Contract Size and Small Firm Competition in Public Procurement

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ABSTRACT

The European Commission encourages public authorities to split procurement contracts into multiple contracts in order to increase the competiveness of small and medium sized enterprises (SMEs). In this paper, I use data from Swedish public procurement auctions for internal regular cleaning service contracts to study the effect of contract size and number of contracts on SME participation and the probability of submitting the winning bid. I found that SME participation is negatively related to both contract size and the number of contracts in the procurement. A possible interpretation is that reduced contract size in order to stimulate SME participation is counteracted by reduced incentives for them to enter into procurements with multiple contracts. Medium-sized firms are also more successful when bidding for smaller contracts relative to large firms. Nevertheless, the results indicate that the SMEs' award rate is positively correlated with the number of contracts in the procurement.

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1. Introduction

The European Commission acknowledges that small and medium sized enterprises (SMEs) are underrepresented when it comes to bidding for and being awarded public procurement contracts. A large contract size is argued to put SMEs at a disadvantage relative to larger firms because SMEs might not have the necessary capacity and financial resources to fulfill the contract. Splitting the procurement contract into lots of limited scope is expected to induce SMEs' likelihood of participating in the auction and winning the contract (European Commission, 2011; 2012).

The implicit assumption for this argument is that SMEs are less efficient at carrying out large projects relative to large firms. Indeed, if the degree of asymmetry in the distribution of production costs for SMEs and large firms are large enough it becomes unprofitable for the least-efficient SMEs to enter into the auction, especially when there are substantial entry costs involved (Krasnokutskaya and Seim, 2011). Large projects might therefore act as a barrier to entry and consequently reduce the level of competition. The objective of this paper is to evaluate to what extent reduced contract size – by splitting the procurement contract into lots – is associated with increased cost symmetry across different firm size categories and whether this is associated with increased competitiveness of SMEs. The effect of procurement design on SME competition is assessed on the basis of the potential bidder's entry decision and their probability of being awarded the contract.

Increased competition through induced participation by SMEs may, all else being equal, result in more aggressive bidding and lower prices. The procurement policy thus has the potential dual benefit of supporting SMEs while reducing public expenditures. However, the net effect on the price the contracting authority has to pay depends on the relative magnitude of the competition effect on the auction clearing price and inefficiencies that could arise due to foregone economies of scale (Greer and Liao, 1986; Seshadri et al., 1991; Klotz and Chatterjee, 1995b). Thus there is a potential trade-off between price on the one hand and increased SME representation in public procurement contracts on the other.

Textbook examples of how to design a procurement auction to encourage entry from disadvantaged potential bidders include bid preference programs, set-asides, and the above-mentioned practice of splitting the procurement into multiple lots, which is referred to in the literature as a split-award (SA) (Milgrom, 2004). A bid preference program can involve giving disadvantaged bidders a price preference in the supplier selection process (see, for example, McAfee and McMillan, 1989; Marion, 2007; Krasnokutskaya and Seim, 2011). A set-aside policy is implemented by setting aside a fraction of contracts for targeted firms, and a bidder is typically not eligible to win more than one contract (Milgrom, 2004; De Silva et al., 2012). Empirical studies have shown that bid preference programs increase participation by the favored bidder category – e.g. small firms – and increase the probability of their winning the contract, but this comes at the expense of decreased participation and award rate

of the non-favored category – e.g. large firms (Marion, 2007; Krasnokutskaya and Seim, 2011). The net effect on the auction clearing price has been found to be either positive (Marion, 2007) or statistically insignificant (Krasnokutskaya and Seim, 2011). Nevertheless, counterfactual simulations in both studies indicate that an optimal bid preference has the potential to achieve substantial redistribution of profits from large firms to small firms at no, or small, costs to the contracting authority. De Silva et al. (2012) do not explicitly model entry, but they find little difference in the bidders' private costs for fulfilling the contract when comparing procurement projects with and without a set-aside program for disadvantaged potential bidders.

The discriminatory policies of set-asides and bid preference programs are used in the US but not in the EU because they violate the general EU principles on equal treatment, transparency, non-discrimination, proportionality, and mutual recognition (Directive 2004/17/EC and Directive 2004/18/EC). The objective of the current study is to empirically evaluate the importance of contract size and the practice within the EU of splitting the procurement into multiple lots with the purpose of creating business opportunities for SMEs. A SA procurement is defined to occur whenever the contracting authority splits the procurement contract into two or more lots with one contract per lot (onward contract). The policy can be characterized as nondiscriminatory because it does not explicitly provide any preferential treatment to a favored bidder category. Package bids are not allowed in the current setting, and potential bidders are invited to submit sealed stand-alone price bids for one or several contracts in the procurement as opposed to the standard winner-take-all (WTA) procurement auction, which explicitly excludes the possibility of divided production over multiple contractors (Anton and Yao, 1992).

The awarded supplier, i.e. the contractor, gets a fixed compensation throughout the contract period in accordance with their price bid. A potentially limiting effect on SME participation and winning is the lack of restrictions on the number of contracts an efficient supplier can be awarded. Thus, the current form of the SA procurement policy enables the bidders to internalize potential economies of scale, or synergy effects, in their stand-alone price bids *across* contracts within the procurement. This may offset, partially or in whole, the goal of the European Commission to support SMEs through splitting the procurement over multiple contracts.

Additional benefits of the contracting authority making contracts with multiple contractors are a reduced risk of nonperformance and increased disciplinary power over the contractors during the contract period (Perry and Sakovics, 2003). These benefits may come at the cost of increased administration and coordination when having to deal with multiple contractors both in the bid-evaluation process as well as during the contract period (Chaturvedi et al., 2014). However, the methods used here were not designed to measure such costs, thus determining the effect of such a tradeoff is beyond the scope of the current study.

The potential of contract size and SAs to increase SME participation and probability of winning the contract has, to my knowledge, not been studied empirically before. Rather, previous studies on SAs have mainly focused on assessing the effect on auction clearing price in highly complex, and often incomplete, procurement projects with learning effects and diseconomies of scale (see, for instance, Lyon, 2006). In contrast to these previous studies, the internal cleaning service contracts investigated in this study are associated with relatively non-complex and labor-intensive production technologies and are not likely to exhibit any substantial learning effects over time (Hyytinen et al., 2015). Furthermore, empirical studies have indicated economies of scale in the number of square meters to be cleaned (see, for instance, Christoffersen and Paldam, 2007; Lunander and Lundberg, 2013). This enables me to evaluate the effect of contract size and multiple contracts on SME participation and award rate in a setting different from previous studies.

The bidding firms in the data were categorized into small, medium, and large firms based on their number of employees. The effect of procurement design on the outcome variables of interest was analyzed using cross-sectional variation in contract size and the number of contracts in the procurements under study. Results from 331 procurements comprising 634 contracts showed substantial heterogeneity in participation rates and award probability across firm size categories, and these differences were related to contract size and number of contracts. Linear probability model (LPM) estimates on the potential bidder's entry decision indicated that SME participation is negatively related to both contract size and the number of contracts in the procurement. This suggests that the reduced contract size intended to stimulate SME participation is counteracted by reduced incentives for SMEs to enter into procurements with multiple contracts. While the award rate for small bidders was not affected by contract size, the award rate for medium-sized firms decreased along with increasing contract size. Nevertheless, the award rate for SMEs was positively correlated with the number of contracts in the procurement. Results from the Swedish cleaning service sector thus provide support for the practice used within the EU of splitting the procurement into multiple contracts in order to provide business opportunities for SMEs.

The rest of the paper is organized as follows. Section 2 accounts for the main findings in the literature on SA auctions. Section 3 gives an overview of the institutional setting and limitations when attempting to pursue a procurement policy in the EU. Section 4 presents the data set and the measurements of variables. Section 5 outlines the empirical approach and the results. Section 6 concludes the paper.

