PACKAGE BIDS AND STAND-ALONE BIDS IN COMBINATORIAL PROCUREMENT AUCTIONS

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ABSTRACT. Combinatorial bidding or package bidding in multi-unit public procurement auctions is becoming more and more common although the single bidding still is the most frequently applied mechanism. One reason for allowing combination bids in procurement auctions is that the mechanism may pass firms' potential cost synergies on the procuring entity leading to a reduction of the cost upon the procuring entity. Another reason is that the mechanism may increase efficiency. However, the option for a firm to submit bids on bundles of contracts gives rise to a strategic effect because a firm's stand-alone bids compete with the firm's package bids. Therefore, bidders might find it profitable to inflate their stand-alone bids in order to favor their package bids. This may take place even in the absence of cost synergies. Using data from single-contract and multi-contract auctions with options to submit package bids, we analyze whether firms submit different stand-alone bids in standard sealed bid procurement auctions and in combinatorial auctions. We find that firms are likely to have cost synergies, but they raise their stand-alone bids in combinatorial auctions compared to their corresponding bids in standard procurement auctions.

INTRODUCTION

Auctions in which bidders are allowed to submit bids on combinations or packages of contracts, beside their stand-alone bids, have received relatively much attention the last years, both in practice

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and in theory. Combinatorial procurement auctions is becoming more and more applied in both the private and in the public sector as an alternative to simultaneous single-items auctions. The mechanism enables suppliers to express synergies across bundles of contracts, which mitigates the exposure problem and has the potential to lower the procurer's cost and enhancing efficiency. A combinatorial auction is very much an interdisciplinary issue and there are a number of complex problems to solve when designing and implementing the mechanism. A large number of studies in this field focus upon the inherent computational difficulty to determine the winner and how to express combined bids. For a review of previous studies on the winner determination problem, the bidding language of combinatorial auctions and of previous reports from practical application of the mechanism, see for example De Vries and Vohra (2003), Sheffi (2004), Cramton *et al.* (2006), Abrache *et al*. (2007). Much of the economic literature deals with the strategic implications of combinatorial auction. A couple of studies analyses the properties of the Vickrey combinatorial auction or the Vickrey-Clarke-Groves mechanism (VCG mechanism), an extension of the Vickrey auction (e.g. Krishna and Rosenthal, 1995; Holzman and Monderer, 2004; Yokoo *et al.,* 2004; Ausubel and Milgrom, 2006; Chew and Serizawa, 2007). Like the single item Vickrey auction, the VCG mechanism is rarely applied in the field. The mechanism has some disadvantages which lower its usefulness as a real-world auction design. Other mechanisms have been proposed in the literature to overcome the drawbacks within the VCG mechanism, like the Adaptive-User-Selection-Mechanism (AUSM), the Progressive-Adaptive-User-Selection-Environment (PAUSE), the clock-proxy auction and a three-stage auction design. For reviews of these mechanisms, see for example Banks *et al.* (1989), Kelly and Steinberg (2000), Kwasnica *et al.* (2005), Ausubel *et al.* (2006), and Day and Raghavan (2008).

Unlike the single item auctions, there is in the multiple unit environments still a lack of theoretical guidance as to general predictions concerning revenue ranking and efficiency ranking of various types of combinatorial auctions. Also, in a firs-price multi unit auction, there exists to our knowledge no unequivocal proof that a simultaneous first-price auction outperforms a firs-price combinatorial auction, although there are some field applications and experimental evidence suggesting that the later mechanism is superior the former mechanism (e.g. Epstein *et al*., 2004; Cantillon and Pesendorfer, 2006; Lunander and Nilsson, 2004, 2006). When estimating the cost savings of a first-price combinatorial procurement auction, one method would be to take the difference between the cost minimizing allocation based on all bids and the cost minimizing allocation based on just the bidders' stand-alone bids. The (naïve) underlying assumption would be that the stand-alone bids mirrors the bids the firms would have submitted in an auction without combinatorial bids. However, one strategic problem that arise in the first-price combinatorial (procurement) auction is that a bidder's stand-alone bids compete with her combinatorial bids. As a result, bidders might find it profitable to inflate their stand-alone bids, or refrain from submitting them, in order to increase the probability of winning on their combinatorial bid. This effect may lower efficiency and increase the procurer's cost. Also, the environment a supplier faces in a first-price combinatorial procurement auction resembles the multi-product monopolist problem, where the price of a product affects both the demand for this product and the demand for other products. Cantillon and Pesendorfer (2006) refer to the results obtained in McAfee *et al.* (1989) and shows that a presence of a combination bid does not necessarily indicate that the bidding firm is facing synergies. The submission of a combination bid can be equally motivated by strategic price discrimination. Cantillon and Pesendorfer conclude that the welfare consequences of first-price combinatorial procurement auctions are an open empirical question. However, the more bidders' unit costs are negatively correlated in the number of contracts won, the more likely it is that the combination bids reflect synergies across contracts rather than strategic price discrimination.

The aim of this paper is to empirically verify if bidders tend to raise their stand-alone bids in sealed bid combinatorial procurement auctions compared to the bids submitted in a standard procurement auction and thereby assess to what extend the package bid discount reflects a cost reduction for the procuring entity. Also, the study includes an evaluation of the presence of synergy effects.

