Auction Formats and Award Rules in Swedish Procurement Auctions

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Abstract

This paper provides an empirical analysis of outcomes from Swedish procurement auctions given award criterion and auction format. The auctions are single unit first-price sealed bid auctions or its simultaneous counterpart, and contracts can be awarded to lowest bidder or in accordance with qualitative criteria. The empirical results provide no evidence of differences in winning bids depending on the auction format. The award rule on the other hand matters, a horizontal comparison show higher winning bids on contracts awarded to some other but the lowest bidder. The effect of bidder interaction and bidder identity is also considered.

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1. Introduction

The main purpose of this paper is to empirically compare the outcomes of two different auction formats, single unit and simultaneous first price auctions of internal cleaning service contracts, and the two award rules that can be applied within public procurement in Sweden. This is an empirical study based on a unique data set with 758 contracts from procurements on the local government level in Sweden from the period 1992 to 1998.

Public procurement in Sweden answers to the Public Procurement Act (LOU 1992:1528), which states, in accordance with the standards applied within the European Union (EU), that sealed bidding is applied and that the lowest bidder should be awarded the contract. The winner is paid in accordance with her bid and the contracts are in general fixed price contracts. The auctions have the character of either single unit or simultaneous first price auctions. In the latter the bidder places separate bids on each single contract. There is one contract for each type of premises to be cleaned (a school, an office, etc.). Bids on the separate contracts should be independently evaluated relative to bids on the other contracts auctioned in one and the same procurement. That is, contracts are auctioned one by one in simultaneous first price auctions and it is not necessary for the bidder to place bids on all these contracts.

An important theoretical difference between the single unit and the simultaneous first price auctions is that the former is under the assumption of private costs efficient, which the latter necessarily is not.[1] One bidder could end up with all the contracts auctioned simultaneously although this bidder does not have the lowest cost to complete some of the contracts. Results by Krishna and Tranæs (2002) show that given combinatorial bidding simultaneous first price auctions can result in efficient allocations. However, there are no combinatorial bids present in the procurements studied here. As a consequence, the contracts that are auctioned under the simultaneous first price format were not necessarily offered to the bidder who had the lowest cost to complete the contract. Since bids are dependent on costs there could be a difference in the price paid to the winning bidder depending on the auction format. The first hypothesis that will be studied in the present paper is that contracts auctioned under the single unit format demand a lower price than simultaneously auctioned contracts.

[1] See Bikhchandani (1999) for a theoretical presentation of the simultaneous first price auction.

Furthermore, publicly procured contracts in Sweden can be awarded to some other but the lowest bidder. A higher bidder than the lowest bidder could be contracted if it is considered to be the economically most advantageous bid with respect to price, quality, environmental aspects, service, maintenance, and so forth. These criteria should be posted in advance of the bidding, but the weight attached to each criterion in the evaluation is in the procurements studied here unknown to the bidders prior to the bidding. High weights on price can in practice be equal to the lowest bid being the award rule. The application of two award rules without pre-announcement of the weights attached to each criterion could complicate the bidders' strategies. It is reasonable to assume a trade-off between posting a regular first-price auction bid and increasing the probability of being the lowest bid in case of a high weight on price, or a less aggressive bid hoping for higher weights on qualitative criteria (i.e. the economically most advantageous bid award rule). This would increase the profit to the bidder if she wins the contract. However, there is always the risk that the local government will go for the lowest bid leading to a loss of the contract. A significant effect of award rule on the winning bids would indicate that this trade off exists and is applied. Furthermore, allocation of contracts to some other but the lowest bidding bidder is inefficient since low bids are associated with low costs. This feature of the institutional rules governing Swedish procurement auctions has, to my knowledge, not been empirically analyzed or theoretically modeled in previous studies. The latter is left for further research to deal with. The second hypothesis to be tested in the present paper is that contracts awarded according to the lowest bid criterion commands a lower price that contracts allocated with the economically most advantageous bid criterion.