2. Previous literature

Predictions from theoretical and empirical models of entry and bidding in SA auctions vary for different assumptions about technology, information setting, and auction rules. Several previous studies on SA procurements have empirically analyzed defense procurements where the auction design

is commonly employed. This environment can be characterized by limited competition and highly complex and often incomplete contracts with significant learning effects over time (Klotz and Chatterjee, 1995a).

In a sealed-bid, first-price auction with only two bidders that have complete information about each other's costs, Anton and Yao (1992) showed that splitting the procurement into two contracts could reduce competition and increase the bidding price by encouraging the bidders to implicitly coordinate their actions. However, they also showed that bidding coordination becomes increasingly difficult when the bidders' cost structure is private information, and in this context the SA may result in lower auction clearing prices than WTA auctions.

The benefits of SAs are more apparent for procurement projects that exhibit diseconomies of scale and considerable learning effects over time, such as the previously mentioned defense procurements (Dasgupta and Spulber, 1990; Anton and Yao, 1992; Lyon, 2006; Anton et al., 2010). In this environment, it is socially efficient to split total demand (i.e., the procurement) into contracts of limited scope and thus enable the contractors to operate at a lower unit cost. A SA may also prevent the dynamic effects of increasing cost asymmetries between incumbent contractors and new entrants due to learning effects over time, and this is highly relevant in terms of the incomplete contracts that are usually awarded in the defense industry (Lyon, 2006).

The benefits of using the SA format are not as evident for technologies characterized by economies of scale, which may be of relevance in the current study. With symmetric potential bidders, multiple contracts are socially inefficient because they restrict the contractors to operating at a higher unit cost. With costly entry, it may still be beneficial for contracting authorities to employ SAs if this can induce entry. However, more competition may not compensate for selecting a less efficient contractor (Greer and Liao, 1986; Seshadri et al., 1991; Klotz and Chatterjee, 1995b).

Relaxing the assumption of symmetric cost types, there are other efficiency arguments in favor of SAs. As noted by Milgrom (2004), multiple contracts may encourage entry when there are systematic cost asymmetries among the potential bidders arising from issues such as capacity constraints. For instance, if small potential bidders have economies of scale in a more narrow range of production, i.e. local economies of scale, compared to large bidders having global economies of scale, there may be efficiency arguments in favor of a SA. In fact, a SA can in such instances restore cost-symmetry and thus the competiveness of the small potential bidders. The auction design can even result in improved efficiency given that the small potential bidders have a local cost advantage over large potential bidders (Greer and Liao, 1986; Krishna and Rosenthal, 1996).

Nevertheless, the strategic considerations in SA procurement auctions with synergies across contracts are quite complex and depend on the auction rules. Krishna and Rosenthal (1996) modeled

equilibrium bidding strategies for a simultaneous second-price, sealed-bid auction with independent private costs and showed that bidding by a large bidder with global economies of scale always becomes more aggressive the larger the synergy effects. Their results also indicate that bidding always becomes less aggressive as the number of large potential bidders increases. The intuition for this "exposure" problem is that the likelihood of ex-post realization of synergy effects through multiple contract awards decreases with the number of large potential bidders. The effect on bidding is mixed when it comes to an increased number of small potential bidders with local economies of scale.

The predictions for the second-price auction derived in Krishna and Rosenthal (1996) have not been generalized to the case of a first-price, sealed-bid auction. However, De Silva et al. (2013) shed light on the mechanisms of multiple contracts with synergy effects in a first-price, sealed-bid procurement auction. In a natural experiment setting, they compared entry and bidding behavior when contracts were being tendered simultaneously or sequentially in a morning and afternoon session. Their results indicated that bidding becomes more aggressive in the sequential setting. The authors argue that the difference in bidding strategy can be attributed to information revealed by the award outcome of the morning session. Thus, it seems that sequential auctioning of multiple contracts instead of a simultaneous auction can resolve some of the uncertainty regarding the ex-post realization of synergy effects.

Theory predicts that smaller contracts by means of a SA can result in increased cost symmetry across bidder categories. A potential counteracting effect is the possibility for bidders to internalize expected synergy effects in their price bids across contracts within a given procurement. By examining the effect of contract size and the number contracts on the SME's probability of entry and being awarded the contract, this study contributes to the existing literature on procurement policies with the intention to provide business opportunities for a disadvantaged category of potential bidders.

3. Institutional Background

The European Commission acknowledges that SMEs play a vital role in the economy, and facilitated access to public procurement is one of the ten principles in the Small Business Act for Europe to promote SME growth. Whereas SMEs represent about 99% of all firms in the economy, they are recognized as being highly underrepresented when it comes to bidding for, and being awarded, public contracts. The most widespread policies currently used to encourage participation by SMEs are SAs, simplified access to information through centralized websites, and other e-procurement developments (European Commission, 2011). Public procurement in Sweden is highly dispersed, and procurement decisions are made by numerous distinct authorities – including municipalities, county councils, public enterprises, and central governments. Local contracting authorities have full discretion regarding contract size and the number of contracts when designing the procurement auction. The consequent

variation in procurement design is useful when studying the effect of contract size and the number of contracts on the SME's probability of entry and of winning the contract.

Procurement of public contracts in the EU is generally done by means of a descending-bid auction in which potential bidders are invited to enter a sealed bid in accordance with the specification in a call for tender. The contracting authority is fully committed to the number of contracts specified in the call for tender. All contracts within a given procurement are identical with respect to letting date, criteria to be fulfilled, and supplier selection method. However, contracts can differ when it comes to size and other contract-specific characteristics.

A bid for a given procurement includes one set of documents detailing how the criteria in the specification are to be fulfilled and a stand-alone price-bid for each contract the potential bidder intends to compete for. After the letting date falls due, the contracting authority evaluates all received bids according to the criteria specified in the call for tender. Only submitted bids that comply with each mandatory criterion are qualified for supplier selection on the basis of either the lowest price or the most economically advantageous tender (MEAT).[2] MEAT implies that all qualified bids are ranked according to a multidimensional scoring rule including price and other quality attributes (Asker and Cantillon, 2008; 2010; Bergman and Lundberg, 2013; Hyytinen et al., 2015). Within the current procurement segment, the designated winner of each contract is compensated with a fixed payment throughout the contract period in accordance with the winner's price bid. The procurement design ultimately affects the potential bidder's expected profitability of entering a particular contract, as detailed further below.

4. Data

The empirical analysis was carried using extensive data from internal regular cleaning service contracts awarded by Swedish public authorities from Dec. 2008 through Dec. 2010. The data were extracted from an official database that covers about 90% of all public procurement auctions in Sweden. The full sample consisted of 338 procurement auctions comprising 725 contracts and 3,974 bids that qualified for the supplier selection process. By excluding procurements with only partial information on contract size, the sample was reduced to 331 procurements comprising 634 contracts and 3,433 bids. The data included detailed information on procurement, contract, and bidder characteristics. These characteristics will be discussed in more detail in Sections 4.1 and 4.2. To get a sense of how the data were structured, the full sample of $m = 331$ procurements was partitioned into two subsamples including SA and WTA auctions. The first subsample included 66 SA procurements

[2] See Wan and Beil (2009) for a discussion on the difference between post-qualification (as employed in this work) and pre-qualification.

(i.e. multiple contracts auctioned in one and the same procurement), and the second subsample included 265 WTA procurements (single contracts).

The European Commission uses two main criteria to establish SME status, the number of employees or the company's turnover (European Commission, 2003). The cleaning service sector is highly labor intensive, so SME status was established in this paper according to the most commonly used criteria of number of employees. A medium-sized firm has fewer than 250 employees whereas a firm with fewer than 50 employees is considered to be small.