This empirical study is very much related to the issue what motivates firms to submit package bid in a sealed bid combinatorial procurement auction with the character of a first-price sealed bid auction. In the paper we investigate whether bidders tend to raise their stand-alone bids in a sealed bid combinatorial procurement auction compared to the bids submitted in a standard procurement auction. By comparing the single bids in standard auctions with the stand-alone bids in combinatorial auctions from the procurement of an identical service, with identical bidding firms, we may assess to what extend the package bid discount reflects a cost reduction for the procuring entity. As mentioned above, if bidding firms foresee the interdependency between their single bids and their package bids in a combinatorial auction, we may expect higher stand-alone bids in the combinatorial setting than in the standard format. As a result, the package bid discount would then overestimate the actual reduction in procurement cost. To our knowledge, this study is the first study that compares a firm's observed bidding behavior in procurement auctions with and without the option to submit package bids. The access to bidding data, where the same set of firms has submitted stand-alone bids for identical objects under the two auction mechanisms has enabled the study. A policy implication of our findings is that due to strategic bidder behavior the in the package bids expressed discount is likely to be overestimated, which should be accounted for in the procurement process.

The paper is organized as follows: In chapter 2, which is an extension of the introduction, we very briefly describe the different types of combinatorial public procurement auction that we are aware of have been applied in Sweden the last years. In chapter 3 we describe the design of the three combinatorial auctions from which we have collected part of our data set. Referring to scatter plots, we claim that the firms' motives to submit package bids in these auctions are due to synergies and not to strategic price discrimination. The full data set is presented in chapter 4. Chapter 5 presents our results and chapter 6 concludes. Figures and Tables are found in the Appendix.

COMBINATORIAL PUBLIC PROCUREMENT AUCTIONS IN SWEDEN

Since the enforcement of the EU procurement directives in Sweden in 1994 procurement auctions are held on a regular basis and it is, as in most OECD countries, a substantial part of the economy. About 15 percent of the gross national product is believed to be explained by public procurement (reference). Public procurement auctions are in Sweden regulated by law (following the EU directives) and it stipulates sealed bidding where the contract either is awarded to the bidder with the lowest bid or, when weight is given to other qualities than price also, the bidder who is considered to have submitted the economically most advantageous bid. Under the former setting the procurement auction takes the form of a first-price sealed-bid auction. The procurement auctions can either be single-unit auctions or involve multiple units. Option to submit bids on public contracts are announced by “call for tenders” and the announcement is attached with detailed descriptions of the services to be performed and conditions to be stipulated in the contracts.

In Sweden, combinatorial auctions have been used relatively scantly in public procurement auctions of multiple contracts. The overall applied mechanism has been the standard sealed bid format, having the character of first-price sealed bid auctions, and in most of these auctions the contracts have been more or less substitutes. The design has varied across the auctions as to different restrictions imposed on bidding.[1] In most auctions, bidders have been obliged to submit a stand-alone bid for every contract that made up a package bid. To enable bidders to express diseconomies of scale, bidders could in most auctions, in various ways, reveal that they had limited capacity, i.e., submit so called XOR bids (see Nisan, 2006). Such a bid could look like “We bid 10 for contract A, and 15 for contract B and 25 for contract C but we can only fulfill one of them” or “We bid 10 for contract A, and 15 for contract B and 25 for contract C but we can only fulfill contracts up to a value of 25”. In some auctions, the bidding firms could express their limited capacity in terms of a physical value. To exemplify, when the Swedish National Road Administration procured multiple contracts of road maintenance (asphalt surface), the bidding firms could, besides their stand-alone and package bids, also state how many tons of asphalt they at maximum were willing to supply. In some auctions, there has been a restriction on the maximum number of contracts allowed to have in a package bid.

COMBINATORIAL AUCTIONS OF CLEANING SERVICES

The data analyzed in this paper are bids from sealed bid public procurement auctions of internal regular cleaning services in Sweden. The auctions have the character of first-price sealed bid auctions and are either organized as single-contract or multi-contract auctions. Within the multi-contract procurements, auctions that allowed package bidding and auctions that did not are found. Three of the multi-contracts auctions were carried out as combinatorial auctions and these refer to the years 2006 and 2007. The data from the non-combinatorial auctions originates from the period 1992 to 1998 and 2006 to 2007, respectively. Basically the same set of bidding firms is identified in all sub samples. This enables us to compare the bidding behavior given the design of the auction (package bidding allowed or not) contingent on the bidders submitting all types of bids and also contingent on the identity of the bidder. Before describing the full data set, we briefly review the design of the three combinatorial auctions and the standard auctions.

Combinatorial Auction A and B (Local governments)

Two of the combinatorial procurement auctions were run in 2006. The procuring entity was in both cases a local government. The auctions comprised nine (auction A) and seven (auction B) separate contracts, respectively, with a total cleaning area of 105 000 m^2 and 400 000 m^2. Public offices, public schools and public day nurseries constituted the main part of the premises to be cleaned. In both auctions bidders were free to submit bids on any bundle of contracts. This was, however, contingent on some restrictions. In auction B a restriction was that a package bid at most could contain three contracts. In both auctions bidders had to submit a stand-alone bid for every contract included in a package bid. The package bids had to be non trivial, that is, the package bid had to be lower than the sum of the stand-alone bids making up that package. In auction A, a bidding firm could, besides the various bids, declare how large area, in terms of m^2, it at maximum could accept to be contracted for in case the firm would win too many contracts. In auction B, a firm could express its capacity constraint by stating the maximum contract sum it could be contracted for.

