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Restrictions on Competition in Municipal Competitive Procurement in Sweden

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Abstract

The bidding process in public procurement in Sweden is a first-price sealed bid auction. Although there is a competitive effect on the bids in this type of auction, the contracting entity can, through the choice of procurement procedure, restrict the number of bidders. This paper studies this choice and imposes an implementation cost on the contracting entity to motivate such a restriction. The results, based on data for Swedish municipalities, suggest that contract specifications and municipality characteristics (that are assumed to influence the implementation cost) affect the volume of the procurement and the number of bidders but not necessarily the choice of procurement procedure. (JEL D44, H57, K20)

Introduction

This paper studies Swedish municipalities' choice of procurement procedure when auctioning a fixed price internal cleaning service contract and the factors determining this choice. Auction theory is used to formalize the bidding process and analyze the multiple choices of procurement procedures given in the law. Because of the large amount of money involved in public procurement in Sweden[1] and the increasing number of public goods and services procured by auctions, it is important to learn more about, and analyze the economic implications of, the policies and regulations governing these procurements.

Public procurement in Sweden is regulated by the Public Procurement Act (LOU [1992:1528]), which in accordance with directives from the European Union (EU) promotes competitive bidding for public contracts. There are five different procurement procedures available to the contracting entity (which represents the municipality). These are first price sealed bid auctions or variants of the same.[2] Sealed bids are stipulated[3] and the lowest bidder is awarded the contract and paid in accordance with his or her bid. The main difference between pure auction theory and practice is that the contracting entity can, through the choice of procurement procedure, limit the number of bidders allowed to participate in the auction. Because there is a competitive effect on the bids in the first-price sealed bid auction,[4] the lowest bidder is the one who offers to complete the contract at the lowest cost. The auction is efficient and therefore auction theory does not support restrictions on competition.[5]

The main issue in this paper, is why there is a difference between practice and theory, in other words, why does the contracting entity use the option to restrict the competition

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instead of just using the plain first-price sealed bid auction? This paper aims to empirically study both the possible determinants of this choice and the number of bidders for each contract. The idea is to investigate whether the option to restrict the number of bidders may be motivated by an implementation cost, for the contracting entity. When the contracting entity makes its choice, the total cost of the procurement is minimized, which includes the implementation cost as well as the expected payment to the winning bidder. There is a trade off between a low implementation cost and the competitive effect on the payment to the contracted supplier. Further, the paper discusses whether municipalities may differ in their preferences with regard to the type of procurement procedure used. One can argue that a more densely populated municipality will be more inclined to choose a restrictive mechanism, as more bidders can be expected. This will give rise to higher implementation costs, compared with less densely populated municipalities. On the other hand, these municipalities will benefit more from the competitive effect on the bids.

According to theoretical evidence presented by Levin and Smith [1994], the contracting entity (and the society) benefits from competition restrictions given common values. Given private values, which apply for the contracts in the present paper, the contracting entity will not benefit from such restrictions. It is optimal to allow free entry. The authors conclude that competition restrictions could be motivated when the item is unique or technically complicated so that the evaluation of bids is complex. These arguments do not translate into the cases studied here. A theoretical paper by Taylor and Wiggins [1997] discuss two extreme forms of procurement mechanisms, the American (which is a bidding process) and the Japanese (direct purchase). They show that the former results in large-scale procurements with many suppliers and demands high inspection frequency. The opposite is true for the Japanese mechanism. This one is low on inspections and results in long-term relationships, few suppliers, and small-scale procurements. The Japanese mechanism corresponds to what in the Swedish Public Procurement Act is called direct procurement. This form of procurement is exceptional and only allowed for very small-scale procurements (low value).

Arguments for procurement procedures that include competition restrictions in the context of the EU legislation are discussed in Mardas [1999]. However, Mardas points out that a drawback with the restricted and negotiated procedures is the limited competition. Additional arguments for restricting the number of bidders are found in Hallwood [1996], who discusses the advantages and disadvantages with an invited bidding procurement auction compared with an open bidding procurement auction and posted-pricing and negotiation. The theoretical results show that the invited auction could result in prices close to the equilibrium and a stabilization of the number of bidders in successive procurement auctions.

