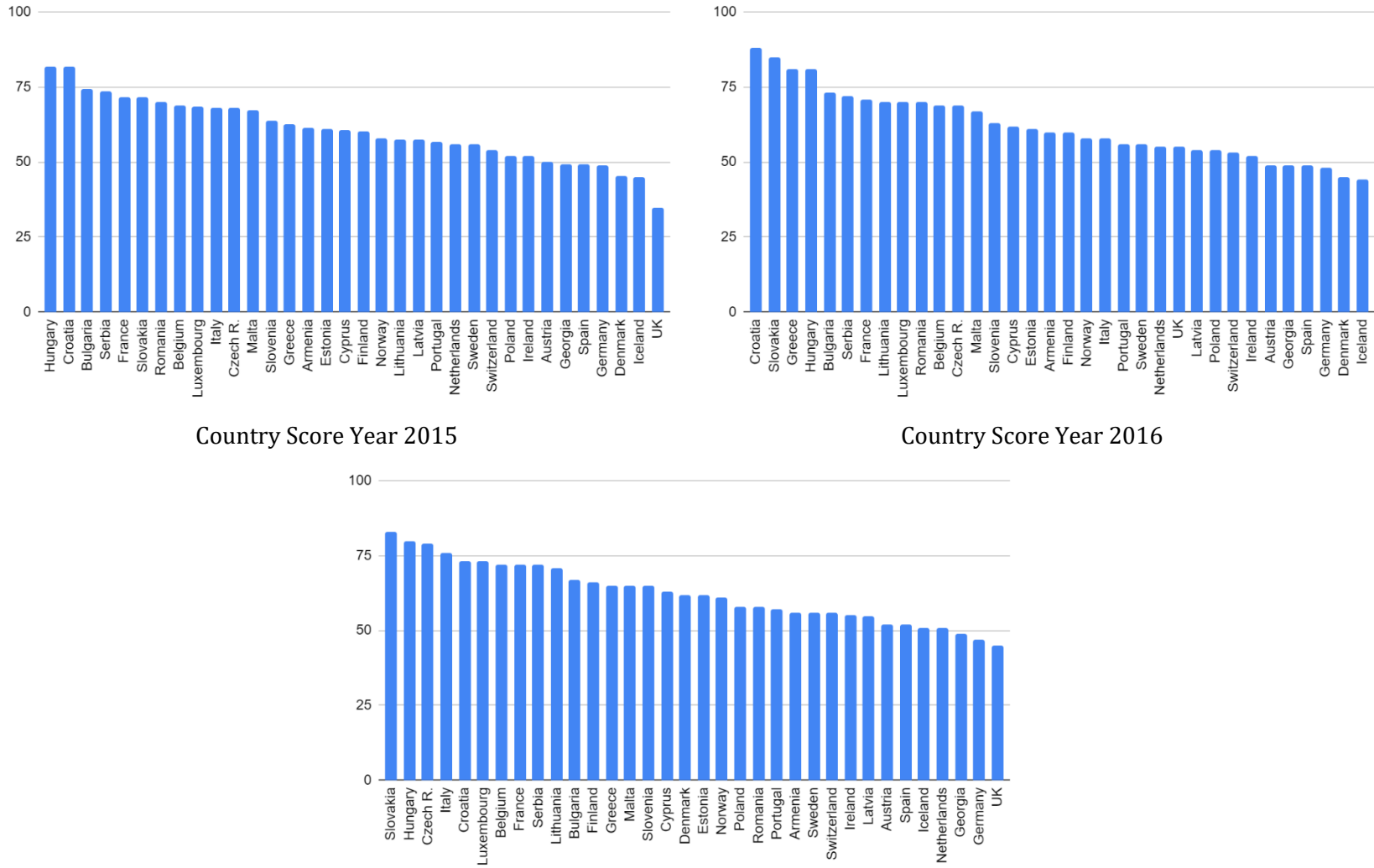
	Evaluation	Open Competition	Institutional Arrangement	Country Score	PP Overall Index
Evaluation	1				
Open Competition	0.066	1			
Institutional Arrangement	0.047	-0.121	1		
Country Score	0.448	0.286	0.585	1	0.26

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

Figure 2 presents the EuroPAM regulation quality scores during 2015-2017; it shows the significant changes in procurement quality over time. For example, the situation in Slovakia has improved over time and it had the highest country score in 2017. Like BPP, the EuroPAM country score differs substantially across the European countries. Table OA.5 in the online appendix displays the EuroPAM scores for all countries.