Vickrey (1961, 1962) was the first to formalize auction theory and, since then, the contributions to this area have been considerable, both with respect to theoretical issues, empirical papers, as well as applied studies. The number of different formalized auction formats has with time become substantial. There are several variants of both single unit auctions and multi unit auctions. When it comes to comparisons of different auction formats thereof there are a numerous number of papers to choose among and many of them are theoretical. The comparisons mainly focus on differences within single unit auction formats (e.g. Lucking-Riley, 1999), or within different multi unit auctions (e.g. Engelbrecht-Wiggans, 1988 and Szentes and Rosenthal, 2003), such as the discriminatory pay auction and the

uniform pay auction.[2] Krishna (2002) provides an exposition of different auction formats and the adherent theory. However, there are exceptions that compare single unit auctions to multi unit auctions. For example, Wilson (1979) compares the prices from auctions of one indivisible good (unit auctions) to auctions of one divisible good (share auctions). The uniform price auction is compared to the second price auction in List and Lucking-Reiley (2000). The bids from the two auction formats are compared with experimental auctions of sports cards. Comparisons of outcomes of different auction settings based on experiments within a common value setting can be found in Lunander and Nilsson (2004). As for comparisons of single unit and simultaneous first-price auctions Alsemgeest, Noussair, and Olson (1998) provide results from an empirical study based on experiments. The bidders compete for one or two (identical) units.

This paper contributes to the previous mentioned literature with an empirical comparison of the outcome of single unit first-price auctions to simultaneous first-price auctions and award criteria based on a rich data set with procurements on the local government level in Sweden. The 758 contracts concern internal cleaning of different public premises such as schools and day care centers. This has important policy implications for local governments regarding how they should auction their contracts and evaluate the bids. The effect of different auction formats on the winning bid is estimated in the same way as MacDonald, Handy, and Plato (2002) estimated the competitive effect on winning bids in US commodity procurements. However, these procurements did not have the diversity in auction format since all contracts were auctioned by single unit first price auctions. Another difference is the incorporation of bidder interaction effects on the winning bid. The computation of the interaction variables follows Gupta (2002).

The rest of this paper is organized as follows; a description of the bidding environment is given in Section 2. This is followed by a presentation of the data with a discussion of possible implications given by the bidding environment and variable definition in Section 3. The empirical approach and regression are presented in section 4 followed by presentation and

[2] Under both these auction formats the units are identical and the highest bidder wins. But, in the discriminatory price auction the winning bidders pay the sum of their bids on the units they are awarded. As a contrast, in the uniform price auction, the winning bidders pay the market-clearing price. That is; the price at which the bidders' demand equals supply. The winners are awarded units in accordance with the number of competing bids that they have overbid (see Krishna, 2002).

interpretation of the results. Finally, there is a discussion and an appendix with tables of descriptive statistics.

2. A simple model

The bidders' costs for completing an internal cleaning service contract are assumed to be private and independent. That is, the firms privately know their own cost to complete the contract with certainty and this is independent of the competitors' costs. It is reasonable to assume that the level of uncertainty regarding the cost for completing an internal cleaning service contract to be negligible. The firm knows the square meters to be cleaned, the internal cleaning frequency, the type of building, and resources demanded to do so. The contracts are not complex. Consequently, it is assumed that the cost for internal cleaning one square meter is independently drawn from a commonly known distribution. This cost is to be regarded as a basic internal cleaning cost for one square meter to be cleaned. Additional costs due to heterogeneity in contracts and bidding environment should be added to the basic internal cleaning cost. The bidders draw one cost for each contract auctioned in a single unit or a simultaneous first-price auction. If there are multiple contracts at stake, the cost for completing each contract is assumed to be independent of the costs for completing the other contracts auctioned simultaneously. This is reasonable due to the evaluation process in these procurements, which is described above. It is further assumed that the bidders in the market for internal cleaning services know each other well. Because of the local character of the market (firms compete in general within regions[3]) it is further assumed that the bidder in the market for internal cleaning services know each other well. Therefore, it is assumed to be no uncertainty about the number of bidders. So in each auction $i = 1,\ldots,n$ commonly known bidders compete for contract k, where $k=1,\ldots K$ is the number of contracts and the auction format is either single unit first-price auctions ($k = 1$) or simultaneous first-price auctions ($1 < k \leq K$).