As for empirical work, there is to my knowledge no paper that deals with the choice of open or restrictive bidding for well-defined contracts. An empirical study based on complex contracts by Bajari et al. [2003] confirm the results from Levin and Smith [1994]. Examples of other applications of procurement can, for example, be found in Vistnes [1994], who uses data from Medicaid's procurements of health services in California, to test hypotheses regarding optimal contracts when the information about costs is asymmetric. McAfee and McMillan [1996] analyze government auctions of airwaves in the U.S. Jofre-Bonet and Pesendorfer [2000] exhibit a repeated procurement auction and apply data from the California Department of Transportation.

The probability of observing a particular choice of procurement procedure is estimated using data from Swedish municipalities' procurement of internal cleaning services during the period 1992–1998. The contracting entity's choice of procurement procedure is related to the volume of the procurement. If this exceeds a specific threshold value, the contracting entity can, through its choice of procurement procedure, restrict the number of bidders in the auction. The contracting entity is assumed to make such a choice if this maximizes its random utility. The determinants of the probability that the procurement is below the threshold value and the probability that the contracting entity makes a competitive restrictive choice of mechanism are estimated in two separate binary logit models. Contract specifications and municipality characteristics are used as explanatory variables. The variables in the regression equations are assumed to affect the implementation cost of the procurement, which the contracting entity seeks to minimize. Finally, negative binomial regression is used to estimate the determinants of the number of bidders for each contract.

The rest of this paper is organized as follows. The theoretical approach and a presentation of the contracting entity's cost minimizing are presented in the following section. A presentation of the empirical model is included in the next section, followed by a description of the data and regression equations. Then, the results are discussed, and a summary and conclusions are given in the final section.

Theoretical Model

Assume that a number of fixed price public internal cleaning contracts (NC) are auctioned by means of a first-price sealed bid auction. The number of contracts is assumed to be exogenously given. The bidders cost (c) to carry out the contract are assumed to be privately known and independent of the competitors cost (i.e., the cost is independently drawn from a commonly known distribution).[6] The auction could be a single unit (one contract) or a multi- unit auction (more than one contract is simultaneously auctioned). In the latter case, the bidder is assumed to draw one cost for each contract independent of the cost for completing the other contracts simultaneously auctioned. Combinatorial bidding is not allowed. The expected payment from the contracting entity to the winner is the expected value of her bid. That is, the expected value of the bid given by the non-cooperative Nash equilibrium bid function:[7]

$$b = \beta(c) = c + \frac{\int_c^{\infty} [1 - F(u)]^{n-1} \mathrm{d}u}{[1 - F(c)]^{n-1}} \tag{1}$$

given that this is the lowest bid among the n submitted bids. The expected payment from the contracting entity to the winner of the contract is then:[8]

$$E[\beta(c)] = n \int_0^{\infty} \left[c(1 - F(c))^{n-1} + \int_c^{\infty} (1 - F(u))^{n-1} \mathrm{d}u \right] f(c) \mathrm{d}c \tag{2}$$

The expected payment is assumed to be zero if no contract is signed. It is further assumed that the contracting entity accepts bids between zero and infinity and, consequently, does not state a reservation cost, i.e., an upper bound on the bid. Since the equilibrium bid function decreases as the number of bidder's increases, so does the expected payment to the winner and the auction is, thereby, efficient.[9] Thus, auction theory does not support a procurement procedure with respect to the possibility of limiting the degree of competition in the auction, i.e., apply invited bidding.

Accordingly, there must be some other reason why the contracting entity uses the option to restrict entry. As mentioned in the introduction, arguments supporting the use of a competitive restrictive procurement procedure in public procurement within the EU can be found in Mardas [1999]. However, these arguments are not necessarily valid for the type of contracts studied here. Other reasons for limiting the number of potential bidders could be that the contracting entity wants to avoid unqualified bids and be forced to contract a 'bad' supplier who later has to be replaced before the contract period has expired. To terminate a running contract and auction the same contract again is costly (as is also spending time on unqualified bids). These costs are, together with the number of contracts auctioned in the same procurement and other contract characteristics, examples of implementation costs. Therefore, it is assumed that when the contracting entity decides the procurement procedure account is taken not only of the internal cleaning service market and the expected payment to the winning bidder, but also of the cost of implementation. The same procurement procedure is applied to all contracts in one and the same procurement. It is also assumed that the contracting entity designs each contract before determining the procurement procedure. The contracting entity minimizes the expected total cost of the procurement that is the sum of the expected payment to the winner of each contract j plus the expected implementation cost (IC), that is:

$$\underset{n}{\text{Min}}\, E[\text{TC}] = \sum_{j=1}^{\text{NC}} E[\beta(c)] + E[\text{IC}(n, x, y, \text{NC})] \tag{3}$$