Figure 2: Digiwhist Public Procurement Country Scores of European Countries for Years 2015-2017



The TED data is available online in CSV format for 2006-2017.<sup>5</sup> The EU extracts the data from the contract notice and contract award notice standard forms filled in by the authorities.<sup>6</sup> The original dataset contains information about 5,303,219 public procurement contracts for the European Economic Area, Switzerland, and the Former Yugoslav Republic of Macedonia. For each contract, the TED data includes variables about the estimated and contract price, detailed CPV code<sup>7</sup> of the subject of procurement, procurement method, types of contracting authorities, and detailed names and locations of procuring agencies and contract-winning firms. I identify the sector of each contract using the first two digits of the CPV code and find that there are 72 major sectors.

BPP regulation scores of Djankov et al. (2017) are based on surveys conducted in 2016. Accordingly, I examine 412,491 EU contracts from 2016. Tables OA.1 through OA.3 in the online appendix display the number of contacts with respect to countries, procurement procedures, and types of contracting authority. EuroPAM is available for 2015-2017. I study 1,353,042 contracts during 2015-2017 when I analyze the effect of the EuroPAM public procurement quality scores.

## **4. Results**

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

### **4.1 Competition**

This section empirically examines the effect of regulation quality on the level of competition in the European public procurement markets. I follow Branzoli and Decarolis (2015) to measure the level of competition using the number of bidders participating to the procurement. Figure 3 displays a histogram of the number of bidders in 2016.<sup>8</sup> The mean of the number of bidders for a contract is 12.75, with a maximum value of 999.<sup>9</sup>

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<sup>5</sup> I use the contract award notices csv files. The files are available at <https://data.europa.eu/euodp/data/dataset/ted-csv>.

<sup>6</sup> The standard forms prescribed by 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 Kutlina-Dimitrova and Lakatos (2016), contract awards below the threshold are also reported on TED because authorities are generally not prevented from announcing the tender on TED even if the tender's value is below the threshold.

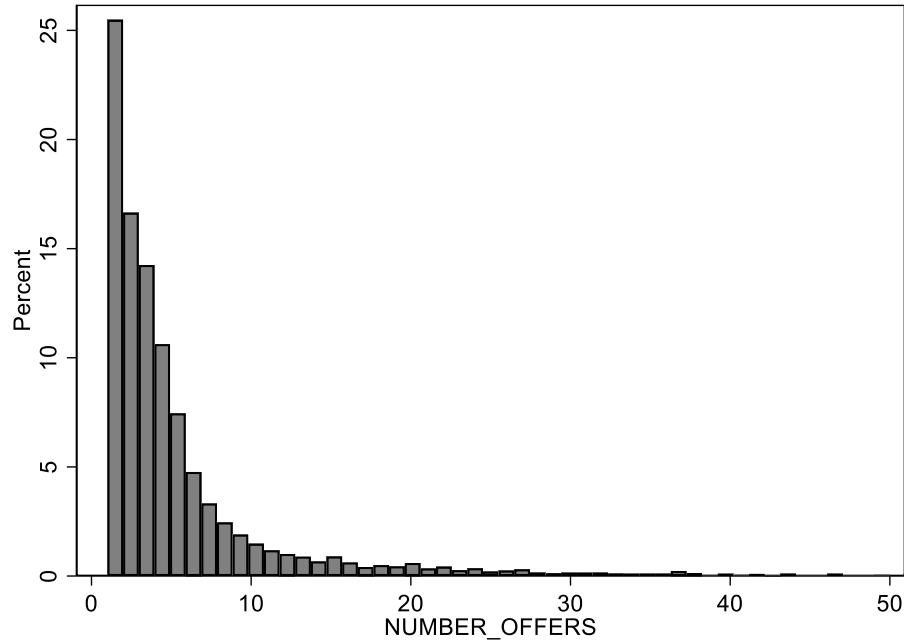
<sup>7</sup> Common Procurement Vocabulary (CPV) establishes a single classification system for public procurement aimed at standardizing the references used by contracting authorities and entities to describe the subject of procurement contracts.