Combinatorial Auction C (The Swedish Social Insurance Agency)

The auction was conducted in 2007 and comprised cleaning service contract in all of the agency's local offices in Sweden, divided into 42 separate contracts. Each contract comprised one or more offices in the same geographical area. The total area to be cleaned was about 445 000 m^2. A bidder was free to submit non trivial package bids on any bundle of contracts. Also, the bidders could submit package bids in terms of a "price list" with restrictions. To exemplify, a price-list bid could be like "We bid 10 for contract A, 15 for contract B, 18 for contract C and 20 for contract D. The price for each contract in the price list is valid given that we are awarded contracts worth at least 25." A price list bid could also take the form of "We bid 10 for contract A, 15 for contract B, 18 for contract C and 20 for contract D. The price for each contract in the price list is valid given that we are awarded contract A and D." No matter what type of package bid a bidder submitted, she always had in line with the combinatorial auctions described above, to submit a stand-alone bid for every contract belonging to a package bid. No restriction was imposed as to the maximum allowed package bid discount. To adjust for differences in other aspects than price when evaluating the bids, the agency applied a scoring rule where bidders received discounts on their bids, given documented quality assurances. As in auction A, bidders could express diseconomies of scale by stating the maximum number of m^2 they were willing to be contracted for.

Synergies behind Package Bids

The costs of cleaning services are mainly driven by the size of the area to be cleaned, that is, the number of m^2. Most cleaning contracts of public offices and public schools include sweeping floors, cleaning toilets and emptying waste-paper baskets on a regular basis, often once a week. The cleaning branch is relatively labor intensive with low fix costs. Therefore, one would *a priori* expect that the branch would have a low degree of economies of scale which would reduce the firms' incentives to submit package bids for synergy reasons. However, looking at the data from the three combinatorial auctions, we observe decreasing average bids with respect to number of m^2. Both the stand-alone bids and the package bids exhibit, with some exception, the same pattern; the larger contract in terms of volume a firm is awarded, the lower unit price (bid/ m^2) it can offer. Figures 1-6 show a scatter plot of the stand-alone bids and the package bids, where a bid has been divided with the total number of m^2 that the bid was aimed for. A regression of bids against cleaning area shows that an increase in the number of m^2 in a contract significantly lowers the unit bid. We take these observed patterns as evidence that the bidding firms do face decreasing average cost in the number of m^2 to be cleaned. In personal contacts with some of the bidding firms, we have been told that there are cost advantages of winning larger contracts. A larger contract means more personnel but at a diminishing ratio. The branch suffers from a relatively high frequency of sick leaves. The nature of the work makes people get back and shoulder pain. Because the cleaning contracts are very close substitutes, firms with more employees can easier replace those who are on sick leave than firms with fewer employees. In other words, the flexibility to move personnel from one area to another area or within the same area is increasing in the contract size. Hence, the cleaning firms' motives to submit package bids would then be because of the presence of synergies, and not because of strategic price discrimination and these synergies are present in both the stand-alone bids and the bids in the package. Evidently, we can proceed with a comparison of stand-alone bids from the combinatorial auctions and standard procurement auctions in order to empirically evaluate the presence of strategic behavior in the combinatorial auctions.

The Standard Procurement Auctions

The stand-alone bids that are used as reference to the stand-alone bids from the combinatorial auctions, originate from single – and multi-contract public procurement auctions - of cleaning services, organized by local governments as well as government authorities. The data originates from two surveys. The first one was conducted in 1998 and covers the time period 1992 to 1998 and includes 758 contracts. The second survey covers 2006 and 2007 and compromises 81 contracts. Within the multi-unit auctions there was no package bidding and stand-alone bids were instead submitted on separate contracts (one for each premises to be cleaned) auctioned in one and the same procurement. Bids from the standard procurement auctions are then used as contra factual to the stand-alone bids from the combinatorial auctions. Firms identified in the combinatorial auctions A, B, and C that had submitted at least one package bid are namely, also identified in the standard procurement auctions. Bids from these firms under the two procurement auction formats are included in the empirical analysis. The data is described in the following section.

THE DATA

General

In total the data covers 1,986 bids submitted by 14 firms in sealed bid procurement auctions of cleaning contracts. The contracts are internal regular cleaning service contracts regarding public premises such as schools, day nurseries, offices, health care centers, and other type of public premises such as public restrooms and libraries. The data is based on submitted bids requested from the procuring entities which also have provided us with the documents surrounding the call for tender. All bids are expressed as annual total cost in SEK.

Two of the bidding firms in our data are nationwide. They have submitted bids on almost every contract in the data. Their share of the total number of submitted bids is about 70 percent. The majority of the bids in the data set consist of bids collected from either single contract auctions or multi contract auctions, without the option to submit package bids. About 85 percent of these bids originate from auctions in the 1992 to 1998 period, and the rest are bids from either standard or combinatorial procurement auctions in the years 2006 and 2007. A minor part of the data is collected from the three combinatorial auctions described above. In order to analyze bidding behavior, we compare stand-alone bids submitted under a non-combinatorial format with stand-alone bids from combinatorial auctions for the same set of firms. Descriptive statistics for the annual bid in SEK per square meter (in the 1994 price level) is found in Table 1 and correlations are found in Table A1 in the Appendix. The average stand-alone bid from the combinatorial auctions is 67 percent of the average stand-alone bid from the standard auctions. The degree of competition in these auctions is fairly good; on average each bidder is faced with 6.8 competitors.