Bidder i could place a bid on a contract k in accordance with the traditional equilibrium bid function for the sealed bid first-price auction, b_{ik}, or another bid, b'_{ik}, than that depending on her belief about award rule or equally, the weights attached to price and qualitative criteria,

[3] The geographical area corresponding to the municipality in which the contract is auctioned defines the region.

where $b_{ik} \leq b'_{ik}$.[4] This belief is reflected in a probability attached to each award rule. The probability that the lowest bid will win is denoted λ_{ik} and the probability that some other bid than the lowest bid will win is $(1-\lambda_{ik})$. Then the expected bid from bidder *i* is

$$E[b'_{ik}] = b_{ik} + (1-\lambda_{ik})\theta_{ik} \quad (1)$$

where θ_{ik} is a price mark up given the expectation that the economically most advantageous award rule will be applied. For $\lambda_{ik} > 0$ the bid from bidder *i* on contract *k* will be higher than the bid given in accordance with the standard equilibrium bid function based on the basic internal cleaning cost corresponding to a given quality and competition level. The profit to bidder *i* given that she is awarded the contract and the lowest bid award rule is applied is lower than the profit if she wins with a higher bid under the economically most advantageous award rule.

The bid from bidder *i* on each contract *k*, is further assumed to be a function of procurement characteristics (PC_k), the basic cost for internal cleaning of one square meter, c_k the number of bidders n_k, and municipality characteristics, MC_k.

$$b'_{ik} = b'_{ik}(PC_{ik}, c_{ik}, n_{ik}, MC_{ik}) \quad (2)$$

The bid is the demanded annual price per square meter to be cleaned. Turning back to expression (2) a motivation to consider possible differences in winning bid due to auction format is found in auction theory.[5] If the bidders follow the bidding strategy given by the equilibrium bid function for first-price sealed bid auctions their bids are decreasing in costs. All things equal, if a significant difference in winning bids is found between the auction formats, bidders behave differently depending on the format. This could indicate that the supposed independency among simultaneously auctioned contracts is questionable. This is the first hypothesis that will be tested with the data at my disposal. The second hypothesis concerns the potential effect on the winning bid from the award rule. As mentioned in the introduction, the bidders' uncertainty about the selection criteria or award rule prior to

[4] The derivation of the standard equilibrium bid function and the necessary assumptions are for example presented in Donald and Paarsch (1993).
[5] See, for example, Krishna (2004).

bidding could affect the bidding behavior and result in an efficient contract allocation. Should they go for the lowest possible bid hoping for price as the only selection criteria or a less aggressive bid increasing the profit in case of winning the contract? If contracts selected on the basis of price is found to demand a significantly lower price than contracts allocated according to the economically most advantageous bid criterion this could be evidence of such a trade-off.

3. Data

The empirical analysis is based on a data set from public procurements of internal cleaning contracts carried out by Swedish local governments during the 1992 to 1998 time period.[6] The data was collected from a survey of all Swedish local governments asking them for documents regarding procurements of internal cleaning service contracts.[7] The response rate was 79.5 percent. According to the survey, in 59 out of 229 municipalities the local government had procured this service during the time period.[8] The remaining of the local governments reported in-house production and many of them stated that they were ready to start to procure internal cleaning services, or discussing to do so. In Sweden, this is a political decision, which makes this study even more interesting because it has policy implications that could be important not only for those who already have put their in-house production up for competition but also for the local governments that are about to do so.[9] There are three settings in the data. The number of procurements is 131 consisting of 758 contracts and a total of 5 926 bids were placed on these. The variables of main interest in this paper are the winning bids (endogenous variable), the auction format, and the applied award rule (procurement characteristics). The other control variables are procurement-, winner-, and municipality characteristics.