The supplier's cost for carrying out the contract is observed by neither the contracting entity nor the researcher, and it is not affected by the choice of procurement procedure. The option to restrict the number of potential bidders means that the contracting entity's choice of procurement procedure indirectly affects both the expected payment to the winner of each contract and the implementation cost. The latter is assumed to be dependent on and increasing in the number of potential bidders, n and dependent on contract specifications, x, characteristics of the municipality, y, and the number of contracts. The implementation cost is assumed not to affect the bidding strategies of the bidders. The contracting entity is assumed to invite the same number of bidders for all contracts auctioned in one and the same procurement. This is the rule of the game. In order to simplify the notation, the cost minimization problem is re-written as:

$$\underset{n}{\text{Min}}\, \phi(n, x, y, \text{NC}) \tag{4}$$

The contracting entity minimizes the expected total cost with respect to the number of potential bidders. The number of bidders who solve this problem n^* will be a function of contract specifications, characteristics of the municipality, and the number of contracts in the auction $n^* = n^*(x, y, \text{NC})$. This generates the following value function:

$$\phi(n^*, x, y, \text{NC}). \tag{5}$$

If the vector n^* is strictly less than the number of potential bidders expected by the contracting entity under invitation with free entry, $n^{**} = (n_1^{**}, n_2^{**}, \ldots, n_{\text{NC}}^{**})$ the contracting entity chooses a competitive restrictive procedure in order to limit the number of potential bidders. If $n^* > n^{**}$, the contracting entity applies as procurement procedure that allows free entry, i.e., the standard first-price sealed bid auction. To conclude, the contracting entity would, under any circumstances, make a cost minimizing choice between restricting the competition or not in the procurement.

Empirical Model

The part of the total cost, see expression (3), that consists of the sum of the expected payment to the winner of each contract is mainly determined by factors outside the control of the contracting entity. Accordingly, the focus in the empirical analysis is on factors that can affect the total cost through the implementation cost, which the contracting entity can control. Through its choice of procurement procedure, the contracting entity minimizes the expected total cost. Here, the choice is mimicked by a random utility function, by setting $-E[\mathrm{TC}(\cdot)] = U(\cdot)$.

The option to restrict entry is related to a so-called threshold value. This value is related to the volume of the procurement and determined by the size of building (many square meters to be cleaned) and/or the number of contracts auctioned.[10] Therefore, the possible determinants of the probability of observing a particular choice of procurement procedure are estimated in two separate binary logit regressions. The first logit regression focuses on determinants of the probability that the volume of the procurement is below the threshold value. The second logit regression estimates the probability that the contracting entity allows free entry, given that the volume exceeds the threshold value. The effect of municipal characteristics and contract specifications on the number of bidders for each contract is estimated using a negative binomial regression. This is interesting and important as the number of bidders on each contract affects the payment to the winner of the contract and the implementation cost and, thereby, the total cost.

If the volume of the procurement, V, is below the threshold value, V_{T} the simplified procedure is applied.[11] Estimation of the probability that the volume of the procurement is below the threshold value is, therefore, tantamount to estimating the probability of observing a procurement k where the simplified procedure is applied, that is:

$$\Pr[\mathrm{V}_k - V_T < 0|z_k] = \Pr[\mathrm{Procedure}_k = \mathrm{Simplified}|z_k] = \Pr[\beta' z_k + \varepsilon < 0|z_k] \tag{6}$$

where β is the parameter vector. Contract specifications, characteristics of the municipality, and the number of contracts auctioned in the procurement k are included in the z_k vector. The error term is assumed to represent unobserved circumstances that affect the probability that the procurement is below the threshold value. This probability is estimated using a binary logit model:

$$\Pr[\mathrm{Procedure}_k = \mathrm{Simplified}|z_k] = \Lambda(\beta' z_k) = \frac{\exp(\beta' z_k)}{1 + \exp(\beta' z_k)} \tag{7}$$

where Λ is the logistic cumulative distribution. The cumulative density for the difference between the error terms is given by the logistic function. The marginal effects are calculated according to:[12]

$$\frac{\partial \Lambda(\beta' z_k)}{\partial z_k} = \Lambda(\beta' z_k)(1 - \Lambda(\beta' z_k))\beta. \tag{8}$$