Information about the number of employees for the 301 unique bidders identified in the data was retrieved from Statistics Sweden. This information did not include the exact number of employees, but based on their definition the bidders were divided into 16 size categories (*SIZE*). See Table A1 in the Appendix for more information on the number of unique bidders per size category. A value of *SIZE* less than or equal to 5 was used to indicate a small firm (*S*) with fewer than 50 employees. The data from Statistics Sweden were somewhat limited in exactly identifying medium sized firms. The upper threshold according to the European Commission of 250 employees was contained in size category 8, which comprised the broad interval of 200–499 employees. Therefore, in this paper I have used a somewhat more restrictive definition of medium-sized enterprise (*M*) as a firm being in the interval of 50 to 199 employees, which corresponds to *SIZE* being 6 or 7. A large firm (*L*) was defined as having more than 199 employees.

The models of participation and entry required a measure of the competitive environment for each contract. A potential bidder was defined on the basis of the observed bidding behavior of cleaning firms in the relevant market for the sample period of two years.[3] Because internal regular cleaning services are both produced and consumed locally, the relevant geographic market was assumed to follow the Labor Market Area (LMA) as defined by Statistics Sweden.[4] Following Lundberg et al. (2015), the set of potential bidders for each LMA was based on the observed number of unique bidders that submitted at least one bid during the sample period.

4.1 Procurement characteristics (Z_m)

Table 1 presents summary statistics of the number of contracts and procurement size in terms of total number of square meters to be cleaned. The number of contracts in the procurement (*#CONTR*) is a proxy for the potential bidders' possibility to internalize expected synergy effects across contracts in the procurement. The average SA procurement was divided into 5.59 contracts compared to the single

[3] A similar method to construct a set of potential bidders was used in Athey et al. (2011).
[4] LMA is based on actual commuting pattern of workers in Sweden and consists of 70 areas.

contract in WTA procurements. SA procurements were also on average about 6 times larger than WTA procurements.

Table 1. Summary statistics of procurement-level characteristics and outcomes.

	SA Obs. = 66		WTA Obs. = 265	
Variable	Mean	Std. dev.	Mean	Std. dev.
Number of contracts (*#CONTR*)	5.59	5.64	1.00	0.00
Procurement size, area to be cleaned in m^2	54,820	124,059	9,007	22,656
Number of unique bidders	7.09	4.21	5.45	3.77
Number of unique contractors	2.36	1.35	1.00	0.00

Procurement-level outcomes for the two subsamples indicate a slightly higher number of unique bidders in SA procurements relative to WTA procurements (Table 1). This number might, however, not be very informative without information on contract-level competition as presented in Table 2. The summary statistics further indicate that contract awards were concentrated to a limited number of contractors. Specifically, the average number of unique contractors per SA procurement was 2.36, which was less than half the amount of the number of contracts. Thus the possibility to realize synergies across contracts is substantiated by the relatively small ex-post number of unique contractors in SA procurements. Procurement-level outcomes served only to illustrate how the data were structured. The subsequent analysis of entry and winning was made on the contract level to better reflect the potential bidders' choice set and the fact that contract characteristics often vary across contracts within the procurement.

4.2 Contract characteristics (X_j)

To illustrate potential heterogeneity in contract characteristics and contract-level outcomes, Table 2 presents summary statistics of contract characteristics, potential number of bidders, and contract-level outcomes for j = 634 contracts by procurement format. The average contract size (*SQMC*) did not differ much across subsamples, and a Welch's t-test for unequal variances could not reject the null of equal mean (t-statistic of equality = 0.41). Additional contract characteristics included in the empirical analysis of participation, entry, and contract award were contract period, supplier selection method (*MEAT*), additional cleaning services, contract complexity, facility type to be cleaned, authority type, and potential number of bidders. In addition, a contracting authority can be geographically dispersed across several LMAs and municipalities, thus geographic dispersion was measured by the number of LMAs at the procurement level and by the number of municipalities at the contract level.

The marginal distributions of the two subsamples overlapped quite well on contract characteristics in all but a few variables. Contract period (*#YEARS*) was shorter for SA procurements than for WTA, while contracts in SA procurements had a longer option period (*#OPTY*). Furthermore, no WTA procurement spanned over more than one LMA, whereas SA contracts covered an average of 4.51 LMAs. Also related to geographical dispersion was the variable *MDELIVERY*, which took a value of

one if the delivery sites spanned across more than one municipality. This was the case for 14% of the contracts in the SA procurements and 2% of the WTA procurements. The total number of environmental or quality criteria in the specification (*#CRITERIA*) was used in this paper as a proxy of contract complexity (see, for instance, De Silva et al., 2012, for a similar approach). In total, 54 criteria related to environmental or quality aspects of the service were identified from the procurement documents, and the average number of criteria was significantly higher for SA contracts (*t*-statistic of equality = 4.42).

Table 2. Summary statistics of contract-level characteristics, potential bidders, and outcomes.

	SA Obs. = 369		WTA Obs. = 265		Welch test of equality
Variable	Mean	Std. dev.	Mean	Std. dev.	*t*-statistic
Contract characteristics (X_{jm})					
Contract size, area to be cleaned (*SQMC*)	9,805	25,337	9,007	22,656	0.41
Contract period, years (*#YEARS*)	2.22	0.63	2.35	0.78	–2.17
Option period, years (*#OPTY*)	1.85	0.56	1.49	0.74	6.64
Most economically advantageous tender (*MEAT*)	0.45	0.50	0.49	0.50	–0.94
Number of labor market areas per procurement (*#LMA*)	4.51	6.25	1.00	0.00	10.79
Multiple municipalities per contract (*MDELIVERY*)	0.14	0.35	0.02	0.14	6.20
Periodic floor cleaning (*FLOOR*)	0.69	0.46	0.72	0.45	–0.63
Window cleaning (*WDW*)	0.56	0.50	0.52	0.50	0.77
Number of criteria (*#CRITERIA*)	16.68	3.95	15.09	4.80	4.42
Type of facility[¤]:					
(*SCHOOL*)	0.26	0.44	0.32	0.47	–1.63
(*OFFICE*)	0.59	0.49	0.58	0.49	0.08
(*CHILDCARE*)	0.21	0.40	0.22	0.41	–0.28
(*HOSPITAL*)	0.08	0.27	0.02	0.14	3.53
(*WORKSHOP*)	0.02	0.15	0.04	0.20	–1.37
(*CORRECTIONS*)	0.03	0.16	0.03	0.16	0.05
Potential bidders (N_{jm})					
Total number of firms in the LMA (*N*)	84.21	77.98	59.02	66.52	4.37
Contract outcomes (Y_{jm})					
Bidders total (*n*)	5.61	2.70	5.44	3.78	0.62
Bidders small (n_S)	0.95	1.24	1.08	1.76	–1.01
Bidders medium (n_M)	1.57	1.45	1.49	1.62	0.58
Bidders large (n_L)	2.99	1.64	2.75	1.67	1.83
Fraction of small contractors	0.11	0.31	0.09	0.28	0.80
Fraction of medium contractors	0.36	0.48	0.26	0.44	2.72
Fraction of large contractors	0.53	0.50	0.65	0.48	–3.04
Contractor firm size	9.56	4.36	10.36	4.26	–2.31

Notes. [¤]The dummy variables indicating type of facility are not mutually exclusive because a given contract can include several different types of premises to be cleaned.

The descriptive statistics thus suggest that SA is used more often in large and geographically dispersed procurements. The governing body for hospitals is typically a large and geographically dispersed organization, and this facility type was significantly more often represented in SA contracts than WTA contracts (*t*-statistic = 3.53). These differences in the marginal distributions of the observables emphasize the need to control for contract characteristics in the empirical analysis to isolate the effect of contract size and SA on outcome variables.

Other contract characteristics included in the vector X_j that might affect SME participation and their probability of being awarded the contract were additional cleaning services and the type of facility to be cleaned. Periodic floor cleaning (*FLOOR*) and window cleaning (*WDW*) are additional cleaning services that are associated with investments in special equipment and detergents that might be detrimental for SME participation and winning. The cleaning standard, contract size, and number of contracts in the procurement might further vary systematically with the type of facility to be cleaned, which was indicated by *SCHOOL*, *OFFICE*, *CHILDCARE*, *HOSPITAL*, *WORKSHOP*, and *CORRECTIONS*.