The Procurement characteristics (PC): Dummy variables for auction format (*single*=1) and award rule (*lowest bid*=1) are included in the empirical analysis. The single unit first price auction is the most common auction format in the data. It counts for 61.8 percent of the

[6] Actually, there were three municipalities that contributed with procurements from 1990 and 1991 (4 contracts) and these are included in the data.
[7] The documents are the contract notice, technical specification, list of tenders, and decision protocol.
[8] Fifty one of those were usable.
[9] There have been some changes in the Public procurement act after the time period during which these procurements took place. But, the results and issues discussed in the present paper are still interesting and have policy implications for present and future procurements.

procurements. However, a majority of the contracts, 87.6 percent, were auctioned under the simultaneous first price auction. The economically most advantageous award rule is in general given in the announcement of the contracts in the data. The weights attached to the criteria were only occasionally made public prior to the bidding (in 2.3 percent of the cases). In only two of the procurements the lowest bid award rule was posted prior to the bids were placed. Despite this, 39.2 percent of the contracts were assigned to the lowest bidder. The lowest bid rule is more common under the single unit (68.8 percent) than the simultaneous first price auction (24.6 percent). All the four procurement procedures given by law[10] are represented in the data set. These are aggregated into a dummy variable in the estimations. The dummy variable takes the value one if the contract is auctioned in procurement with a total estimated value under the threshold value and zero otherwise (*simplified*=1).[11] High values are created by big contracts in terms of total square meters to be cleaned and/or many contracts auctioned simultaneously. All procurement procedures have the character of first price auctions and will hereafter be referred to as such. See table A1 in the appendix for frequencies and description of the different procurement procedures.

The contract period and type of internal cleaning premises are also accounted for. The internal cleaning premises could be a school, a day care center, an office etc. There is one contract for each internal cleaning premise. The effect of contract type is measured with dummy variables and school internal cleaning contracts are the reference category. See Table A2 in the appendix for a complete presentation of all the contract types.

Table 1. Descriptive statistics, number of bidders and winning bid with respect to procurement setting.

Procurement setting	Variable	Minimum	Maximum	Mean	Standard deviation	*N*
All	No. of bidders	2	37	7.83	3.90	756
	Winning bid	13.03	1069.51	132.83	76.63	
Single unit	No. of bidders	2	37	6.69	4.77	93
	Winning bid	13.03	1069.51	130.85	114.69	
Simultaneous	No. of bidders	2	18	7.99	3.73	663
	Winning bid	22.36	664.80	133.10	69.78	

The bidders (X): A well-established result in auction theory is that the competition within a first price auction affects the bid. A higher degree of competition does in general lead to lower

[10] The Public Procurement Act (1528:1992).
[11] The threshold value is 200 000 Euro.

bids and thereby lower payment from the local government to the winning bidder (see e.g. Laffont, 1997). This motivates the inclusion of the number of bidders in the empirical analysis, where the number of bidders is treated as exogenous. This variable is assumed to be decreasing. It is reasonable to believe that the competitive effect decreases after a certain number of bidders have entered the auction. The number of bidders per contract in the data set varies between 1 and 37 and is on average 7.8. From Table 1 it is evident that the single unit first-price auctions in the data attract on average significantly less bidders than the simultaneous first-price auctions. There is, however, no significant difference in the average winning bid with respect to auction format. Winning bids are measured in Swedish kronor per square meter to be cleaned in the 1994 price level.[12]

The bidding firms in the data are heterogeneous in size. There are five national firms who compete against smaller local firms where the former dominate the market for internal cleaning services in Sweden. Another dominant bidder category is the municipalities' in-house production.[13] The two most dominating national firms were together with in-house production assigned 68 percent of all contracts in the data. The five national firms and in-house production received 75 percent of all contracts. Little was left to the other smaller local firms. In-house production is the most successful bidder category with a success rate of approximately 50 percent (see Table A3 in the appendix). In accordance with Bajari and Hortacsu (2003), the effect of bidder heterogeneity is measured with firm specific dummy variables for the five dominating firms and the in-house production. The other smaller firms are reference category. See Table A4 in the appendix for descriptive statistics on winning bids contingent on bidder identity.