<sup>8</sup> Values larger than 50 (2%) are not displayed for the sake of brevity.

<sup>9</sup> 44 contracts have 999 bidders.



**Figure 3: Histogram of Number of Bidders**



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

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

where  $N_c$  is the number of bids submitted for each contract.  $PPQ_c^i$  is the public procurement quality measure  $i$ ;  $PM_c^k$  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.<sup>10</sup> All estimations use robust standard errors. The first four columns of Table 3 show the estimation results of equation 1 with alternative public procurement quality measures,  $PPQ_c^i$ . All quality measures have positive coefficients that are statistically significant. Accordingly, public procurement regulation promotes the level of competition in EU public procurement markets. Countries with better scores attract significantly more bidders.

<sup>10</sup> 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**

	<b>Negative-Binomial</b>				<b>HB-IV GMM</b>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>World Bank BPP Measures</b>								
Bid Preparation	1.87 (68.19)**				6.92 (3.05)**			
Management		2.03 (68.17)**				6.98 (6.87)**		
Payment			2.24 (68.17)**				8.99 (9.27)**	
PP Overall				2.03 (68.17)**				8.44 (4.57)**
Observations	412,491	412,491	412,491	412,491	412,491	412,491	412,491	412,491
<b>EuroPAM Public Procurement Scores</b>								
Evaluation	0.014 (127.45)**				0.06 (9.80)**			
Open Competition		0.011 (97.44)**				0.04 (4.86)**		
Instit. Arrangement			0.005 (36.27)**				0.087 (17.15)**	
Country Score				0.02 (121.83)**				0.62 (62.76)**
Observations	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042
Procedure FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3 also considers the case that the BPP and EuroPAM quality scores may be endogenous. There might be unobserved factors that affect both the number of bidders and quality scores. In such a case, the error term of the regression equation,  $\varepsilon_c$ , 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 the possible endogeneity of the quality score variables. Lewbel (2012) developed a heteroscedasticity-based (HB) identification approach that identifies structural parameters when valid IVs do not exist.<sup>11</sup> Lewbel (2012) constructs valid IVs that are independent of the error term using the heteroscedasticity structure of the error term.<sup>12</sup> I implement the HB-IV methodology to assess whether the potential endogeneity of the PP quality scores affects the empirical results of the paper. Columns 5 through 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 the potential endogeneity of the PP quality scores. Countries with higher levels of regulation quality attract a significantly higher number of bidders and achieve higher levels of competition.

#### 4.2 Procurement Procedure

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

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

where  $Open_c$  is a dummy variable that takes the value 1 if authorities employ the open procedure, and 0 otherwise.  $F(x'_{irt}\beta)$  is a logit probability function of  $x'_{irt}\beta$ .  $x'_{irt}$  that contains the explanatory variables described in the previous section. The coefficient on  $PPQ_c^i$  gauges the impact of regulation quality on the probability that authorities use the competitive procedure. The empirical analysis also considers the case 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 consider the possible endogeneity of the  $PPQ_c^i$  variables by implementing the IV GMM methodology of Lewbel (2012). The coefficients of the following linear probability model are estimated:

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

<sup>11</sup> 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 datasets with different structures, including 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 it 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 suitable instrumental variables are not available. The methodology uses the heteroscedasticity of the errors to construct valid IVs; further, consistent and unbiased parameters of the empirical model can be estimated by employing these IVs in an IV-GMM setting.

<sup>12</sup> 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 the selection of procurement procedure in 11,400 public procurement contracts in Italy during 2007-2012.