TABLE 1
Descriptive Statistics, Stand-Alone Bids Per Square Meter Given Format and Procurement Characteristics

Sample	*N*	Minimum	Maximum	Mean	Standard deviation
All bids	1 968	17.38	8 496.04	134.93	217.96
Bids from standard procurement auctions	1 768	17.38	8 496.04	139.65	229.39
Bids from combinatorial procurement auctions	200	60.30	169.04	93.24	20.56
Number of contracts	1 968	1	74	24.44	18.96
Number of square meters	1 968	4.6	53 802	3 413.55	5 494.09
Number of bidders	1 968	1	37	7.75	3.92

Combinatorial Auction A

In the auction 14 firms participated. Almost every firm bid a stand-alone bid on each of the nine contracts. Six firms submitted package bids of various sizes, from a two-contract bundle up to a nine-contract bundle. The total number of package bids was 54, of which 35 bids were submitted by one of the firms. The discount in all package bids was 2 to 9 percent. No firm used the option to submit an XOR bid. All winning bids were stand-alone bids.

Combinatorial Auction B

The number of bidders in combinatorial auction B was six firms. All firms, except one, bid stand-alone bids on each of the seven contracts. Four of the six participating firms submitted in total 104 package bid, where the maximum number of contracts allowed in a package bid was three contracts. The discount in these package bids ranged from 2 to 6 percent. Again, no bidder used the option to submit an XOR bid. The allocation of the contracts was to award three each of them to two firms, and one single contract to one firm.

Combinatorial Auction C

Contrary to the combinatorial auctions A and B, which both were local government auctions, combinatorial auction C was a nationwide auction. The number of bidders in this auction was 22 firms. Three firms submitted only stand-alone bids on each of the 42 contracts. Eight firms submitted a total of 69 package bids. Two of these firms also gave, among several other package bids, a package bid comprising all 42 contracts. One of the nationwide bidders submitted three “price-list bids” which all covered the 42 contracts. These price-list bids were formulated as follows: “We bid the following price for each of the 42 contracts, and if we are awarded contracts worth at least 17.5 Million SEK from the list below, we offer the procurer to pick any arbitrary combination of the 42 contracts”. The second and the third price list bid were equally formulated, with the exception that each of the prices of the 42 contracts was reduced and the threshold value (least required contract sum) was raised to 22.5 Million and 30 Million SEK, respectively. Such a price-list bid comprises a very large number of package bids. By submitting an XOR bid (maximum m^2 that could be handled), two firms declared that they had limited capacity. These two firms bid for contracts with a total volume about 1.5 times higher than their individually declared capacity.

One of the nationwide firms was awarded all 42 contracts through one package bid. The estimated cost saving from the package bids was about 6 percent.

EMPIRICAL SETTING AND RESULTS

So, from the previous discussion we know that cost savings from using package bidding was anticipated but is this cost saving real? The aim of the paper is to test the strategy that the bidders foresee the interdependency between their stand-alone bids and package bids in the combinatorial auctions and therefore bid higher stand-alone bids compared to their stand-alone bids in standard auctions indicating over-estimated cost reductions by the use of packaged bidding.

Empirically this will be tested with the total yearly bids ($i = 1,..., I$) in the 1994 price level from both formats (combinatorial versus standard procurement auctions) in SEK from the same set of firms as the explanatory variable (*y*) as explained by format. Here, *FORMAT* is a discrete variable that takes the value one if stand-alone bid is submitted in a standard auction and zero if it is submitted in companion with a package bid in a combinatorial auction.

The main hypothesis to be empirically tested then is that bidders submit identical stand-alone bids in standard procurement auctions (indexed by *s*) and combinatorial multi-object procurement auctions (indexed by *c*), ceteris paribus:

(1) $$H1_0 : Bid_s = Bid_c \tag{1}$$

Of interest is also if this behavior is contingent on bidder identity, so we also test the hypothesis that bidder *j* submits identical stand-alone bids in standard procurement auctions and combinatorial multi-object procurement auctions, ceteris paribus:

$$H2_0 : Bid_{js} = Bid_{jc} \tag{2}$$

In order to test the two hypotheses, differences in procurement characteristics and contract characteristics need also to be controlled for. The *procurement characteristic* is number of contracts (*NC*) included in the procurement auction. This variable is included in order to control for if the bidders express synergies in stand-alone bids irrespective of format or not. The standard procurement auctions can, namely, either be single-contract or multi-contract auctions while the combinatorial procurement auctions by definition always are multi-contract auctions. The *contract characteristics* are square meters (m^2) to be cleaned (*SQM*) and type of premises to be cleaned. Dummy variables for type of premises are defined as schools (*SCHOOL*), day nurseries (*NURSERY*), offices (*OFFICE*) and “others” (reference category). The degree of competition is also accounted for – which is measured as the observed number of bidders in each auction – and, based on results by Gupta (2002), this effect is assumed to be nonlinear; the more bidders the lower the bids at a diminishing rate (*COMP* and $COMP^2$). The equation to be estimated is

$$y_i = \alpha_i + + \beta_1 FORMAT_i + \beta_2 NC_i + \beta_3 SQM_i + \beta_4 SCHOOL_i + \beta_5 NURSERY_i + \beta_6 OFFICE_i + \beta_7 COMP_i + \beta_8 COMP_i^2 + \varepsilon_i \quad (3)$$

To keep things simple equation (3) is estimated with ordinary least square. Firstly, in order to test H1 equation (3) is estimated using all bids with no respect given to bidder identity. Secondly, equation (3) is estimated contingent on bidder identity for the most frequently represented bidders in the data. That is, separate regressions are run for six of the 14 firms including the two national firms dominating the market for cleaning services in Sweden. All results are based on standard White-corrected standard errors to correct for heteroscedasticity.

