

APPLICATION OF PROPOSED METHODOLOGY TO PROVE EXPECTED BIDDING STRATEGY FOR SEALED BID AND ENGLISH REVERSE AUCTION

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ABSTRACT

In this paper the assumed sellers bidding strategy for two selected tender methods, a Sealed bid and an English reverse auction, is verified. The bidding strategy for each tender method is based on rational strategy of the sellers in each tender method. The assumption for the Sealed bid is that the sellers submit the best bid they can. The assumption for the English reverse auction is that the sellers submit an overvalued initial bid for the auction, which is higher than their best bid. The verification is based on the comparison of coefficient of variation between these two tender methods.

KEY WORDS

Purchase. Negotiation. Supplier selection. Sealed bid. English reverse auction.

JEL CLASSIFICATION

D440, M190, M210.

INTRODUCTION

The price negotiation is a big issue in the purchasing process. For finding the right price it is necessary to select the appropriate negotiation method with the evaluation criterion to compare the seller bids and choose a supplier (Kotler, Wong, Saunders and Armstrong, 2007).

In this paper assumed sellers bidding strategies in Sealed bid and the English reverse auction are verified. It is based on a designed methodology (Heinisch, 2017) for verifying the assumed strategy of the sellers. Selection of these tender methods is based on the widespread use in practice (Fiala, 2012).

Individual chapters define the characteristics of mentioned tender methods, methodology for verification, application of the methodology, results and their discussion.

1 THEORETICAL BACKGROUND

In this chapter Sealed bid and English reverse auction is characterized. Basic characteristics of the different methods, the process of submitting bids by the seller and comparison of both methods are described.

1.1 Sealed bid

Sealed bid is a method commonly characterized by the possibility to offer only one bid (Fiala, 2012). The entire bidding process is a secret (Schneider, 2014). Individual sellers have no information about the number of all invited sellers, the number of sellers taking part or their bids. While keeping the bidding secret, the sellers can change their bids until the bidding end. The purchase with the Sealed bid method contains usually one bidding phase. Valid bid is always the last submitted bid within the set time interval (Milgrom, 2004). After the bid opening the purchaser evaluates and selects the best seller, the supplier (Fiala, 2012).

High emphasis is on keeping the bidding secret, which is the essential element without which this method has no effect. It secures equal access to information and no discrimination of the sellers (Maschler, Solan and Zamir, 2013).

The bidding begins with an invitation of the sellers with tender specification. The tender specification generally contains a description of purchased products, purchase conditions and the evaluation procedure.

The aim of the sellers is to maximize their profit by selling the product at the highest possible price. Sellers decide about the amount of their bids according to market information, which is due to the bidding secret incomplete (Binmore, 2014). To win the tender, the sellers have to offer a lower price than their competitors, yet high enough to ensure the profitability of the transaction. If the sellers know the common market price, which is the assumption for a rational seller, it is highly probable that the submitted bid is in the range breakeven point of sellers and the common market price (Hirshleifer, Glazer and Hirshleifer, 2005).

1.2 English reverse auction

English reverse auction is a purchasing auction that gives sellers an opportunity to change the submitted bid in response to a published actual information about the tender (Schneider, 2014). The submitted bids can only decrease.

The invitation process for the English reverse auction is similar to the Sealed bid. English reverse auction usually contains two phases (Fiala, 2012). In the first phase the sellers submit an initial bid. This initial bid determines the maximum sellers' price for the product and their starting bid in the second phase, the auction. In the auction the purchaser allows the sellers to see some information (ranking of the sellers, the best bid of each item or the best total bid) of the tender to motivate them to decrease the bids (Schneider, 2014). To limit the bid changes the purchaser uses following instruments: the minimum step of bid change (in absolute or relative values) and the inability to match the bids and the time interval for bid change. The last submitted bid of each seller in the defined time interval is always valid, regardless of whether it was submitted in the first or second phase (Maschler, Solan and Zamir, 2013).

The first phase runs generally in days or weeks to provide sufficient space for sellers to submit the initial bid. Because it is not necessary to keep the bidding secret (like in the Sealed bid), the purchaser has no extra costs. An effect of this method is delivered by the auction. The purchaser has to guarantee all tender rules and to provide a space to participate in real time for all the sellers (Kaplan and Zrník, 2007). The sellers who are interested to get the additional information published during the auction have to participate in it.

The sellers acquainted with this tender method know that their bid can be changed during the auction. They also know the limitations caused by their initial bid. That is why the sellers are motivated to submit a higher initial bid than the one they would submit in case there would be no correction option during the auction (Milgrom, 2004). Higher initial bid gives the sellers a comparative advantage in the auction. They use this overview of the situation and their position to decrease their bids if it is needed to win.

2 OBJECTIVE AND METHODOLOGY

This chapter contains the hypothesis for verification of assumed sellers bidding strategy in Sealed bid and English reverse auction and the methodology for its verification.