Given that the volume of the procurement exceeds the threshold value, the contracting entity has a choice between three different mechanisms, the open, restricted, or negotiated procedures.[13] The contracting entity is assumed to make a utility maximizing choice among these mechanisms and chooses one mechanism over another if the random utility of that choice exceeds the random utility from all other alternatives. In order to avoid problem with the assumption of independence of irrelevant alternatives (i.i.a.) and since they are so similar, the restricted and negotiated procedures are categorized together as one competitive restrictive procurement procedure (indexed cr).[14] A non-competitive restrictive mechanism (the open procedure, indexed o) is the observed choice in procurement k, if:

$$U_o = \beta_o' q_k + \varepsilon_o > U_{\mathrm{cr}} = \beta_{\mathrm{cr}}' q_k + \varepsilon_{\mathrm{cr}} \tag{9}$$

This choice is determined by the same contract specifications and municipality characteristics as in expression (6) with two exceptions. The q vector also contains a variable measuring the reluctance of the contracting entity to switch between procurement procedures (i.e., the habit behavior), given that the volume of the procurement exceeds the threshold value, as well as a variable reflecting the political situation in the municipality. This could, in turn, affect the size of the cleaning service market and reflect the contracting entity's attitude towards competition. The random utility error terms are assumed to represent unobserved circumstances affecting the choice of procurement procedure. This leads to a binary logit model and the probability of observing the choice of the open procedure is under these circumstances:

$$\Pr[\mathrm{Choice}_k = \mathrm{open}|q_k] = \Pr[\beta_o' q_k + \varepsilon_o - \beta_{\mathrm{cr}}' q_k + \varepsilon_{\mathrm{cr}} > 0|q_k] = \Pr[\beta' q_k + \varepsilon > 0|q_k] \tag{10}$$

where β is the difference between the parameter vectors β_{o} and β_{cr}. This probability is estimated as:

$$\Pr[\mathrm{Choice}_k = \mathrm{open}|q_k] = \Lambda\,(\beta' q_k) = \frac{\exp(\beta' q_k)}{1 + \exp(\beta' q_k)}. \tag{11}$$

where Λ is, again, the logistic cumulative distribution function. The marginal effects are calculated according to Equation (8).

Data

The data set used in this paper consists of 131 procurements, in which Swedish municipalities have auctioned one or several fixed price cleaning service contracts during the period 1992–1998. A request was sent to all Swedish municipalities[15] asking them for documents regarding their procurement of cleaning services.[16] The response rate was 79.5 percent, i.e., 229 municipalities answered, of which 50 had actually purchased cleaning services during the time period in question. One explanation for the small number of municipalities actually having auctioned cleaning service contracts might be that public sector cleaning services have only recently been subject to competition in Sweden. In addition, the local council in each the municipality should be subject to competition. The data are fairly representative. Municipalities from the whole of Sweden responded. The data are organized on three levels. First, there are the procurements for which 758 contracts were distributed and finally a total of 5,925 bids for these contracts.

Table 1 shows descriptive statistics and frequencies for procurement and contract level, by procurement procedure and for the whole sample. The open procedure had the largest number of bidders. There were, on average, 8.9 potential suppliers who submitted bids for each contract and the procurements had on average 8.1 bidders. The negotiated procedure, where both a second bidding round and a restriction of the competition are allowed, had the lowest number of bidders for each contract, 5.5 on average. A Mann–Whitney test showed that the distribution functions for the number of bidders