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

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

	Logit				HB-IV GMM			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>World Bank BPP Measures</b>								
Bid Preparation	2.84 (31.20)**				1.14 (87.85)**			
Management		2.57 (31.20)**				1.20 (68.27)**		
Payment			2.84 (31.20)**				0.59 (97.53)**	
PP Overall				2.57 (31.20)**				0.78 (101.53)**
Observations	412,491	412,491	412,491	412,491	412,491	412,491	412,491	412,491
<b>EuroPAM Public Procurement Scores</b>								
Evaluation	0.02 (73.03)**				0.001 (32.18)**			
Open Competition		0.024 (74.25)**				0.003 (54.13)**		
Instit. Arrangement			0.007 (20.40)**				0.002 (66.88)**	
Country Score				0.04 (78.08)**				0.004 (49.91)**
Observations	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042
Authority FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: \*  $p < 0.05$ ; \*\*  $p < 0.01$ . Robust z-statistics in parentheses. EuroPAM is available for year 2015-2017. Regressions with EuroPAM scores contain dummy variables for year 2016 and 2017.

### 4.3 Cost-Effectiveness

Finally, I examine the impact of public procurement quality on the cost-effectiveness of government procurement. I measure cost-effectiveness by assessing whether the 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 from 170,112 observations during 2016 and 543,880 observations during 2015-2017. Further, I check for the consistency 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.6 in the online appendix displays the summary statistics of the contract price, estimated cost, and the ratio for 2016 and 2006-2017. I implement Billor et al. (2000)'s blocked adaptive computationally efficient outlier nominators (BACON) methodology to identify the outliers. The BACON method identifies contracts with ratios lower than 0.25 and higher than 1.87 as outliers; there are 3,100 such contracts during 2016 and 10,309 during 2015-2017. I remove the observations with unrealistic values. Table OA.6 in the online appendix displays 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 for simple roadwork contracts in Northern Italy. Similarly, Ishii (2009) shows that the ratio of the winning bid to estimated cost is between 0.80 and 0.95 in Okinawa Prefecture road construction auctions in Japan.

I follow the description in 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 during 2016 and 358,391 (66%) contracts during 2015-2017. I label these contracts as cost-effective.

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

where  $Cost\ Effective_c$  is a dummy variable that takes the value 1 if contract price is lower than the estimated cost, and 0 otherwise.  $F(x'_{irt}\beta)$  is a logit probability function of  $x'_{irt}\beta$ .  $x'_{irt}$  contains the explanatory variables described in section 4.1. Additionally, I estimate the following linear probability model using HB-IV GMM to consider the potential endogeneity of the 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 in equations 4 and 5. Both models conclude that public procurement regulation quality has a significant positive effect on the probability that the contract is cost-effective. Countries with better regulation quality are more likely to have cost-effective contracts with procurement prices lower than the estimated costs.

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

	<b>Logit</b>				<b>HB-IV GMM</b>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>World Bank BPP Measures</b>								
Bid Preparation	0.97 (15.63)**				0.69 (40.50)**			
Management		1.06 (15.62)**				0.79 (56.32)**		
Payment			1.17 (15.62)**				0.71 (61.66)**	
PP Overall				1.06 (15.62)**				0.97 (57.28)**
Observations	158,355	158,355	158,355	158,355	158,355	158,355	158,355	158,355
<b>EuroPAM Public Procurement Scores</b>								
Evaluation	0.005 (24.38)**				0.007 (156.11)**			
Open Competition		0.009 (47.32)**				0.005 (59.25)**		
Instit. Arrangement			0.005 (19.07)**				0.001 (9.76)**	
Country Score				0.009 (33.70)**				0.002 (24.35)**
Observations	543,880	543,880	543,880	543,880	543,880	543,880	543,880	543,880
Procedure FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: \*  $p < 0.05$ ; \*\*  $p < 0.01$ . Robust z-statistics in parentheses. EuroPAM is available for year 2015-2017. Regressions with EuroPAM scores contain dummy variables for year 2016 and 2017.

#### 4.4 Information Content of Different Public Procurement Quality Indicators

In addition to the BPP overall quality score and EuroPAM country score, I investigate whether the sub-indices contain distinctive information. The sub-indices of BPP are bid preparation, management, and payment. I study evaluation, open competition, and institutional sub-indices of EuroPAM. In this section, I employ the interaction variables to study whether different dimensions of public procurement measured by sub-indices have different effects.