Results all firms regression (H1)

The regression results from estimation of equation (3) testing H1 is displayed in Table 2. The coefficient for *FORMAT* that tests if bidders submit identical stand-alone bids in standard procurement auctions (*ceteris paribus*) is significant and has a negative sign. As such H1 can be rejected; bidders submit significantly lower stand-alone bids in standard procurement auctions compared to stand-alone bids submitted in combinatorial procurement auctions. Consequently, the sign of the coefficient for *FORMAT* reflects that bidders foresee the interdependency between their stand-alone bids and package bids in the combinatorial auctions and therefore bid higher stand-alone bids compared to their stand-alone bids in standard procurement auctions. Note that this contradicts the difference in mean value displayed in Table 1 showing the descriptive statistics.

TABLE 2
Estimation Results, all Firms (H1)

	Coefficient	*t*-value
Format	-94 942.28	-3.15
Number of contracts	-1 369.32	-9.41
Square meters	84.33	32.15
Schools	-2 945.49	-0.14
Day Nurseries	2 949.76	0.19
Offices	-80 259.07	-4.11
Number of bids	-10 004.68	-1.52
Number of bid squared	654.89	1.81
Constant	205 192.9	5.45
Adjusted R^2		0.91
F(8,1 959)		752.48
N		1 968

Looking at the other coefficients, we observe that the variable square meter (SQM) has a significant coefficient with positive sign, that is, bids are increasing in square meters to be cleaned. An additional square meter to be cleaned increases the annual price with approximately 13.28 USD (or 84.33 SEK). Also, the more contracts the lower is the price, synergy effects are thereby concluded to be present. If this variable is replaced with a dummy variable taking the value one for single-contract auctions and zero for multi-contracts it is significant only at the ten percent level. Other estimates are stable for this change in specification. Furthermore, type of contract matters to some extent, office contracts commands significantly lower prices than contracts that are defined as “others”. As for the competition effect the coefficients have the expected signs in terms of the competition effect expected to be decreasing but they are not significant. The explanatory power of the model is good with an adjusted R^2 value of 91 percent. These findings are robust for inclusion of year dummy variables with the years 2006 and 2007 as references. VIF – values are reported in Table A2 in the Appendix and based on the rule of thumb that individual values above 10 indicate problems with multicollinearity the conclusion is that there is no immediate reason to suspect such problems (Chatterjee, Hadi, and Price; 2000).

Results Firm Specific Regressions (H2)

Bidder behavior on firm level is tested with regressions of expression (3) given firm identity for the six most frequently represented firms in the data. The sub-sample size for the remaining eight firms is too small for carrying out firm level regressions. Results for the format and synergy coefficients on firm level are shown in Table 3. Tables A3 to A8 in the Appendix display complete firm level estimation results. Evidently, the rejection of H2 is contingent on firm identity. Outcomes for three of the firms, B, D, and F clearly points towards rejection of H2. The negative sign of the format coefficient confirms the full sample results in Table 2. These firms clearly shade their stand-alone bids in the combinatorial auctions in order to increase the attractiveness of their package bids and thereby likelihood of winning with a package bid. Notable (from tables A4, A6, and A8 in the appendix) is the difference in marginal price increment in the stand-alone bid in combinatorial auctions among the firms. Firm F for example shades their bid approximately 2.5 times more than firm B and firm D adds two times as much as firm B.

However, for the remaining three firms the conlusion is that H2 cannot be rejected. The format coefficient lack significance for all three firms. A possible interpretation is then that firm A, C, and E do not apply the same strategy as firms B, D, and E. Consequently, all things equal they submit stand-alone bids of the same magnitude irrespective of format; combinatorial bidding or not.

TABLE 3
Estimation Results, Format and Number of Contracts Coefficients From Firm Specific Regressions

Firm	Format coefficient	*t*- value	No of contracts coefficient	*t*- value	*N*	Adj R^2
A	59 881.85	0.84	-1 232.44	-6.16	755	0.88
B	-123 009.30	-2.83	-1 277.13	-5.38	632	0.90
C	-52 120.15	-0.97	-1 255.56	-0.96	136	0.97
D	-264 998.40	-5.33	-688.38	-1.27	132	0.98
E	-139 238.30	-1.23	-3 558.87	-2.97	84	0.95
F	-329 943.80	-6.52	-1 271.63	-1.47	64	0.96

The number of contracts coefficients are inlcuded since it would be interesting to see if the synergy effect is valid for all firms. The results confirms that this is the case. Differences in outcomes are also found in the competition effect and contract type. The expected decreasing effect of competition is found for firms B, C, and F. For firms A and E no significant difference in bids is found due to contract type. Firms B and C bid signficantly lower on office contracts compared to contracts specified as ”other” while firms D and F bids higher on school and day nursery contracts compared to the reference category. Note that firm F did not place any bids on office contracts. Bids are, however, inreasing in the number of square meters for all firms.

SUMMARY AND CONCLUSIONS

The purpose with the empirical analysis carried out in this study has been to investigate if bidders anticipate the interdependency between their stand-alone bids and their packages bids in combinatorial procurement auctions, and if the motive behind the package bids is a synergy effect or a strategic effect.