TABLE 1
Descriptive Statistics and Frequencies

		Procurement Procedure				
		Simplified	Open	Restrictive	Negotiated	All
Number of Procurements		60	32	24	15	131
Number of Contracts		129	315	255	59	758
Variable	Statistic					
No of contracts	Mean	2.2	9.8	10.6	4.5	5.9
	Stand. dev.	3.9	10.7	16.3	8.1	10.1
	Maximum	27	37	74	29	74
	Minimum	1	1	1	1	1
No of bids on each contract	Mean	7.1	8.9	7.4	5.5	7.8
	Stand. dev.	3.9	4.3	3.3	2.5	3.9
	Maximum	37	25	16	22	37
	Minimum	1	1	2	2	1
No of bids in each procurement	Mean	6.1	8.1	7.8	6.3	6.9
	Stand. dev.	4.6	5.4	4.0	4.9	4.8
	Maximum	37	25	16	22	37
	Minimum	1	1	2	2	1
Contract period	Mean	1.5	2.0	1.6	1.7	1.7
	Stand. dev.	0.6	0.6	0.6	0.8	0.7
	Maximum	3.0	4.0	3.0	3.0	4.0
	Minimum	0.2	0.5	0.8	0.5	0.2
Prolongation period	Mean	0.7	0.8	0.8	0.3	0.7
	Stand. dev.	0.6	0.5	0.7	0.5	0.6
	Maximum	2.0	2.0	2.0	1.0	2.0
	Minimum	0	0	0	0	0
Density	Mean	204.73	243.61	681.46	846.25	375.02
	Stand. dev.	441.85	666.69	616.39	1,228.22	696.32
	Maximum	2,808.0	2,783.1	2,796.4	2,749.69	2,808.0
	Minimum	4.6	8.8	60.5	16.29	4.6
Red	Mean	0.48	0.47	0.47	0.43	0.46
	Stand. dev.	0.01	0.01	0.16	0.12	0.11
	Maximum	0.61	0.63	0.66	0.67	0.67
	Minimum	0.29	0.27	0.21	0.18	0.18

in procurements where the simplified procedure was applied was significantly different from the distribution of bidders in procurements where the negotiated or the open procedures were applied.[17] The test statistics were -1.761 and -2.145, respectively. The average number of procurements per municipality was 2.5, and the average number of contracts per municipality was 15.2. The average number of contracts auctioned in one, and the same procurement was 5.9. The simplified procedure was the most frequently used mechanism in the data. It was applied in 45.8 percent of the procurements. The open was applied in 24.4 percent, the restricted in 18.3 percent, and the negotiated in 11.4 percent of the procurements. This is in accordance with the distribution of procurement procedures for Swedish municipalities' total procurement of cleaning services (see NOU [1999]).

Regression Equations

The probability of observing procurement below the threshold value and a choice of a non-competitive restrictive procurement procedure are estimated in two separate binary logit models and are, by assumption, determined by contract specifications and municipality characteristics. The regression equations are, respectively:

$$\begin{aligned}&\Pr[\text{Procurement}_k = \text{Simplified}]\\ &\quad = \Lambda\left[\beta_{1b} + \beta_{2b}\text{NC}_k + \beta_{3b}\text{NC}_k^2 + \beta_{4b}\text{DENS}_k + \beta_{5b}\text{CP}_k + \beta_{6b}\text{PP}_k\right]\end{aligned} \tag{12}$$

$$\begin{aligned}&\Pr[\text{Choice}_k = \text{open}]\\ &\quad = \Lambda\left[\beta_{1o} + \beta_{2o}\text{NC}_k + \beta_{3o}\text{NC}_k^2 + \beta_{4o}\text{DENS}_k + \beta_{5o}\text{CP}_k + \beta_{6o}\text{PP}_k + \beta_{7o}\text{RED}_k + \beta_{8o}\text{SAME}_k\right]\end{aligned} \tag{13}$$

where $\Lambda(\cdot)$ is the logistic cumulative distribution function, NC is number of contracts included in one and the same procurement (one contract for each object), DENS is the population density in the municipality, CP is the contract period, PP is the length of the prolongation period (measured in years), RED is the socialist parties' share of the seats in the local council, and SAME is a dummy variable reflecting the effect on the choice of procurement procedure of the contracting entity choosing a particular mechanism in a previous procurement, i.e., the effect of habitual behavior.

$$\text{SAME} = \begin{cases} \text{1 if the observed choice of allocation mechanism is the same as a previous} \\ \text{choice in the municipality} \\ \text{0 otherwise} \end{cases}$$

Both regression equations are estimated using maximum likelihood. The data set used to analyze the factors that could affect the volume of the procurement consists of 131 procurements. Those where the simplified procedure is the observed choice are excluded from the data set. The remaining 71 contracts are used in the estimation of the factors that could affect the probability that the contracting entity chooses not to restrict the competition. In eight of the procurements the contract period was not specified. These cases are treated as missing observations.