I estimate the following regression equation to measure the differences in the effect of sub-indices on the level of competition:

$$N_c = \theta subPPI_c^i + \sum_{n=1}^2 \delta_n subPPI_c^i * 1(subPPI_c^n > mean(subPPI_c^n)) + \sum_{k=1}^5 \beta_{k+1} PM_c^k + \sum_{z=1}^9 \beta_{z+5} PA_c^z + \theta FE + \varepsilon_c \quad (6)$$

where  $subPPI_c^i$  is the public procurement index  $i$  for contract  $c$ . The variable  $subPPI_c^n$  denotes the remaining sub-indices. The function  $1(subPPI_c^n > mean(subPPI_c^n))$  takes the value 1 if the value of the index is larger than its mean. Table 6 displays the coefficients of equation 6 for each World Bank BPP sub-index. For example, the first column of Table 6 examines the impact of the bid preparation sub-index when management and payment indices are high in that country. Equation 6 states that when the management and payment scores are higher than average, the coefficient of bid preparation index is  $\theta + \delta_1 + \delta_2$ . Therefore, the coefficients on the interaction terms,  $\delta_1$  and  $\delta_2$ , measure the impact of the bid preparation index when the country has strong management and payment quality.



**Table 6: Interaction Among Sub-Indices of World Bank BPP**

	Competition (Negative Binomial)			Procurement Procedure (Logit)			Cost-Effectiveness (Logit)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bid Preparation	4.43 (480.05)**			2.38 (136.13)**			-0.55 (19.52)**		
Management		3.57 (407.61)**			2.25 (142.27)**			-0.01 (0.44)	
Payment			4.90 (468.34)**			2.85 (136.77)**			-0.27 (9.64)**
Bid-Prep*Above- Man	-1.22 (153.07)**			0.11 (7.06)**			1.09 (45.10)**		
Bid-Prep*Above-Pay	-0.69 (81.90)**			-0.03 (2.01)*			0.69 (27.74)**		
Man* Above-Bid		-0.00 (0.07)			0.05 (3.18)**			0.04 (1.76)	
Man*Above-Pay		-1.27 (146.40)**			-0.16 (9.97)**			1.13 (51.03)**	
Pay* Above-Bid			-1.40 (162.65)**			-0.81 (48.16)**			0.27 (11.35)**
Pay* Above-Man			-1.90 (230.86)**			-0.41 (24.22)**			1.54 (66.69)**
Observations	412,491	412,491	412,491	412,491	412,491	412,491	158,355	158,355	158,355
Procedure FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: \*  $p < 0.05$ ; \*\*  $p < 0.01$ . Robust z-statistics in parentheses. Above-Bid, Above-Pay and Above-Man are dummy variables that are 1 if the Bid-Preparation, Management and Payment scores are above their respective means.

The first three columns of Table 6 examine the impact of BPP sub-indices on the number of bidders, as in section 4.1. The interaction variables are significant with negative signs for all three BPP sub-indices. Accordingly, I conclude that the impacts of bid preparation, management, and payment are lower when the remaining sub-indices are above their mean values. When a country has above average management and payment regulation quality, the impact of bid preparation quality is lower. Columns 4 through 6 examine the probability of the open procedure, as in Section 4.2. The interaction variables are significant, but the coefficients are small. Consequently, I conclude that all indices have distinctive effects on the probability that an authority employs an open procedure. Columns 7 through 9 study the cost-effectiveness, as in section 4.3. Interestingly, the coefficients of the bid preparation and payment sub-indices are significant and negative. The coefficients on the interaction variables are significant and positive. These results indicate that all three indices must be of a high quality to have a positive effect on cost-effectiveness. For example, the impact of payment quality score is positive only if the bid preparation and management scores in that country are above the average value.

Table 7 examines the information contents of the EuroPAM sub-indices. The evaluation, open competition, and institutional arrangement sub-indices have significant positive effects on the number of bidders when other quality scores are above the average value. As in Table 6, all indices have distinctive effects on the probability that authorities employ an open procedure. Column 7 shows that evaluation score has a positive impact on cost effectiveness when a country has a high institutional arrangement score.