Descriptive statistics on the total number of potential bidders (*N*) in the LMA suggest that SA procurements are more commonly used in LMAs with a large number of potential bidders. A bidder is defined as a firm with a bid that has passed the post-qualification process (Wan and Beil, 2009). There was no evidence in the data that contracts in SA procurements attract more bidders relative to WTA contracts, and the average numbers of bidders (*n*) were 5.61 and 5.44, respectively. That only 7% and 9% of the number of the potential bidders (*N*) submitted a qualified bid is evidence of entry behavior. Based on the summary statistics, there was no significant difference in the number of bidders across procurement formats for the category of small and medium-sized firms. However, the average number of large bidders was larger for contracts in SA procurements (*t*-statistic = 1.83).

The fraction of small contractors was 9% and 11%, of WTA and SA, respectively, and there was no significant difference across procurement formats. In contrast, the fraction of medium-sized contractors was significantly larger for contracts in SA procurements relative to WTA procurements (*t*-statistic = 2.72). The difference in contract awards to medium-sized firms was also reflected in the average size of the contractor, and the number was significantly lower for SA contracts (*t*-statistic = –2.31). Hence, the difference in contract awards to medium-sized firms was reflected in the fraction of large contractors being smaller in SA procurements relative to WTA procurements (*t*-statistic = –3.04). The observed differences suggest that SA increases competiveness for medium-sized firms.

Summary statistics of contract-level and bidder-level characteristics of the full sample used in the empirical analysis are presented in Table A2 in the Appendix. As indicated by the reported medians and means, the variables *#CONTR*, *SQMP*, *SQMC*, and *#LMA* appeared to be skewed to the right, and in the empirical analysis these were handled by using a natural log transformation.

The set of potential bidders was defined on the basis of the observed bidding behavior during the sample period. Table 3 reports summary statistics of bidder characteristics, entry, and the proportion of bids that were awarded the contract. The majority of potential bidders consisted of small firms (63%), and the shares of medium sized and large bidders were 19% and 18%, respectively. The variable *HEADQ* took a value of one if the potential bidder had its headquarters located in the same LMA as the facilities to be cleaned. This was the case for 78% of the potential bidders. On the

aggregate level, about 8% of the potential bidders submitted a qualified bid, out of which 18% were awarded the contract.

Table 3. Summary statistics of bidder characteristics.

Variable	Mean	Min.	Max.	#
Small firm (S)	0.63	0	1	42,762
Medium firm (*M*)	0.19	0	1	42,762
Large firm (*L*)	0.18	0	1	42,762
Headquarters is within the same LMA as the delivery site (*HEADQ*)	0.78	0	1	42,762
Entry decision (*ENTRY*)	0.08	0	1	42,762
Awarded contract, conditional on bidding (*AWARD*)	0.18	0	1	3,442

Summary statistics of entry (*ENTRY*) and contract award (*AWARD*) by firm size category in Table 4 further suggest that the proportion of SMEs that entered into contracts was fairly stable across the empirical distribution of contract size. However, the proportion of large potential bidders that entered into contracts increased from 20% in the 1st quartile to 32% in the 4th quartile. This provides evidence that the large potential bidders tend to self-select into large contracts.

Table 4. Summary statistics of bid-level outcomes for different quartiles of contract size.

Quartile	1	2	3	4
Square meters	(40–1,000)	(1,001–3,000)	(3,001–8,000)	(8,001–240,000)
Variable	Mean	Mean	Mean	Mean
Entry small firm ($ENTRY_S$)	0.02	0.03	0.03	0.02
Entry medium firm ($ENTRY_M$)	0.11	0.11	0.13	0.13
Entry large firm ($ENTRY_L$)	0.20	0.20	0.23	0.32
Award small bidder ($AWARD_S$)	0.15	0.06	0.09	0.10
Award medium bidder ($AWARD_M$)	0.28	0.30	0.17	0.11
Award large bidder ($AWARD_L$)	0.24	0.18	0.20	0.19

Conditional on bidding, the proportion of contracts awarded to medium sized bidders decreased along with increasing contract size, but there was no clear tendency for small bidders. The proportion of contracts awarded to large bidders fluctuated around 20% across the empirical distribution of contract size. Section 5 addresses the effect of contract size and number of contracts more formally.

5. Empirical analysis

The empirical analysis evaluated the effect of contract size on SMEs' entry decision and their probability of being awarded the contract conditional on them submitting a bid. The contracting authority's demand for cleaning services in a given time period was assumed to be given and thus was represented by the total procurement size. Key policy variables for the contracting authority to decide upon are the individual contract size and the number of contracts in the procurement.

For a given outcome (Y), suppose that

$$Y = f(SQMC, \#CONTR, Z, X, N, \varepsilon). \quad (1)$$

This relationship captures the effect of contract size (*SQMC*) and the number of contracts (*#CONTR*) on the relevant outcome variables of interest conditional on the procurement characteristics (Z), contract characteristics (X), and proxy variables (N) for the competitive environment. The crucial identifying assumption is that the assignment of contract size and the number of contracts is independent of the unobserved factors, ε, conditional on observables. It is for that reason important that Z and X include facility type and other contract characteristics given that some facilities such as hospitals are geographically dispersed and such procurements or contracts are represented to a higher extent in SA procurements. The first part of the analysis addresses heterogeneity in contract-level participation across firm size categories in more detail.

5.1 Entry

The motivation for studying the firm's entry decision in closer detail is as follows. With costly entry, the potential bidders tend to self-select into contracts where the expected net profit of the contract is non-negative (see, for example Samuelson, 1985; Levin and Smith, 1994). The continuous random net profit function is a latent variable that is not directly observed in the data. However, the potential bidder's binary decision to submit a bid is observed and takes a value of one whenever the expected net profitability of the contract is greater than zero. Systematic heterogeneity in the entry probability across firm size categories related to contract size and the number of contracts could be taken to indicate group-specific asymmetry in the firms' underlying private cost distribution for carrying out a particular contract type (see e.g. Marion, 2007; Krasnokutskaya and Seim, 2011; Lundberg et al., 2015). The probability of submitting a bid was estimated as a LPM[5] and a logit model with the following specification:

$$\Pr(ENTRY_{ijm} = 1) = \beta_0 + \beta_1 \ln(SQMC_j) + \beta_2 \ln(\#CONTR_m) + \sum_k \delta_k d_k +$$
$$\sum_k d_k \left[\delta_{k1} \ln(SQMC_j) + \delta_{k2} \ln(\#CONTR_m)\right] + \tau' Z_m + \gamma' X_j + \beta_3 N_j + \beta_4 HEADQ_i + u_{ijm} \quad (2)$$

where $ENTRY_{ijm}$ takes the value one if potential bidder i has entered a bid for contract j in procurement m. Contract size ($\ln(SQMC_j)$) and number of contracts ($\ln(\#CONTR_m)$) were entered into the regression model in natural logarithmic form.

[5] In the nonlinear logit model, interpreting the marginal effects is not a trivial matter in the presence of interaction effects (see e.g. Greene, 2010). Therefore, the LPM is motivated because it provides a direct estimate of the sample average marginal effects of the included interaction variables.

The firm size category was indicated by dummy variables (d_k) that take a value of one if the potential bidder is of the k^{th} firm size category (k = *S*, *M*, or *L*). To test the hypothesis that contract size and number of contracts have an adverse effect on SMEs' incentives to enter a bid relative to large firms, interaction effects between d_k and the variables $\ln(SQMC_j)$ and $\ln(\#CONTR_m)$ were included in the regression model. Additional procurement and contract characteristics to control for the potential bidder's incentives to enter a bid were included in the vectors Z_m and X_j. Variables included in these vectors were contract period, supplier selection method, geographic dispersion of delivery sites, optional cleaning services, and facility type to be cleaned as defined in Section 4. At the time of bidding, the potential bidders do not know the number of actual number of firms bidding for the contract. However, they are assumed to have prior knowledge of the number of potential bidders in the LMA. Thus the number of potential bidders (N_j) serves as a proxy for the competitive environment in the LMA. Lastly, the variable $HEADQ_i$ takes the value one if the potential bidder has its headquarters located within the same LMA as the delivery site, and this value was included to control for possible home field advantage, or home bias (Figueiredo et al., 2002). Finally, the β variables are the parameters to be estimated and u_{ijm} represents the unobserved factors that affect participation.