As shown in a previous section, the number of potential bidders is important for the choice of procurement procedure. Depending on how it is affected by contract specifications and municipality characteristics, a more or less restrictive procedure will be the cost minimizing choice for the contracting entity. Empirically, the number of bidders differs between contracts auctioned in one and the same procurement. Therefore, it is interesting to study the effect of contract specifications and characteristics of the municipality on the number of bidders for each contract. A negative binomial regression will be estimated to further explore this issue. Here the number of bidders is treated as endogenous and the exogenous variables are contract specifications and municipality characteristics. As the endogenous variable is count data it would be reasonable to assume generation by a Poisson distribution. However, such an approach assumes that the variance and mean for the variable are equal. This is not the case. There is evidence of over-dispersion in the variable, see Table 6, where the $\chi^2(1)$ value is a test of over-dispersion. Because of this, the negative binomial regression model is used instead.[18] The model is:

$$\Pr[n_j | x_j, \varepsilon_j] = \mathrm{P}(\lambda_j) \tag{14}$$

where P is the Poisson distribution function and:

$$\ln\lambda_j = \beta' x_j + \varepsilon_j \tag{15}$$

and exp(ε) has the gamma distribution Γ, with mean 1.0 and variance α, n_j is the number of bidders on a contract j, the variables DENS, NC, CP, PP, and RED are defined as above, PRP is a dummy variable for choice of procurement procedure, and CC is a dummy variable for contract category, included in the x_j vector. The open procedure is the reference mechanism. There are eight contract categories, schools, day care centers, medical health centers, offices, purifying plants, sports centers, libraries, and unspecified (others). Office is used as reference category.

Results

The results presented in Table 2 suggest that the probability that the volume of the procurement is below the threshold value decreases significantly with the population density in the municipality. This indicates, not surprisingly, that low value procurements are more common in less densely populated municipalities. The parameter for the number of contracts auctioned in one and the same procurement is significant and negative, whereas the parameter for the number of contracts squared is positive and significant. As the latter parameter is very small compared with the former, one can conclude that the probability that the volume of the procurement exceeds the threshold value is increasing with the number of contracts included in the same procurement. However, this relationship is nonlinear. This is reasonable, as descriptive statistics show that procurement with many small contracts can have a volume below the threshold value in the same way as a procurement that only includes one big contract (measured as square meters to be cleaned).[19] The prolongation period and contract period parameters are not significant.

TABLE 2
Maximum Likelihood Estimates and Partial Derivatives, Expression (12)

	MLE		Partial Derivatives	
Variable	Coefficient	t-value	Coefficient	t-value
Constant	1.123	3.020		
No of contracts (NC)	−0.262	−3.698	−0.062	−3.967
No of contracts squared (NC^2)	0.003	2.349	0.001	2.400
Density (DENS)	−0.001	−2.073	−0.000	−2.083
Contract period (CP)	0.002	1.602	0.000	1.613
Prolongation period (PP)	−0.052	−0.147	−0.012	−0.147
Log L		−69.83		
Log L_0		−90.34		
χ^2		41.01		
No of observations		131 (123)		

TABLE 3
Actual and Predicted Values, Simplified Procedure

	Predicted Values		
Actual Values	Simplified = 0	Simplified = 1	Total
Simplified = 0	47	24	71
Simplified = 1	10	50	60
Total	57	74	131

The likelihood ratio index is 0.23, which indicates that the variables have explanatory power. The fact that the model cannot be rejected is further underlined by the χ^2 statistic from the likelihood ratio test,[20] which is well above the critical value on the 0.5 percent level. The estimated average probability that the simplified procedure is the observed choice, calculated according to expression (10), is 0.47. Actual *versus* predicted values of the choice of the simplified procedure are found in Table 3. The percentage of correctly predicted values is 74.

The estimation results from the binary logit model for procurements above the threshold value is presented in Table 4. The results show no single significant impact from these parameters on the decision to restrict the competition or not. However, the variables have some explanatory power according to the likelihood ratio index, which is 0.14. The χ^2 statistic from the likelihood ratio test shows that the model cannot be rejected at a 10 percent significance level.

Although it is possible theoretically to motivate the option to restrict the competition in public procurement on the basis of an implementation cost, there is no empirically support of this in the current study. One explanation of the lack of significant results could be the small number of observations. Another explanation is that the type of costs previously discussed is difficult to measure and the variables used here do not reflect these costs correctly.