The municipality characteristics (MC): The population density, political situation, and unemployment per capita are used as municipality characteristics. The political situation is measured as the share of seats in the local council assigned to the social-democratic and leftwing parties. The population density is calculated as the population divided by land area. The average municipality in the data has a population density of 284.29, a local council where the left wing parties are assigned 45 percent of the seats, and an unemployment rate of approximately 8 percent. These variables are assumed to reflect the business environment

[12] The winning bids are normalized to a cleaning frequency of 260 days per year.
[13] There is one in-house production for each municipality. These are treated as one bidder category.

within the municipality and the character of the local government running the auction. More information on the municipality characteristics is found in Table A5 in the appendix.

4. The empirical model and estimation

The payment from the local government to the winning bidder is equal to her bid and assumed to be determined by expression (2). As in MacDonald, Handy, and Plato (2002) the estimated model has the character of the winning bid, b_k on an internal cleaning service contract, *k*, as a function of matrices with procurement-, winning bidder-, and municipality characteristics, respectively.

(3) $$b_k' = b_k'(PC_k, X_k, MC_k)$$

The potential effect of interaction among bidders is included in the empirical analysis. Interaction is a relevant issue since the data set covers a time period of six years and the local character of the market. The interaction effect is measured by the two interaction measures from Gupta (2002). The first one, $r1_k$, is the average of $C1_i$ which is the number of unique competitors *J* facing bidder i in relation to the total number of competing bids $n_k - 1$ facing bidder i on each contract k, over all contracts and procurements *p=1,…P* in a municipality.

(4) $$C1_i = \frac{J}{\sum_{k=1}^{K}\sum_{p=1}^{P}(n_{kp} - 1)}$$

(5) $$R1_k = \frac{\sum_{i=1}^{N} C1_i}{n_k}$$

Low values on $C1_i$ indicate that bidder *i* is frequently interacting with the same bidders. The measure is distributed between 0 and 1. A high value on $r1_k$ is the same as low interaction among bidders and more competitive bids (Gupta, 2002). The second interaction measure, $r2_k$, is the average of $C2_i$, defined as the number of unique competitors J facing bidder i in relation to the total number of contracts that bidder i has submitted bids on over all contracts and procurements in a municipality.

(6) $$C2_i = \frac{J}{\sum_{p=1}^{P} k_p}$$

(7) $$R2_k = \frac{\sum_{i=1}^{N} C2_i}{n_k}$$

Many unique competitors facing bidder *i* in relation to the number of contracts where *i* has been an active bidder explain a high value on $C2_i$. Low values on $r2_k$ indicate high interaction among bidders and reasons to suspect collusion and higher winning bids as a result. This interaction measure is empirically distributed between 0.08 and 29.39. More descriptive statistics on both interaction measures are found in Table A6 in the appendix. The use of the two different interaction measures is motivated since it is possible for a bidder to be active on many contracts but not interacting with the same bidders and vice versa. The time series in the data is incomplete; there are local governments that did not deliver documents regarding all procurements for the requested time period. So the interaction variables (presented later) are measures of the observed minimum level of the interaction among bidders within each municipality.

Two regression equations will be estimated. There are separate equations for each measure of bidder interaction.

(8) $$b'_k = \alpha_1 + PC_k\beta_{1PC} + X_k\beta_{1X} + MC_k\beta_{1MC} + \beta_{1r1}r1_k + \varepsilon_{1k}$$

(9) $$b'_k = \alpha_2 + PC_k\beta_{2PC} + X_k\beta_{2X} + MC_k\beta_{2MC} + \beta_{2r2}r2_k + \varepsilon_{2k}$$

The bidders' cost for completing the contract is the by piecewise pseudo maximum likelihood estimated cost (Donald and Paarsch, 1993) under the assumption of Pareto distributed costs. The error term is assumed to reflect unobservable things that can affect the bid and assumed to be normally distributed. The regression equations are estimated with ordinary least square.