Of primary interest to the analysis of entry was whether the effect of contract size on entry would differ across firm size categories. Increased contract size was expected to be associated with reduced incentives for SMEs to submit a bid. The coefficient on $\ln(SQMC_j) \times d_k$ captures group-specific heterogeneity in the effect of contract size on the contract's expected net-profitability. A significant negative difference on the SME's probability of entry relative to the reference category of large firms is consistent with the hypothesis that SMEs are at a disadvantage when it comes to bidding for large contracts.

The estimated coefficient on $\ln(\#CONTR_m)$ captures the relationship between the number of contracts in the procurement and the expected net profitability of individual contracts. Conditional on contract size and other covariates, a positive coefficient on $\ln(\#CONTR_m)$ would suggest that an increased number of contracts is associated with greater incentive to submit a bid. For instance, a bidder for a SA procurement is required to submit only one set of documents detailing how the firm meets the criteria in the specification. A general increase in the probability of entry could be taken to indicate scale effects on the entry cost across contracts (Milgrom, 2004). That is, even firms with a relatively high cost for contract delivery, and thus low expected net profitability from entering a bid, may find it worthwhile to undertake the relatively lower bid preparation cost and to submit a bid.

In contrast, heterogeneity in the firms' responses to an increased number of contracts could indicate differences in the firms' ability to internalize expected synergy effects across contracts in the procurement. Thus the estimated coefficients on $\ln(\#CONTR_m) \times d_k$ capture potential group-specific

heterogeneity in the ability of firms of different sizes to internalize expected synergy effects across contracts within one and the same procurement. Results from the regressions of the potential bidder's entry decision are presented in Table 5.

Table 5. Estimated sample average marginal effects on the probability of entry.

Variable	(1) Logit marginal effects *ENTRY*		(2) Linear probability model *ENTRY*		(3) Linear probability model *ENTRY*	
	$\hat{\beta}$	SE	$\hat{\beta}$	SE	$\hat{\beta}$	SE
ln(SQMC)	0.007***	0.002	0.008***	0.002	0.037***	0.007
ln(#CONTR)	0.009***	0.003	0.012***	0.004	0.030**	0.012
SMALL	–0.148***	0.011	–0.169***	0.015	0.165**	0.071
MEDIUM	–0.036***	0.005	–0.087***	0.014	0.204***	0.062
$S \times \ln(SQMC)$	-		-		–0.037***	0.008
$M \times \ln(SQMC)$	-		-		–0.032***	0.007
$S \times \ln(\#CONTR)$	-		-		–0.024*	0.012
$M \times \ln(\#CONTR)$	-		-		–0.022*	0.012
#YEAR	–0.009**	0.005	–0.012*	0.006	–0.013**	0.007
#OPTY	0.001	0.005	0.000	0.006	0.000	0.006
MEAT	–0.007	0.005	–0.012*	0.007	–0.012*	0.006
ln(#LMA)	–0.012**	0.006	–0.017**	0.008	–0.017**	0.008
MDELIVERY	–0.015*	0.008	–0.014	0.011	–0.019*	0.010
FLOOR	–0.014*	0.008	–0.013	0.010	–0.013	0.010
WDW	–0.012*	0.006	–0.015*	0.008	–0.014*	0.008
#CRITERIA	–0.001*	0.001	–0.002**	0.001	–0.001*	0.001
SCHOOL	–0.004	0.006	–0.007	0.007	–0.007	0.007
OFFICE	0.004	0.005	0.005	0.007	0.005	0.007
CHILDCARE	–0.006	0.006	–0.005	0.008	–0.006	0.007
HOSPITAL	–0.011	0.010	–0.016	0.016	–0.020	0.018
WORKSHOP	–0.020	0.014	–0.036	0.023	–0.037	0.024
CORRECTIONS	–0.010	0.008	–0.000	0.010	–0.002	0.010
HEADQ	0.027***	0.006	0.030***	0.008	0.030***	0.008
N	–0.001***	0.000	–0.001***	0.000	–0.001***	0.000
Constant			0.354***	0.031	0.095	0.064
Observations	42,762		42,762		42,762	
Pseudo R^2	0.201					
Adjusted R^2			0.133		0.138	

Notes. Standard errors (SE) are robust and account for 331 clusters at the procurement level. The model specification in column (1) reports the sample average of the marginal effects based on logit estimates.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The model specifications in columns (1) and (2) of Table 5 were estimated without interaction effects. The estimated sample average of the marginal effects did not differ much in magnitude or significance level across the different functional form assumptions. The probability of submitting a bid increased with contract size and the number of contracts in the procurement ($p < 0.01$ for both). Furthermore, the estimated coefficients on the firm size dummy variables indicate that the SMEs entered less frequently relative to the reference category of large firms ($p < 0.01$). The probability of entry was also smaller for small potential bidders relative to medium-sized bidders, and a Wald test based on the specification in column (2) could reject the null of equal coefficients at the 1% significance level. Another covariate

worth mentioning is that the probability of submitting a bid increased when the potential bidder had its headquarters located in the same LMA as the facilities to be cleaned.[6]

To test for heterogeneity across firm size categories related to contract size and the number of contracts, the model specification in column (3) presents the estimated marginal effects of the full model including interaction effects. While the main effect of contract size was significantly positive ($p < 0.01$), the interaction effects between contract size and the dummy variables indicating small and medium sized potential bidders were significantly negative ($p < 0.01$ for both). A Wald test could not reject the null of equal interaction effects for the categories of small and medium-sized potential bidders. The results indicate heterogeneity in the response to increased contract size, and this is especially the case for large potential bidders systematically self-selecting for large contracts. This pattern thus gives support to the argument that SMEs are capacity constrained, or inefficient, to carry out large contracts relative to larger firms.

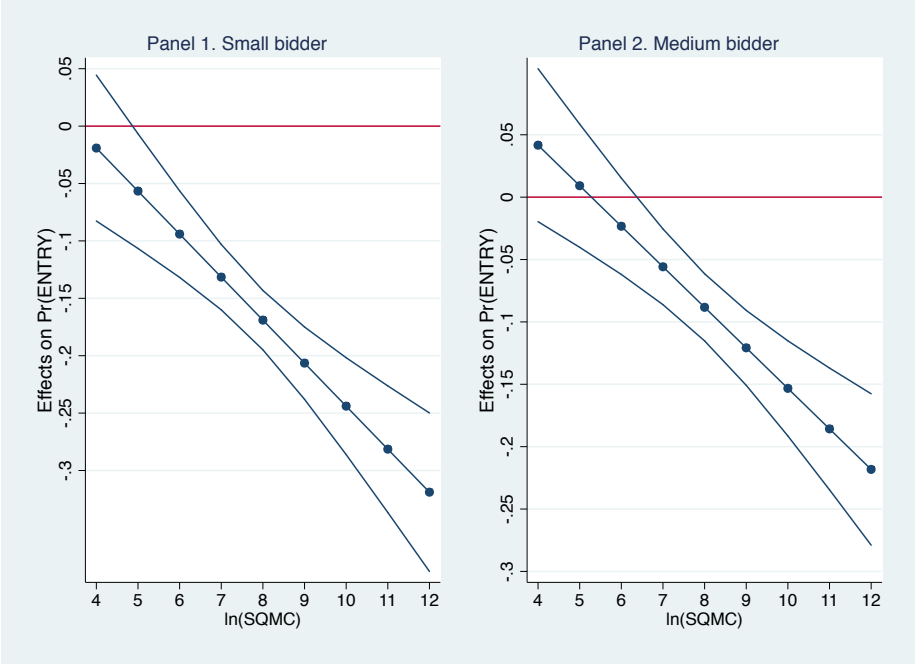
The results also indicate heterogeneity in the potential bidder's response to varying numbers of contracts in the procurement. The main effect on the probability of entry of an increased number of contracts was significantly positive ($p < 0.1$), and the interaction effects for both small and medium sized potential bidders were significantly negative (both at $p < 0.1$). The results are thus consistent with group-specific heterogeneity in the ability of various firm sizes to internalize expected synergies across contracts within the same procurement. Lastly, the estimated coefficient on the number of potential bidders (N) indicates that the entry probability decreases along with increasing number of potential bidders in the LMA.[7]