TABLE 4
Maximum Likelihood Estimates and Partial Derivatives, Expression (13)

	MLE		Partial Derivatives	
Variable	Coefficient	t-value	Coefficient	t-value
Constant	−0.782	−0.637		
No of contracts (NC)	0.078	1.492	0.019	1.494
No of contracts squared (NC^2)	−0.002	−1.375	−0.000	−1.381
Density (DENS)	−0.001	−1.227	−0.000	−1.240
Contract period (CP)	0.000	0.201	0.000	0.201
Prolongation period (PP)	0.201	0.354	0.046	0.355
Same mechanism (SAME)	−0.824	−1.399	−0.195	−1.466
Socialists share (RED)	1.476	0.653	0.361	0.651
Log L		−42.206		
Log L_0		−48.868		
χ^2		13.323		
No of observations		71 (64)		

TABLE 5
Actual and Predicted Values, Open Procedure

	Predicted Values		
Actual Values	Open	Restrictive	Total
Open	24	15	39
Restrictive	11	21	32
Total	35	36	71

The estimated average probability that the open procedure is the observed choice is 0.48 and the percentage of correct predictions is 63 percent. The number of correct and actual values is given in Table 5.

The results from the negative binomial regression in which the determinants of the number of bidders for each contract are estimated are presented in Table 6. The model has explanatory power because the $\chi^2(15)$ statistic is well above the critical value. The $\chi^2(1)$ shows that the results from the negative binomial regression are significantly different from the Poisson regression, i.e., there is evidence of over-dispersion. The results show, as one would expect, that there is significantly more bidders competing for contracts in more densely populated municipalities. The political variable affects the

TABLE 6
Negative Binomial Regression Estimates (Expression (14))

Variable	Coefficient	t-value
Constant	2.230	22.632
Density (DENS)	0.000	8.162
Socialist (RED)	−0.843	−5.470
No of contracts (NC)	−0.002	−1.833
Schools (CC_5)	−0.002	−0.040
Day care centers (CC_6)	0.039	0.629
Medical health centers (CC_7)	−0.053	−0.617
Purifying plants (CC_8)	0.073	0.437
Sport centers (CC_9)	−0.161	−1.093
Libraries (CC_{10})	0.068	0.422
Others (CC_{11})	−0.054	−0.446
Simplified procedure (PRP_{12})	−0.150	−3.709
Restrictive procedure (PRP_{13})	−0.336	−8.409
Negotiated procedure (PRP_{14})	−0.521	−6.101
Contract period (CP)	−0.000	−1.158
Prolongation period (PP)	0.371	12.274
Log L		−1,845.862
Log L_p (Poisson Regression)		−1,850.521
$LogL_0$		−2,118.394
$\chi^2(1)$		9.317
$\chi^2(15)$		545.064
Dispersion parameter	0.185	2.937
No of observations		758

number of bidders significantly. The number of bidders is decreasing in proportion to the number of seats in the local council assigned to the socialist parties. The contract category has no significant impact on the number of bidders for each contract compared with the reference category, office.

Contracts auctioned under the open procedure attract significantly more bidders than contracts auctioned under the simplified procedure. This indicates that the number of interested suppliers increases the larger the volume of the procurement in which the contract is auctioned. One possible explanation is that some potential suppliers do not bother to bid for contracts, that they consider having too low a value in comparison with devoting their capacity to other projects. The negotiated and restricted procedures had significantly less bidders than the open procedure. A Wald-test shows that the negotiated procedure parameter is significantly less than the restricted procedure parameter. The test statistic, which is χ^2 distributed, is 16.19.[21]

The length of the contract has no significant effect on the number of bidders. However, contracts with longer prolongation periods tend to attract more bidders. One possible explanation is that some firms might not find it worthwhile to bid for contracts that would require investments on their part, in order to be able to carry out the work, if the expected total contract period is only short. These results suggest that the length of the contract and prolongation periods should be set with caution when the contract is designed.

To summarize the findings in the empirical section, the data and the regression results do not support the assumption that an implementation cost actually affects the choice of procurement procedure. From the regression results, it is possible to conclude that contract specifications and municipality characteristics have, together with the number of contracts auctioned in one and the same procurement, an effect on whether the volume of the procurement is below or above the threshold value. There is also evidence that the number of bidders is dependent on contract specifications and municipality characteristics.