6. Results

The estimation results for all the contracts and contracts auctioned with simultaneous first price auctions are presented in Table 2. From the table it is obvious that the award rule matters for the size of the winning bid in these procurements. As one perhaps would expect the winning bids are significantly lower if the lowest bid award rule has been applied instead of the economically most advantageous award rule. But this was not ex ante given since bids are determined (vertically) within each auction. This result supports the hypothesis that the bidder's strategy is affected by the auction format. The auction format has no significant effect on the winning bid. One interpretation is that bids on simultaneous auctioned contracts are independently of each other submitted as if they were auctioned one by one.

Table 2. Estimation results.

Variable	Expression (8) β	*t*-value	Expression (9) β	*t*-value
Constant	79.93	6.46	79.23	6.62
Auction format (*single*=1)	-3.97	-0.76	-2.28	-0.44
Award rule (*lowest bid*= 1)	-32.81	-14.37	-33.01	-14.48
Procurement procedure (*simplified*=1)	-6.59	-1.58	-6.51	-1.55
Contract period	-0.00	-0.24	-0.00	-0.29
Child care contracts	16.19	5.00	16.22	4.96
Care contracts	1.74	0.45	2.33	0.61
Office contracts	17.57	3.15	17.51	3.17
Other contracts	12.84	1.93	12.75	1.92
Number of bidders (n)	-3.39	-4.48	-3.79	-4.67
Number of bidders squared (n^2)	0.09	3.80	0.12	3.52
Cost ($\hat{c}$)	0.86	33.95	0.87	34.03
Firm 1 winner	6.52	1.78	6.23	1.71
Firm 2 winner	15.34	3.30	15.18	3.27
Firm 3 winner	0.45	0.08	0.91	0.15
Firm 4 winner	-3.68	-0.70	-3.59	-0.69
Firm 5 winner	17.61	3.96	16.78	3.77
In-house winner	8.12	2.54	7.65	2.40
Population density (*density*)	0.00	1.68	0.01	2.16
Political situation (*red*)	-41.38	-2.86	-38.59	-2.75
Unemployment rate (*unemp*)	-2.79	-4.18	-2.68	-4.02
r1	-1.58	-0.24	-	-
r2	-	-	-1.16	-1.43
R^2_{adj}		0.75		0.75
N		756		756

It is clear that contract type matters for the size of the price. Winning bids on child care, office, and the other type of premises[14] internal cleaning contracts are significantly higher

[14] The other premises parameter is significant on the 10 percent level.

than on school internal cleaning contracts. A Wald test shows that health care internal cleaning contracts demand lower winning bids than contracts regarding child care premises (ten percent significance level). The test statistics from the Wald test are presented in Table A7 in the Appendix.

The firm specific parameters show that bidder identity matters for the size of the winning bids. A contract given to firm 2, firm 5, or in-house production commands a higher price than a contract given to some of the smaller firms in the data. Table A8 in the appendix provide test statistics from Wald tests where the coefficients from the firm dummy variables are tested against each other.

A look at the municipality characteristic parameters shows that these have a significant effect on the winning bids. Contracted firms in more densely populated municipalities have submitted higher bids than in sparsely populated municipalities. The parameter for political situation is negative and significant and so is the unemployment rate parameter. The higher the unemployment rate, the lower the winning bids. Consequently, the business environment and the character of the local government matters for the amount paid to the winning bidder. The estimation results do not indicate any effect on the winning bids from bidder interaction indexes.

The parameter estimates in Tables 2 is corrected for heteroscedasticity in accordance with White's corrected covariance matrix. The winning bids have also been estimated according to different specifications of bidder types, for example the two most dominating firms, firm 1 and firm 2, have been aggregated into one dummy variable together with the in-house production. There has also been an approach with a dummy variable for all five dominating firms and one for the in-house production. The estimation results on the other parameters are robust with regard to these different specifications. A try with the natural logarithm of the continuous variables was also made, but gave a worse model fit than a linear approach.