Intuitively, a bidder’s motive to submit a package bid in a combinatorial procurement auction is because there are cost synergies in production. A package bid mitigates the exposure problem and by passing the synergies on the procurer, a bidder can bid more competitively in the auction. However, even with additive costs for cleaning there is still a strategic motive for the bidder to submit a non trivial package bid. Hence, observing package bid in a procurement auction is not a guarantee that there are cost synergies in production. Irrespectively of what the bidder’s cost function looks like, her stand-alone bids and her package bids will compete with one another in the auction. Therefore, it might be tempting for the bidder to raise her stand-alone bids in order to increase the probability of winning with the package bid.

Based on data from Swedish procurement auctions of cleaning services, our findings are that the motives behind the package bids are cost synergies in production, but also that bidders tend to behave strategically and submit higher stand-alone bids in the combinatorial setting compared to their stand-alone bids in the standard setting.

A clear policy implication from the conclusions drawn from our study is that one needs to be careful when interpreting the size of the package discount in first-price combinatorial auction. Even if package bids are motivated by synergy effects, and therefore has the potential of lowering the procurer's cost, the observed package discount is overstating the actual cost reduction of a combinatorial auction. The questions of cost-savings need to be carefully evaluated with analysis based on winning bids given the type of auction applied. Another question that also needs attention in future research is whether or not the bidders are successful in applying this strategy.

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APPENDIX

FIGURE 1
Stand-Alone Bids in Auction A (SEK)

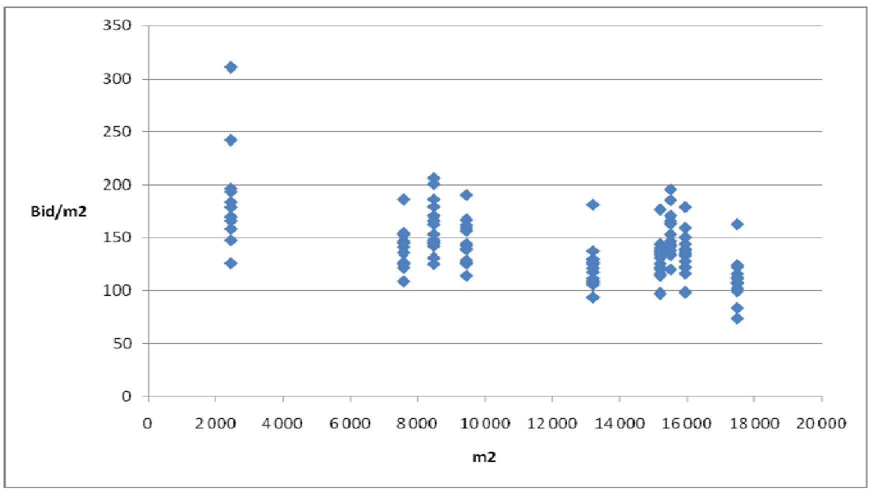

FIGURE 2
Package Bids in Auction A (SEK)

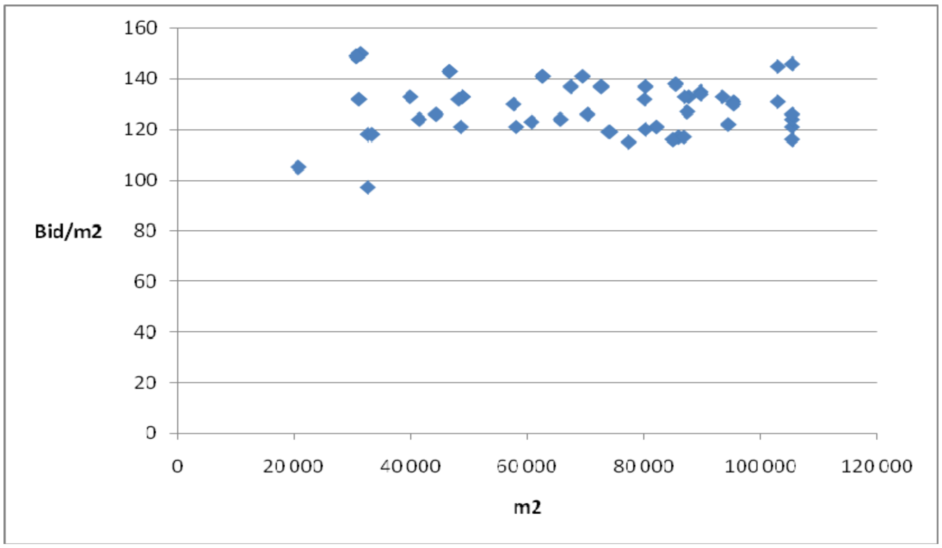

FIGURE 3
Stand-Alone Bids in Auction B (SEK)