To facilitate interpretation, the interaction effects are illustrated by calculating the sample average of the marginal effect on entry of being an SME relative to the reference category of large firms evaluated at specific values of contract size and number of contracts. Panel 1 in Figure 1 shows that the representative small firm's probability of entry is a monotonically decreasing function of contract size. However, there is no significant difference between medium and large firms for small contracts (up to $e^{6.5} = 665$ square meters) as shown in Panel 2 of Figure 1. The heterogeneity only becomes significant for larger contract size, and the probability of entry drops by about 20% compared to large firms as contracts approach $e^{12} = 162{,}755$ square meters.

[6] The specifications in columns (2) and (3) were re-estimated without procurement and contract characteristics included in the vectors Z_m and X_j. The results presented in Table A3 in the Appendix are broadly consistent with the results presented in Table 5.

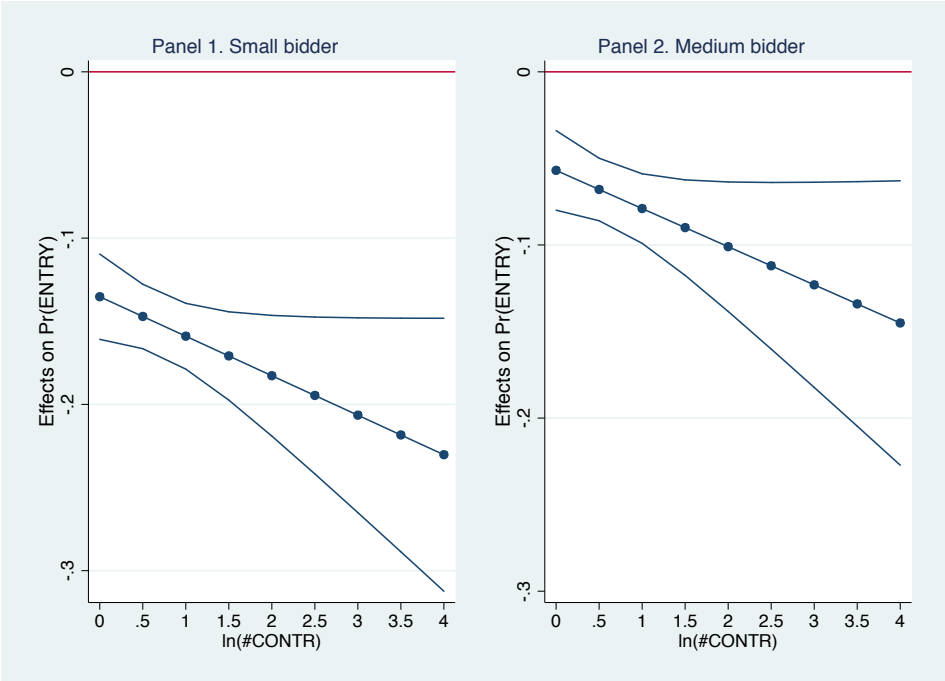
[7] The measure of potential number of bidders might suffer from a degree of endogeneity – especially in LMAs with a small number of procurements carried out during the sample period. As a robustness exercise, the specification in column (3) was re-estimated using the subsample of Stockholm LMA, which contained approximately one third of the procurements under study. Parameter estimates shown in Table A4 in the Appendix are consistent with the results presented in Table 5.

Figure 1. Marginal effects on the probability of entry by firm size category at specific values of ln(#SQMC). The solid curved lines are the 95% confidence intervals.



The response to varying numbers of contracts in the procurement differs across firm size categories. As shown in Panel 1 of Figure 2, both the small and medium-sized firms' probability of entry decrease monotonically as the number of contracts increases. The analysis of individual firm's entry decision indicates that an increased number of contracts in the procurement provides relatively greater incentive for large firms to bid on individual contracts.

Figure 2. Marginal effects on probability of entry by firm size category at specific values of ln(#CONTR). The solid curved lines are the 95% confidence intervals.



To conclude, the analysis of entry supports the hypothesis that large contract size is of concern for SMEs when bidding for public contracts. In light of this result, splitting the procurement into multiple contracts may provide more business opportunities for SMEs. However, the results presented here indicate that the practice of splitting the procurement into multiple contracts has a counteracting effect on SMEs' probability of entry relative to large firms. A possible interpretation is that multiple contracts in a given procurement enable the potential bidders to internalize expected synergies across contracts when bidding for individual contracts. The next section examines the effect of contract size and the number of contracts on the bidding SMEs' likelihood of winning the contract.

5.2 Contract Award

Business opportunities for potential bidders are ultimately provided through the supplier selection process. If SMEs are disadvantaged when it comes to carrying out large contracts, this will appear in the award rates. Therefore, this section examines the effect of contract size and the number of contracts on the award rate across firm size categories. Following De Silva et al. (2012; 2013), the probability of contract award, conditional upon bidding, is estimated as an LPM and a logit model with the following specification:

$$\Pr\left(AWARD_{ijm} = 1 | ENTRY_{ijm} = 1\right) =$$

$$\beta_0 + \beta_1 \ln\left(SQMC_j\right) + \beta_2 \ln(\#CONTR_m) + \sum_k \delta_k d_k + \sum_k d_k \left[\delta_{k1} \ln\left(SQMC_j\right) + \delta_{k2} \ln(\#CONTR_m)\right] + \beta_3 n_j + \beta_4 HEADQ_i + u_{ijm} \quad (3)$$

where the dependent variable $AWARD_{ijm}$ takes a value of one if bidder *i* in contract *j* of procurement *m* is awarded the contract, and zero otherwise. To test for heterogeneity in the award probability across bidder size, the dummy variables indicating firm size category (d_k) are interacted with contract size ($\ln\left(SQMC_j\right)$) and the number of contracts in the procurement ($\ln(\#CONTR_m)$). Note that Equation (3) deviates slightly from Equation (2) in that Equation (3) does not include additional procurement characteristics and contract characteristics in the vectors Z_m and X_j nor does it include the number of potential bidders (N_j). These characteristics indirectly influence the number of submitted bids and, therefore, the probability that bidder *i* will be awarded the contract. A more direct control variate approach was utilized instead by including the number of actual bidders (n_j) in the regression set up. This variable was entered into the model in natural logarithmic form to capture the nonlinear effect on the probability of being awarded the contract. As before, the variable $HEADQ_i$ was included to control for possible home field advantage. The results of this analysis are presented in Table 6.

Table 6. Estimated effects on the probability of being awarded the contract.