The overall conclusion is that these types of contracts should be awarded to the lowest bidder given that this does not lower the standards of quality and there is no indication of effect of auction format.

7. Summary and discussion

The aim of this paper is to analyze the outcome from Swedish procurement auctions of internal cleaning service contract given different award criteria and auction format. The contracts can be auctioned in single unit first-price sealed bid auctions or its simultaneous counterpart. There is a theoretical difference in the likelihood of the auction being efficient depending on the auction format, indicating a possible difference in outcome (the price paid to the winner). The empirical results provide no evidence of differences in winning bids depending on the auction format. The logical conclusion is that the bids on contracts auctioned simultaneously are indeed submitted independently of each other. The bids on simultaneously auctioned contracts should be and are evaluated independently of each other and the results indicate that the bidders act in accordance with this. The award rule on the other hand matters for the winning bids. Contracts can according to the Swedish Public Procurement Act (1992:1528) be awarded to some other but the lowest bidder in accordance with a qualitative criterion motivated as the economically most advantageous bid. There can be a mix of contracts assigned to the lowest bidder and some other but the lowest bidder within a simultaneous auction. A horizontal comparison of winning bids show higher bids on contracts awarded to some other but the lowest bidder. The paper also considers the effect of interaction among bidders. There is no evidence of collusive behavior among bidders in terms of how frequently they interact with each other in relation to how many competitors they face or how frequently they participate in the auctions. According to the results, the business environment and character of local government as well as the bidder identity matters for the price paid to the winner. Contracts assigned to the in-house production are more expensive than contracts given to smaller firms or some of the other dominating firms. This is particular interesting since the in-house production is one of the bidder types that dominates the market for public internal cleaning contracts and has the highest success rate in terms of likelihood of winning a contract.

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Appendix. Tables

Table A1. Description of the procurement procedures.

Procurement Mechanism	Description	#	Lowest bid award	Single unit first price auction
	MECHANISMS APPLICABLE UNDER THE THRESHOLD VALUE			
Simplified	All potential suppliers are allowed to bid. The contracting entity can invite some or all bidders to a negotiation after the auction.	129	82	63
Direct	No bidding process. Not an auction.	-	-	-
	MECHANISMS APPLICABLE OVER THE THRESHOLD VALUE			
Open	All potential suppliers are allowed to bid.	315	137	13
Restricted	Only potential suppliers invited by the contracting entity are allowed to bid.	255	64	8
Negotiated	As restricted. but the contracting entity can invite some or all bidders to a negotiation after the auction.	59	15	10
N		758	298	94

Table A2. Descriptive statistics, winning bids given contract type

		Statistics				
Variable	Sample	Min	Max	Mean	σ	*N*
School	All	22.83	412.59	108.10	41.97	319
	Single	59.96	311.40	100.96	46.20	32
	Simultaneous	22.83	412.59	108.88	41.49	287
Child care	All	46.50	664.80	168.42	80.23	302
	Single	84.24	413.24	154.58	56.63	32
	Simultaneous	46.50	664.80	170.06	82.34	270
Care	All	26.76	191.75	101.16	35.85	27
	Single	43.47	154.59	99.22	33.41	11
	Simultaneous	26.76	191.75	102.49	38.46	16
Office	All	32.19	283.74	104.40	62.55	65
	Single	53.36	207.59	113.21	56.34	10
	Simultaneous	32.19	283.74	102.80	63.96	55
Other	All	22.36	239.47	110.38	52.93	34
	Single	78.51	196.76	137.63	83.62	2
	Simultaneous	22.36	239.47	108.68	52.02	32

Table A3. Statistics on bidding behavior and success rate for national firms and in-house production.