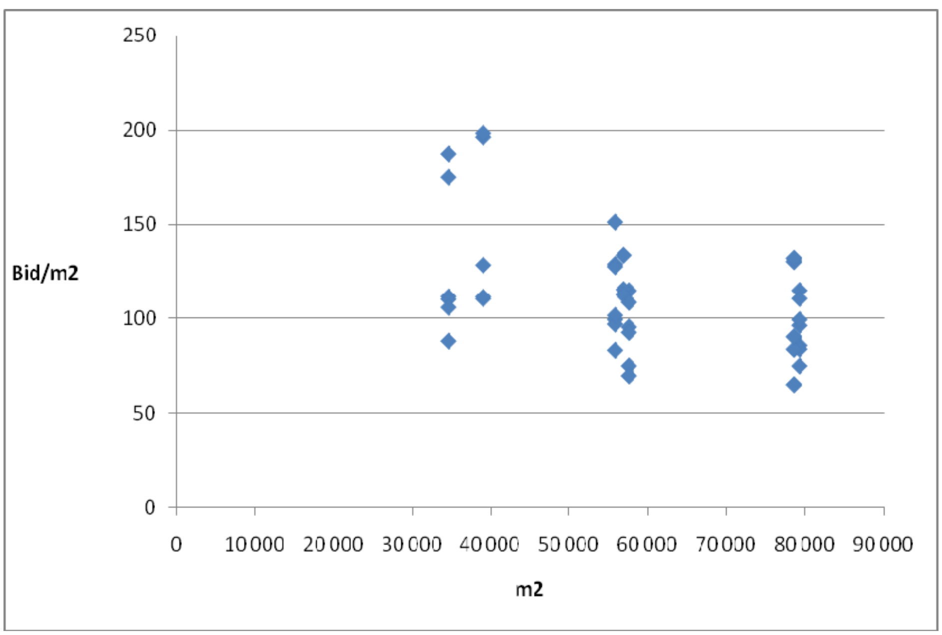

FIGURE 4
Package Bids in Auction B (SEK)

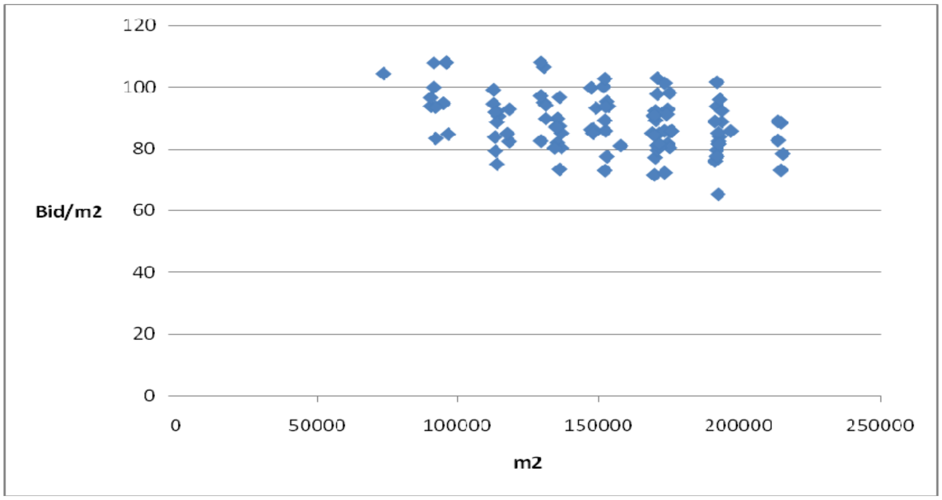

FIGURE 5
Stand-Alone Bids in Auction C (SEK)

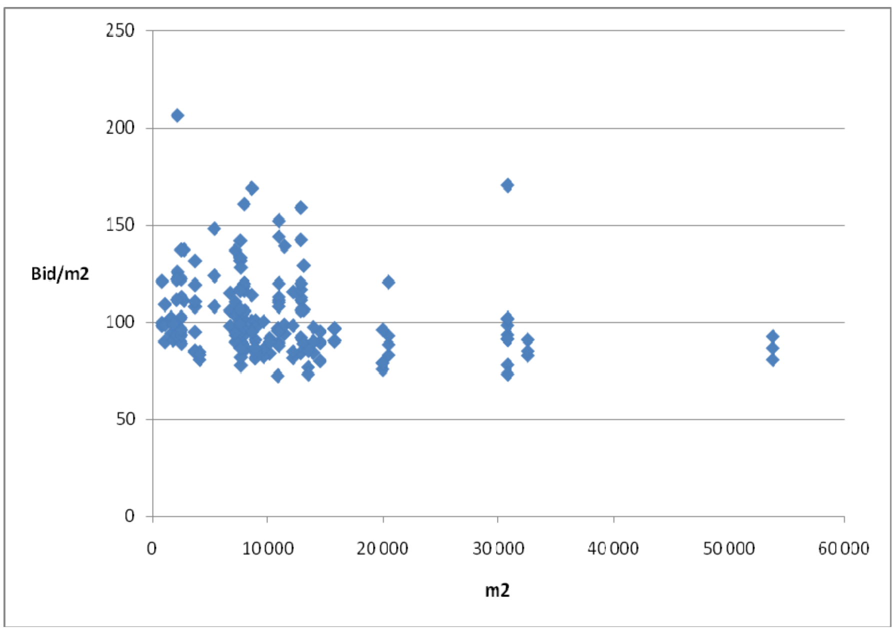

FIGURE 6
Stand-Alone Bids in Auction C (SEK)