Variable	(1) Logit marginal effects *AWARD*		(2) Linear probability model *AWARD*		(3) Linear probability model *AWARD*	
	$\hat{\beta}$	SE	$\hat{\beta}$	SE	$\hat{\beta}$	SE
ln(SQMC)	–0.004	0.002	–0.005	0.003	0.005	0.007
ln(#CONTR)	–0.003	0.002	–0.009**	0.004	–0.028***	0.011
SMALL	–0.079**	0.034	–0.063**	0.026	–0.058	0.155
MEDIUM	0.038	0.029	0.036	0.032	0.274	0.169
$S \times \ln(SQMC)$	-		-		–0.005	0.019
$M \times \ln(SQMC)$	-		-		–0.035*	0.019
$S \times \ln(\#CONTR)$	-		-		0.032**	0.016
$M \times \ln(\#CONTR)$	-		-		0.039*	0.023
HEADQ	0.029**	0.014	0.038***	0.015	0.037**	0.015
ln(n)	–0.198***	0.008	–0.217***	0.013	–0.215***	0.014
Constant			0.621***	0.041	0.557***	0.069
Observations	3,442		3,442		3,442	
Pseudo R^2			0.090		0.097	
Adjusted R^2	0.096					

Notes. Standard errors (SE) are robust and account for 331 clusters at the procurement level. The model specification in column (1) reports the sample average of the marginal effects based on logit estimates.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The model specifications in columns (1) and (2) are estimated without interaction effects. The marginal effects are broadly consistent across the different functional form assumptions. The results indicate that the bidder's probability of being awarded the contract decreases as the number of actual bidders increases, and it increases when the bidder has its headquarters located within the same LMA as the delivery site. While the effect on medium-sized bidders was non-significant, the probability of contract award was significantly lower for small bidders relative to the reference category of large bidders ($p < 0.05$).

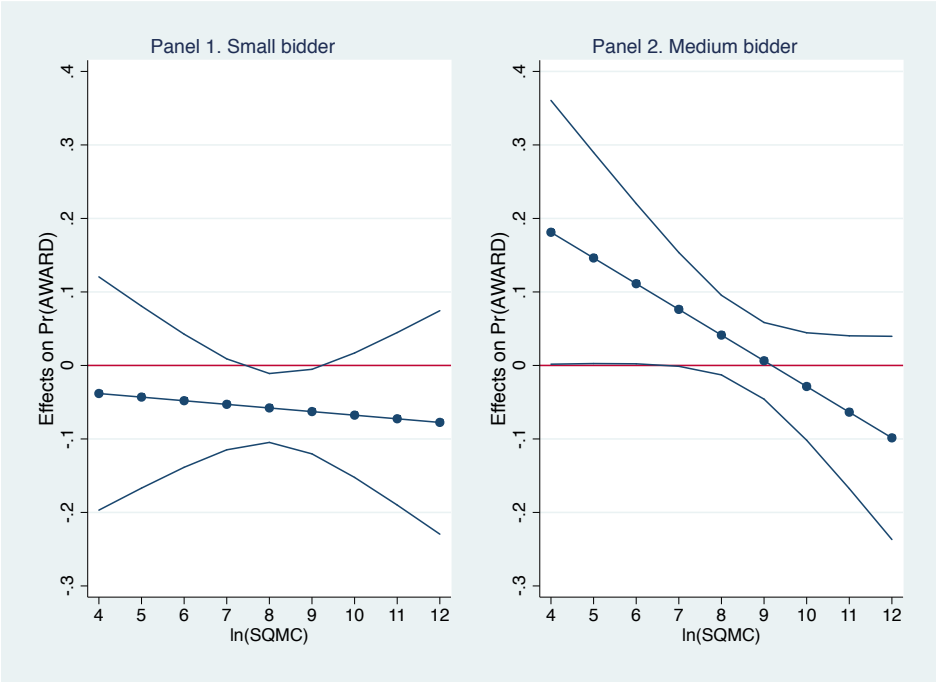
The estimated interaction effects provided in column (3) indicate heterogeneity in the award rate across bidder size categories related to contract size. While the effect on small bidders is non-significant, there is a significant negative relationship between contract size and the medium-sized bidder's probability of being awarded the contract relative to the reference category of large bidders ($p < 0.1$). The results indicate that medium-sized bidders in particular are more competitive for smaller contract size relative to large bidders. A possible explanation for the relatively small differences in the award probability across small and large bidders is that the entry decision serves as an efficient screening mechanism; only the most efficient small potential bidders self-select into contracts of a given size.

The interaction effects presented in column (3) of Table 6 further indicate that an increasing number of contracts in the procurement has an adverse effect on the bidder's probability of being awarded the contract. Specifically, the award probability for both small and medium-sized bidders relative to the reference category of large bidders is an increasing function of the number of contracts in the procurement (at $p < 0.05$ and $p < 0.1$ significance level, respectively). Hence, the negative relationship

established in Section 5.1 between the number of contracts and SME participation translates into an increased award rate for those bidders that enter.

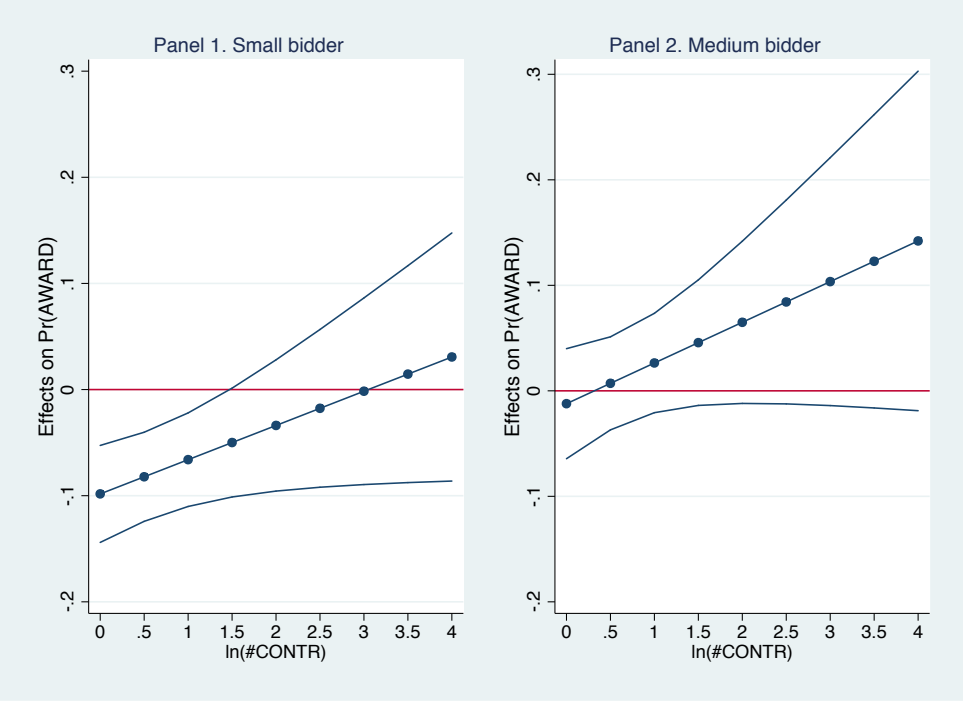
To facilitate interpretation of the results, the interaction effects are illustrated by calculating the sample average of the marginal effect of being an SME relative to the reference category of large firms on the probability of contract award evaluated at specific values of contract size and number of contracts. Panel 1 in Figure 3 shows that the representative small bidder has a lower probability of being awarded the contract throughout the empirical support of contract size relative to the reference category of large bidders. However, the effect is imprecisely estimated and is not statistically significant. On the contrary, a medium sized bidder has a significantly higher probability of being awarded the contract for contract sizes up to about $e^7 = 1{,}100$ square meters. The estimates provided in column (3) of Table 6 thus suggest that medium-sized firms are the ones that benefit the most from smaller contract size.

Figure 3. Marginal effects on the probability of being awarded the contract by firm size category at specific values of ln(SQMC). The solid curved lines are the 95% confidence intervals.



The analysis of entry in Section 5.1 indicates that the large potential bidders to a larger extent self-select into procurements with many contracts. Panels 1 and 2 in Figure 4 illustrate the average marginal effect of firm size on the probability of contract award, as evaluated at specific values of $ln(\#CONTR)$. Both small and medium-sized bidders have award rates that increase along with the number of contracts in the procurement. However, this effect is imprecisely estimated and is only significant for the category of small bidders up to $e^{1.5} = 4.5$ contracts.

Figure 4. Marginal effects on the probability of contract award by firm size category at specific values of ln(#CONTR). The solid curved lines are the 95% confidence intervals.