	Number of placed bids				Number of wins				Success ratio	
	All		Simultaneous		All		Simultaneous			
	#	%	#	%	#	%	#	%	All	Sim.
Firm 1	698	92.1	620	93.4	196	25.9	172	25.9	0.28	0.28
Firm 2	561	74.0	507	76.4	98	12.9	80	12.0	0.17	0.16
Firm 3	338	44.6	321	48.3	23	3.0	20	3.0	0.07	0.06
Firm 4	51	6.7	48	7.2	22	2.9	21	3.2	0.43	0.44
Firm 5	83	10.9	65	9.8	4	0.5	1	0.2	0.05	0.02
In-house	437	57.7	371	55.9	218	28.8	202	30.4	0.50	0.55
N	758		664		758		664		758	664

Table A4. Descriptive statistics, winning bids given bidder identity

		Statistics				
Variable	Sample	Min	Max	Mean	σ	*N*
Firm 1	All	22.83	413.24	121.29	50.20	196
	Single	54.11	413.24	119.83	70.65	24
	Simultaneous	22.83	338.28	121.49	57.66	172
Firm 2	All	31.77	365.71	129.99	58.19	98
	Single	62.19	165.85	116.47	25.70	18
	Simultaneous	31.77	365.71	133.03	62.96	80
Firm 3	All	82.91	443.67	163.41	92.24	23
	Single	115.23	225.24	163.50	56.23	3
	Simultaneous	32.19	443.67	163.40	97.57	20
Firm 4	All	56.82	264.45	140.06	66.51	22
	Single	82.66	82.66	-	-	1
	Simultaneous	56.82	264.45	142.80	68.88	21
Firm 5	All	102.56	190.01	131.94	39.36	4
	Single	102.56	118.33	112.58	8.71	3
	Simultaneous	190.01	190.01	-	-	1
Smaller firm	All	13.03	1069.51	153.04	100.61	241
	Single	13.03	1069.51	135.31	185.36	30
	Simultaneous	42.44	664.80	155.57	82.29	211
In-house production	All	22.36	581.57	124.60	62.16	218
	Single	53.36	311.40	157.33	62.33	16
	Simultaneous	22.36	581.57	122.00	61.56	202

Table A5. Descriptive statistics, municipality characteristics by auction format

		Statistics				
Variable	Sample	Min	Max	Mean	σ	*N*
Population Density	All	4.60	2808.02	284.29	486.52	758
	Single	4.60	2808.02	361.94	701.08	94
	Simultaneous	8.75	2749.69	273.30	447.59	664
Red	All	0.18	0.67	0.45	0.13	758
	Single	0.18	0.67	0.45	0.09	94
	Simultaneous	0.21	0.66	0.45	0.13	664
Unemployment rate	All	1.76	13.96	8.16	2.52	758
	Single	1.76	11.28	7.99	2.00	94
	Simultaneous	3.90	13.96	8.18	2.59	664

Table A6. Descriptive statistics, interaction measures.

Statistics	$r1_k$	$r2_k$
Mean	0.16	1.01
Std.deviation	0.22	1.79
Percentiles		
Minimum	0.02	0.08
5	0.02	0.08
10	0.03	0.16
25	0.04	0.32
50	0.07	0.48
75	0.13	1.05
Maximum	1.00	29.39
N	756	756

Table A7. Wald test. $\chi^2(1)$-statistic for contract categories.
Results from estimation of expression (8)/(9)

	Child care	Health care	Office	Other
Child care	-	3.16*/2.92*	0.06/0.05	0.29/0.32
Health care		-	3.12*/2.86*	1.37/1.20
Office			-	0.39/0.40
Other				-

* Significant at the 0.10 level.

Table A8. Wald test. $\chi^2(1)$-statistic for dominating bidders.
Results from estimation of expression (8)/(9)

	FIRM 1	Firm 2	Firm 3	Firm 4	Firm 5	In-house
Firm 1	-	2.18/2.27	0.47/0.36	1.33/1.23	0.30/0.28	0.16/0.12
Firm 2		-	2.39/2.19	3.93**/3.86**	0.01/0.01	1.68/1.84
Firm 3			-	0.12/0.15	0.65/0.56	0.77/0.59
Firm 4				-	0.98/0.89	1.78/1.60
Firm 5					-	0.23/0.21
In-house						-

** Significant at the 0.05 level.