**Table 7: Interaction Among Sub-Indices of EuroPAM**

	Competition (Negative Binomial)			Procurement Procedure (Logit)			Cost-Effectiveness (Logit)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Evaluation	0.02 (396.45)**			0.03 (205.15)**			-0.004 (30.18)**		
Open Competition		0.03 (708.91)**			0.02 (222.60)**			0.01 (51.64)**	
Instit. Arrangement			0.03 (265.30)**			0.03 (128.87)**			0.01 (40.89)**
Eval*Above-Open	0.004 (85.56)**			-0.002 (15.58)**			0.004 (33.99)**		
Eval*Above-Inst	0.001 (24.05)**			0.001 (3.61)**			0.01 (73.73)**		
Open*Above-Eval		-0.002 (57.19)**			0.004 (45.57)**			-0.01 (63.03)**	
Open*Above-Inst		0.002 (39.13)**			0.003 (20.21)**			0.01 (67.81)**	
Inst*Above_Open			0.02 (240.05)**			0.004 (16.93)**			0.004 (22.80)**
Inst*Above-Eval			-0.01 (107.03)**			0.01 (69.77)**			-0.01 (70.13)**
Observations	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042	1,353,042	543,880	543,880	543,880
Procedure FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Authority FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: \*  $p < 0.05$ ; \*\*  $p < 0.01$ . Robust z-statistics in parentheses. EuroPAM is available for year 2015-2017. Regressions with EuroPAM scores contain dummy variables for year 2016 and 2017. Above-Bid, Above-Pay and Above-Man are dummy variables that are 1 if the Bid-Preparation, Management and Payment scores are above their respective means.

#### **4.5 Robustness**

In this sub-section, I study the robustness of the empirical results presented in tables 3 and 5. It is found that 1 % of the contracts have a 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 4.1. Additionally, I conduct the empirical analyses using the complete TED dataset covering 2006–2017, and having 3,507,656 contracts.<sup>13</sup> Tables OA.7 and OA.8 in the online appendix display the robustness analysis for section 4.1. All analyses confirm the robustness of the results of table 3. The coefficients on the PP quality scores are positive and significant.

Table OA.9 examines the impact of regulation quality on cost-effectiveness using the complete TED dataset. 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 shown in Table 5. Regulation quality improves cost-effectiveness of European public procurement when the empirical analysis considers the complete TED dataset.

#### **5. Conclusions**

I empirically analyze the effect of public procurement regulation quality on competition and cost-effectiveness and find that the tender process in countries with high public procurement quality has a higher level 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 the estimated costs. The paper provides empirical evidence about the favorable effects of appropriate public procurement regulation.

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<sup>13</sup> I employ year fixed effects in these regressions.

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## Annex: Additional Figures and Tables

**Table OA.1**  
**Number of Contracts by Authority Country**

<u>Country</u>	<u>Number of Contracts</u>
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: World Bank (BPP) 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: Digiwhist EuroPAM Average Public Procurement Scores of EU Countries**

Country	Evaluation	Open Competition	Institutional Arrangements	Country Score
Armenia	81.08	47.19	38.24	59.10
Austria	68.92	77.93	35.90	50.32
Belgium	85.42	63.96	28.86	69.98
Bulgaria	96	80.44	28.86	71.51
Croatia	87.75	69.52	73.95	80.90
Cyprus	89.83	80.44	35.90	61.88
Czech R.	79.08	79.63	50.19	72.03
Denmark	60.5	58.33	35.90	50.79
Estonia	81.08	80.85	35.90	61.34
Finland	85.5	80.44	35.90	62.06
France	81.08	80.44	28.86	71.57
Georgia	68.92	11.04	35.90	49.15
Germany	66.92	74.93	21.14	48.01
Greece	91.83	80.44	38.24	69.53
Hungary	56.08	75	100	80.92
Iceland	75	33.41	35.90	46.60
Ireland	66.83	80.44	16.43	52.98
Italy	77	69.37	42.95	67.31
Latvia	87.83	55.56	35.90	55.31
Lithuania	75	83.11	28.86	66.15
Luxembourg	100	83.11	35.90	70.52
Malta	85.5	80.44	35.90	66.46
Netherlands	70.92	85.11	21.14	54.04
Norway	77.08	73	21.14	59.02
Poland	87.83	55.85	35.90	54.7033
Portugal	75	63.96	28.86	56.53
Romania	77.08	76.78	40.62	66.06
Serbia	75	46	42.95	72.48
Slovakia	83.42	65.81	71.52	79.84
Slovenia	77	76.93	28.86	63.91
Spain	50	83.11	28.86	50.13
Sweden	62.83	75	35.90	55.91
Switzerland	81.08	63.96	35.90	54.28
UK	45.75	73.26	21.14	44.89

Note: Average scores for years 2015-2017.