Summary and Conclusions

The aim of this paper was to study the choice of procurement procedure in public procurement in Sweden. The contracting entity, representing the municipality, has a choice between four mechanisms, all of which stipulate sealed bids and that the contract should be awarded to the lowest bidding supplier. The procurement procedures are all first-price sealed bid auctions or variants of the same. Depending on the volume of the procurement, the contracting entity can be selective and restrict entry.

There is no support in standard auction theory for the possibility of limiting the number of bidders. Since the equilibrium bid function is decreasing in the number of bidders, so is the payment from the contracting entity to the winner. To find an argument to support this, an implementation cost is introduced for the contracting entity. This cost is added to the expected payment to the winner. The implementation cost is assumed to be dependent on contract specifications and municipality characteristics.

The possibility that the choice of procurement procedure is independent of the implementation cost is tested on data on the procurement of cleaning service contracts in Swedish municipalities. The determinants of the probability that the volume of the procurement is below or above a threshold value are estimated using the binary logit model. The results show that the probability that the volume of the procurement is below the threshold value is decreasing the lower the population density in the municipality and that the number of contracts auctioned in one procurement has a significant impact on this probability. In the case where the volume exceeds the threshold value, the determinants of the probability that the contracting entity does not restrict the competition in the procurement are estimated using the binary logit model. The results do not show any single significant impact from contract specifications and municipality characteristics on this probability. However, this paper should be seen as a first attempt to formalize and estimate the choice of procurement procedure in public procurement for well-defined contracts. It is left for further research to collect more data and find more robust results.

Footnotes

[1] According to the Swedish Competition Authority [1996], public procurement in Sweden accounts for about 10 percent of the gross national product every year.

[2] This mechanism is proved by Tan [1996] to be the optimal procurement procedure when the contracting entity has private information about its demand.

[3] There is one exception, the direct procurement, which does not involve any bidding process and is not an auction.

[4] The bid is monotonically decreasing in the number of bidders in the auction, given that the costs are assumed to be private (see next section).

[5] See Laffont [1997].

[6] The assumption of private costs is reasonable since the contracts are well defined. Everything from the cleaning frequency to the cleaning equipment is specified in the technical specification of the service.

[7] The derivation of the equilibrium bid function can be found in e.g., Donald and Paarsch [1993]. The equilibrium bid function is valid for all bidders [McAfee and McMillan, 1987].

[8] Laffont et al. [1995].

[9] See Laffont [1997].

[10] The threshold value for internal cleaning services is €200 000 [NOU, 1996].

[11] Under this procedure, entry is free, but the contracting entity can invite some or all bidders to a negotiation after the auction. This is not observed in the procurements in the current study.

[12] For more details see Greene [2000].

[13] The open procedure allows free entry, while the restricted and negotiated procedures apply invited bidding. Further, under the negotiated procedure negotiations with some or all bidders are allowed after the auction. However, this is not found in the auctions studied in this paper. See Wang [2000] for a model that allows for negotiations after a first bidding round.

[14] The implicit assumption of the independence of irrelevant alternatives (i.i.a.) means that, if a fourth irrelevant alternative is added to the choice set, the relative probabilities assigned to the three original procurement procedures will not be changed. This assumption is not necessarily valid in practice but is a consequence of the multinomial logit model that would have been used if the choice set had consisted of three alternative procurement procedures (see Greene [2000]).

[15] During this period, there were 288 municipalities in Sweden distributed between 23 counties. Actually, in 1997, the Kristianstad county and Malmöhus county were merged into one county, the Skåne county. However, this does not affect the present analysis.

[16] The documents are the contract notice, the technical specification, the list of tenders, and the decision protocol.

[17] The Mann–Whitney test is a nonparametric test that ranks the observations for different samples and compares the medians from each sample. The null hypothesis is that the number of bidders under two different procurement procedures has the same distribution function. The Mann–Whitney test is used instead of, for example, the two-sample *t*-test when there is reason to believe that the difference between the procurement procedures in the number of bidders is not normally distributed (see Conover [1999]).

[18] See Greene [2000].

[19] Of the amount of the single contracts in the procurements, 48.8 percent, is below the threshold value. The same number for procurements above the threshold value is 4.9 percent.

[20] Computed according to $\chi^2[J] = -2(\ln L_0 - \ln L)$, where J is the number of possible restrictions (see Greene [2000]).

[21] See Greene [2000].

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