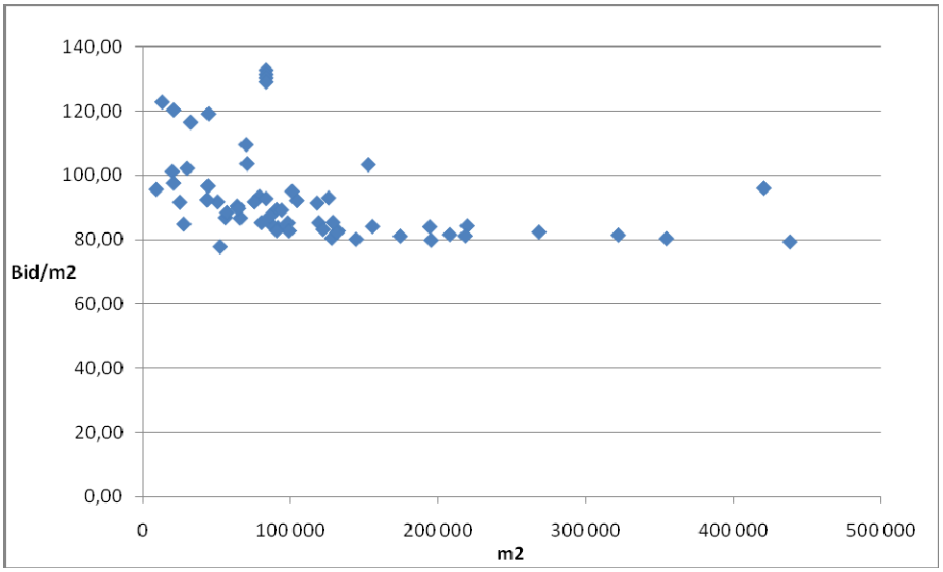

TABLE A1
Correlation Matrix

	No Contracts	No bids	No bids squared	Format	Sqm	School	Day Nursery	Office
No Contracts	1.00							
No bids	-0.08	1.00						
No Bids squared	-0.07	0.93	1.00					
Format	-0.18	0.11	0.06	1.00				
Sqm	-0.06	-0.04	0.01	-0.50	1.00			
School	-0.21	0.05	0.07	0.13	0.21	1.00		
Day nursery	0.14	0.01	-0.04	0.23	-0.35	-0.56	1.00	
Office	0.14	-0.12	-.0.08	-0.51	0.21	-0.40	-0.33	1.00

TABLE A2
VIF- Values

	No Contracts	No bids
No Contracts	7.43	0.13
No bids	7.38	0.14
No Bids squared	3.45	0.29
Format	3.24	0.31
Sqm	3.01	0.33
School	1.80	0.56
Day nursery	1.54	0.65
Office	1.10	0.91
Mean VIF	3.62	

TABLE A3
Estimation Results, Firm A (H2)

	Coefficient	*t*-value
Format	59 881.85	0.84
Number of contracts	-1 232.44	-6.16
Square meters	86.76	13.39
Schools	-20 772.15	-0.51
Day Nurseries	3 038.26	0.12
Offices	-5 5475.36	-1.46
Number of bids	-11 661.30	-1.21
Number of bid squared	693.32	1.33
Constant	51 220.20	0.67
Adjusted R^2		0.88
F(8,1 959)		195.81
N		755

TABLE A4
Estimation Results, Firm B (H2)

	Coefficient	*t*-value
Format	-123 009.30	-2.83
Number of contracts	-1 277.13	-5.38
Square meters	82.64	29.35
Schools	-5 273.28	-0.15
Day Nurseries	-2 819.49	-0.11
Offices	-121 576.00	-3.65
Number of bids	-56 408.14	-2.82
Number of bid squared	3 019.94	2.61
Data period	441 391.40	4.94
Constant	-123 009.30	-2.83
Adjusted R^2		0.90
F(8,1 959)		525.85
N		632

TABLE A5
Estimation Results, Firm C (H2)

	Coefficient	*t*-value
Format	-52 120.15	-2.83
Number of contracts	-1 255.56	-5.38
Square meters	75.95	29.35
Schools	-12 796.60	-0.15
Day Nurseries	-4 793.60	-0.11
Offices	-84 318.99	-3.65
Number of bids	-21 320.16	-2.82
Number of bid squared	1 641.47	2.61
Data period	213 287.30	4.94
Constant	-52 120.15	-2.83
Adjusted R^2		0.97
F(8,1 959)		345.08
N		136

TABLE A6
Estimation Results, Firm D (H2)

	Coefficient	*t*-value
Format	-264 998.40	-5.33
Number of contracts	-688.38	-1.27
Square meters	87.81	25.64
Schools	46 796.74	2.07
Day Nurseries	59 624.51	3.33
Offices	20 480.74	1.15
Number of bids	-158.80	-0.06
Number of bid squared	90.63	1.30
Constant	260 817.20	4.44
Adjusted R^2		0.98
F(8,1 959)		1 925.91
N		132

TABLE A7
Estimation Results, Firm E (H2)

	Coefficient	*t*-value
Format	-139 238.30	-1.23
Number of contracts	-3 558.87	-2.97
Square meters	81.46	12.27
Schools	-14 301.87	-0.30
Day Nurseries	-5 072.85	-0.11
Offices	-30 014.68	-0.82
Number of bids	-50 240.12	-1.42
Number of bid squared	24 16.70	1.85
Constant	505 785.30	2.52
Adjusted R^2		0.96
F(8,1 959)		272.48
N		84

TABLE A8
Estimation Results, Firm F (H2)

	Coefficient	*t*-value
Format	-329 943.80	-6.52
Number of contracts	-1 271.63	-1.47
Square meters	53.84	9.58
Schools	74 832.06	3.95
Day Nurseries	42 483.12	3.95
Offices	(dropped)	
Number of bids	-20 687.72	-2.43
Number of bid squared	1 566.26	3.30
Constant	438 312.10	7.22
Adjusted R^2		0.96
F(8,1 959)		272.48
N		84