**Table OA.6**  
**Summary Statistics of Contract Prices and Estimated Costs**

Variable	Without Outliers in Year 2016				
	Number of Observations	Mean	Standard Deviation	Min	Max
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 <sup>14</sup>	158,463	0.91	0.21	0.25	1.87
Contract Price (Euros)	543,880	2,171,042	9.62e+07	0.01	6.10e+10
Estimated Cost (Euros)	543,880	2,275,235	9.65e+07	0.01	6.10e+10
Ratio	543,880	0.91	0.22	0.25	2
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

<sup>14</sup> Contract price over estimated cost.

**Table OA.7**  
**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 (78.67)**				2.23 (298.85)**			
Management		1.97 (78.64)**				2.42 (298.88)**		
Payment			2.18 (78.64)**				2.68 (298.88)**	
PP Overall				1.97 (78.64)**				2.42 (298.88)**
accelerated negotiated					-0.35 (30.17)**	-0.35 (30.17)**	-0.35 (30.17)**	-0.35 (30.17)**
accelerated restricted					-0.22 (33.59)**	-0.22 (33.58)**	-0.22 (33.58)**	-0.22 (33.58)**
award w. publication	0.29 (30.28)**	0.29 (30.30)**	0.29 (30.30)**	0.29 (30.30)**	0.11 (30.38)**	0.11 (30.43)**	0.11 (30.43)**	0.11 (30.43)**
competitive dialogue	-0.53 (12.29)**	-0.53 (12.34)**	-0.53 (12.34)**	-0.53 (12.34)**	-0.45 (35.88)**	-0.45 (35.88)**	-0.45 (35.88)**	-0.45 (35.88)**
negotiated comp.	-0.12 (14.21)**	-0.12 (14.21)**	-0.12 (14.21)**	-0.12 (14.21)**	-0.23 (79.11)**	-0.23 (79.16)**	-0.23 (79.16)**	-0.23 (79.16)**
Neg. without comp.	-0.89 (78.93)**	-0.89 (78.88)**	-0.89 (78.88)**	-0.89 (78.88)**	-0.89 (255.18)**	-0.89 (255.15)**	-0.89 (255.15)**	-0.89 (255.15)**
restricted	0.16 (20.89)**	0.16 (20.91)**	0.16 (20.91)**	0.16 (20.91)**	-0.04 (15.44)**	-0.04 (15.40)**	-0.04 (15.40)**	-0.04 (15.40)**
Central government	-0.02 (2.86)**	-0.02 (2.78)**	-0.02 (2.78)**	-0.02 (2.78)**	0.03 (15.86)**	0.03 (15.85)**	0.03 (15.85)**	0.03 (15.85)**
Water, energy, transport	0.21 (26.59)**	0.21 (26.63)**	0.21 (26.63)**	0.21 (26.63)**	0.25 (91.27)**	0.25 (91.43)**	0.25 (91.43)**	0.25 (91.43)**
EU institution	0.04 (1.45)	0.04 (1.50)	0.04 (1.50)	0.04 (1.50)	-0.09 (10.39)**	-0.09 (10.31)**	-0.09 (10.31)**	-0.09 (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.8**  
**Effect of Public Procurement Regulation Quality on Competition**  
**Negative-Binomial Regression, Tenders without Outliers**  
**(Number of Bidders <100, 99% of Procurements)**