The analysis of contract award supports the hypothesis that increased contract size results in a reduced award rate, especially for medium-sized bidders. Conditional upon bidding, an increasing number of contracts in the procurement is associated with a reduced difference in the probability of being awarded the contract across bidder size categories. The non-discriminatory SA procurement policy of SA may thus result in homogenized award rates across bidders of different size categories. The results presented in this section are therefore somewhat contradictory to the results in the analysis of entry in which the number of contracts in the procurement is shown to be detrimental to SME participation. A possible explanation for the observed pattern is that the bidding behavior of large bidders is different from that of SMEs. That is, once the necessary bidding documents are put in place for a given procurement, large bidders have the capacity to place phony bids for contracts that they are not interested in winning.

6. Conclusions and suggestions for further research

The practice of using public procurement auctions to achieve political objectives in society is commonplace in the US and in the EU. Discriminatory policies used in the US – such as bid preference programs and set-asides – have been shown in previous studies to shift contract awards towards the favored category of, for instance, small firms at little or no cost to the contracting authority (see e.g. Marion, 2007; Krasnokutskaya and Seim, 2011; De Silva et al., 2012). This paper is primarily concerned with the non-discriminatory policy used in the EU of splitting the procurement into multiple contracts of limited scope with the intention to create business opportunities for SMEs.

In particular, this study has evaluated the effect of contract size and the number of contracts in the procurement on SME participation and the probability of an SME being awarded the contract conditional upon their placing a bid. These questions are important issues from an economic policy point of view because SMEs are expected to foster innovation and competition. Furthermore, one of the central questions in the auction literature is how the auction can be designed to reduce the expected auction clearing price.

The results presented here from field data on Swedish internal regular cleaning contracts speak to the presence of cost asymmetries across firm size categories. The analysis of the individual firm's entry decision confirms heterogeneity in the potential bidder's response to varying contract sizes and numbers of contracts. Large firms, defined as having more than 199 employees, self-select into large contracts and procurements with many contracts. In contrast, SMEs' expected profitability for the contract is found to be a decreasing function of contract size and number of contracts relative to the reference category of large firms. This pattern is consistent with SMEs being capacity constrained, or inefficient, when carrying out large contracts relative to larger firms, and large firms are able to internalize expected synergies across contracts in a given procurement.

The effect of contract size and number of contracts on the probability of being awarded the contract is mixed. Smaller contract size is associated with increased award rates for medium-sized bidders, but there is no significant effect on the small bidder's award rate. On the contrary, there is weak evidence that an increased number of contracts is successful at leveling the playing field in terms of SMEs' award rate in the context of Swedish internal regular cleaning contracts. However, the results in this study are not necessarily valid for other procurement segments.

A potentially limiting factor for SMEs' entry into procurements with multiple contracts is the lack of restrictions on the number of contracts a given bidder can win. This makes it possible for the potential bidders to internalize expected synergy effects in their price bids across contracts. Restricting the number of contracts each bidder is allowed to win would effectively shut down this possibility. Not analyzed in this study are the effects of SA on the transaction costs associated with having to evaluate, administrate, and coordinate multiple contracts. These costs are likely to be substantial, and there is a need for further empirical research on the transaction costs and potential benefits of this policy. Whether the benefits of SA dominate the total costs or not is a question for future research.

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Appendix

Table A1. Frequency table of firm size according to Statistics Sweden's definition.

Firm size category (*SIZE*)	Number of employees	Frequency
1.	0	31
2.	1–4	54
3.	5–9	30
4.	10–19	34
5.	20–49	52
6.	50–99	35
7.	100–199	24
8.	200–499	18
9.	500–999	4
10.	1,000–1,499	3
11.	1,500–1,999	0
12.	2,000–2,999	2
13.	3,000–3,999	3
14.	4,000–4,999	1
15.	5,000–9,999	8
16.	10,000–	2
Observations		301

Table A2. Summary statistics of procurement, contract, and bidder characteristics.

	Median	Mean	Std. dev.	Min.	Max	#
SQMC	2,971.0	9,471.6	24,237.6	40	241,182	634
#CONTR	3.0	6.9	8.5	1	28	634
#YEAR	2.0	2.3	0.7	1	4	634
#OPTY	2.0	1.7	0.7	0	4	634
MEAT	0.0	0.5	-	0	1	634
#LMA	1.0	3.0	5.1	1	21	634
MDELIVERY	0.0	0.1	-	0	1	634
FLOOR	1.0	0.7	-	0	1	634
WDW	1.0	0.5	-	0	1	634
#CRITERIA	15.0	16.0	4.4	3	31	634
SCHOOL	0.0	0.3	-	0	1	634
OFFICE	1.0	0.6	-	0	1	634
CHILDCARE	0.0	0.2	-	0	1	634
HOSPITAL	0.0	0.1	-	0	1	634
WORKSHOP	0.0	0.0	-	0	1	634
CORRECTIONS	0.0	0.0	-	0	1	634
N	29.0	73.7	74.4	2	174	634
n	5.0	5.5	3.2	1	23	634
Bidder characteristics						
SMALL	1.0	0.6	-	0	1	42,762
MEDIUM	0.0	0.2	-	0	1	42,762
LARGE	0.0	0.2	-	0	1	42,762
HEADQ	1.0	0.8	-	0	1	42,762
ENTRY	0.0	0.1	-	0	1	42,762

Estimates from a parsimonious model of entry without additional procurement and contract characteristics are consistent with the estimates presented in Table 3, save for the coefficient on *ln(#CONTR)* becoming non-significant.

Table A3. Parsimonious model of entry without procurement and contract characteristics.

Variable	(1) Linear probability model *ENTRY*		(2) Linear probability model *ENTRY*	
	$\hat{\beta}$	SE	$\hat{\beta}$	SE
ln(SQMC)	0.004*	0.002	0.033***	0.007
ln(#CONTR)	0.003	0.003	0.021	0.013
SMALL	–0.169***	0.015	0.160**	0.074
MEDIUM	–0.088***	0.014	0.199***	0.064
$S \times \ln(SQMC)$	-		–0.037***	0.008
$M \times \ln(SQMC)$	-		–0.032***	0.007
$S \times \ln(\#CONTR)$	-		–0.023*	0.013
$M \times \ln(\#CONTR)$	-		–0.021*	0.012
HEADQ	0.032***	0.008	0.032***	0.008
N	–0.001***	0.000	–0.001***	0.000
Constant	0.306***	0.020	0.052	0.063
Observations	42,762		42,762	
Adjusted R^2	0.129		0.133	

Notes. Standard errors (SE) are robust and account for 331 clusters at the procurement level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4. LPM estimates on the probability of entry for the sub-sample of Stockholm LMA.

Variable	(1) Linear probability model *ENTRY*	
	$\hat{\beta}$	SE
ln(SQMC)	0.038***	0.007
ln(#CONTR)	0.017**	0.007
SMALL	0.211***	0.066
MEDIUM	0.243***	0.067
$S \times \ln(SQMC)$	–0.040***	0.008
$M \times \ln(SQMC)$	–0.035***	0.008
$S \times \ln(\#CONTR)$	–0.021***	0.008
$M \times \ln(\#CONTR)$	–0.018**	0.008
#YEAR	0.003	0.005
#OPTY	0.009*	0.005
MEAT	–0.008*	0.005
ln(#LMA)	0.002	0.004
MDELIVERY	–0.017***	0.004
FLOOR	–0.003	0.005
WDW	–0.014***	0.005
#CRITERIA	–0.001**	0.001
SCHOOL	–0.002	0.005
OFFICE	–0.004	0.004
CHILDCARE	–0.006	0.005
HOSPITAL	–0.024**	0.011
WORKSHOP	–0.025***	0.004
CORRECTIONS	–0.017	0.011
HEADQ	0.039***	0.007
N	-	
Constant	–0.187***	0.061
Observations	35,276	
Adjusted R^2	0.064	

Notes. Standard errors (SE) are robust and account for 96 clusters at the procurement level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.