	(1)	(2)	(3)	(4)
Evaluation	0.01 (93.08)**			
Open Competition		0.01 (121.77)**		
Instit. Arrangement			0.01 (48.30)**	
Country Score				0.01 (105.18)**
accelerated negotiated	0.11 (17.39)**	0.10 (16.93)**	0.10 (15.85)**	0.09 (15.48)**
accelerated restricted	-0.53 (21.32)**	-0.54 (21.78)**	-0.53 (21.47)**	-0.53 (21.51)**
award w. publication	-0.30 (59.46)**	-0.32 (63.08)**	-0.29 (57.78)**	-0.30 (60.38)**
negotiated comp.	-0.89 (139.44)**	-0.89 (139.78)**	-0.88 (138.06)**	-0.89 (139.18)**
restricted	0.03 (5.88)**	0.03 (6.28)**	0.02 (3.95)**	0.03 (7.63)**
Central government	0.03 (8.36)**	0.01 (3.82)**	0.04 (12.22)**	0.03 (7.44)**
Water, energy, transport	0.32 (68.35)**	0.31 (66.32)**	0.33 (70.85)**	0.31 (66.86)**
EU institution	0.02 (1.35)	0.01 (0.55)	0.04 (2.05)*	0.01 (0.62)
other inter. org.	-0.27 (3.89)**	-0.29 (4.12)**	-0.28 (3.99)**	-0.26 (3.73)**
Gov. by public law	0.15 (57.67)**	0.13 (50.59)**	0.17 (64.59)**	0.15 (55.46)**
Other	0.19 (68.39)**	0.17 (60.55)**	0.21 (76.70)**	0.19 (66.37)**
National Agency	0.30 (45.92)**	0.27 (41.82)**	0.30 (46.32)**	0.29 (44.74)**
Local Agency	-0.03 (5.25)**	-0.05 (7.83)**	-0.01 (1.84)	-0.04 (5.96)**
Not specified	0.11 (17.68)**	0.07 (11.97)**	0.13 (21.45)**	0.08 (13.79)**
Observations	1,341,224	1,341,224	1,341,224	1,341,224
Sectoral Fixed Effects	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes

**Table OA.9**  
**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 (34.10)**				0.71 (136.28)**			
Management		0.85 (34.09)**				0.73 (137.00)**		
Payment			0.95 (34.09)**				0.24 (21.52)**	
PP Overall				0.85 (34.09)**				0.84 (58.69)**
accelerated negotiated	-1.13 (25.34)**	-1.13 (25.34)**	-1.13 (25.34)**	-1.13 (25.34)**	-0.26 (27.22)**	-0.26 (27.08)**	-0.25 (25.54)**	-0.26 (27.23)**
accelerated restricted	-0.10 (4.04)**	-0.10 (4.03)**	-0.10 (4.03)**	-0.10 (4.03)**	-0.02 (4.02)**	-0.02 (3.93)**	-0.01 (2.98)**	-0.02 (4.20)**
award w. publication	-0.48 (29.17)**	-0.48 (29.17)**	-0.48 (29.17)**	-0.48 (29.17)**	-0.09 (27.08)**	-0.09 (26.93)**	-0.08 (25.09)**	-0.09 (27.36)**
competitive dialogue	-0.17 (2.53)*	-0.17 (2.53)*	-0.17 (2.53)*	-0.17 (2.53)*	-0.03 (2.54)*	-0.03 (2.49)*	-0.03 (1.96)	-0.04 (2.62)**
negotiated comp.	-0.50 (36.40)**	-0.50 (36.37)**	-0.50 (36.37)**	-0.50 (36.37)**	-0.11 (37.18)**	-0.11 (37.03)**	-0.10 (35.56)**	-0.10 (35.79)**
Neg. without comp.	-0.95 (90.04)**	-0.95 (90.01)**	-0.95 (90.01)**	-0.95 (90.01)**	-0.21 (92.52)**	-0.20 (91.87)**	-0.19 (83.78)**	-0.21 (91.91)**
restricted	-0.08 (6.11)**	-0.08 (6.10)**	-0.08 (6.10)**	-0.08 (6.10)**	-0.02 (6.42)**	-0.02 (6.18)**	-0.01 (3.53)**	-0.02 (6.55)**
Central government	-0.03 (2.83)**	-0.03 (2.89)**	-0.03 (2.89)**	-0.03 (2.89)**	-0.00 (2.14)*	-0.00 (0.44)	0.03 (17.96)**	-0.01 (3.47)**
Water, energy, transport	-0.27 (26.45)**	-0.27 (26.50)**	-0.27 (26.50)**	-0.27 (26.50)**	-0.05 (25.57)**	-0.05 (24.49)**	-0.02 (11.32)**	-0.06 (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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