2.1 Hypothesis of sellers' bidding strategy

The hypothesis of sellers bidding strategy is based on the rational bid submitting in Sealed bid and English reverse auction.

Rational sellers submit their best bid in the Sealed bid. They know the common market price and that is why it is possible to assume the submitted bids will tend to be similar or not to be too different from each other.

Vice versa, rational sellers submit their initial bid overvalued in the English reverse auction. Because the bid decision is individual, the overvaluation is also individual. This makes it possible to assume that the initial bids in the first phase will significantly differ from each other. Sellers participating in the auction with the target to get the additional information of the market, but not to win support the assumption of higher initial bid variation.

Direct verification of these assumed sellers bidding strategies for both tender methods is not possible. The equal tenders, in which both methods are used, are in practice almost absent. For this reason an indirect comparison based on parameter using the coefficient of variation of submitted bids will be done.

The null hypothesis says: coefficient of variation of the submitted bids in the Sealed bid is the same as the coefficient of variation of the initial bids in the English reverse auction.

Alternative hypothesis says: coefficient of variation of the submitted bids in the Sealed bid is not the same as the coefficient of variation of the initial bids in the English reverse auction.

Hypothesis testing is performed on the selected significance level of 5%.

2.2 Methodology for the verification of the sellers' bidding strategies

Verification of the above-mentioned hypothesis is based on paper "Comparison of bidding strategy for sealed bids and English reverse auction" (Heinisch, 2017) and contains following steps:

1. The coefficients of variation from submitted bids in Sealed bid and the coefficients of variation from initial bids of English reverse auctions will be calculated.
2. These two data sets will be cleaned out of the outliers.
3. The normality of the data distribution will be tested by the Shapiro-Wilk test for normality at a significance level of 5%. It is assumed that the distribution of the data sets is not normal.

4. The probability distribution of the data sets will be tested by the Mann-Whitney nonparametric test at a significance level of 5%. It is assumed that the data sets have different distribution.

For application of this methodology conditions of input data to secure the comparison of the submitted bids in different tender methods are defined:

- all tenders have to be evaluated only by price,
- sellers submitted bids to all items of the tender,
- in the tender there is only one winner,
- tenders contain at least 3 submitted bids,
- purchaser published any expected tender price to the sellers.

3 DATA SOURCE

The chapter describes the origins and characteristics of the data used in this paper.

3.1 Origin of the data

The data used in this paper comes from software for electronic tendering called PROebiz. PROebiz has been developed by NAR marketing s.r.o. located in Ostrava, Czech Republic. The company is certified by ČSN ISO/IEC 27001:2006 and ČSN ISO/IEC 9001:2009.

The first application of PROebiz took place in 2001. Since that time PROebiz has been used for more than 100000 tenders. Actual number of companies using PROebiz is over 800 from the private and public sector.

3.2 Data properties

The data source is a database of tenders from the version of "PROebiz 3". The tenders in this version were organized from January 2008 to July 2015.

The modules of PROebiz for the selected tender methods are the module "Sealed bid" and the module "ERMMA" (English Reverse Multi criteria Multi item Auction). For Seal bids there are only the final bids used. For English reverse auction initial bids are used. Tenders with any intervention of the purchaser were excluded from the research. The Sealed bids contain only one sealed phase. The ERMMA tenders contain two bidding phases. Between the two bidding phases there could be one controlling phase, used by tender manager for bid approval. Purchasers are only private subjects. The used tenders content only valid and complete bids from at least 3 sellers. The bid evaluation is based on total price.

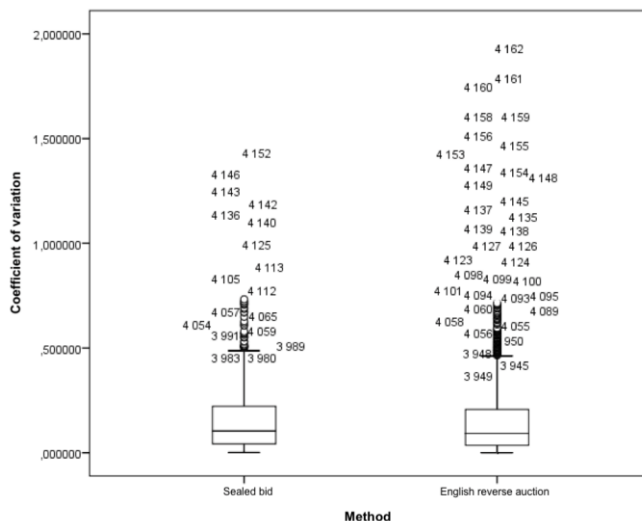
4 RESULTS AND DISCUSSION

This chapter contains the results of statistical comparison of Sealed bid and English reverse auctions. For the statistical verification SPSS software was used.

4.1 Adjusting for outliers

4162 tenders, 1079 Sealed bids and 3083 English reverse auctions were used as input for the research. For each of the tender type the coefficients of variation were calculated. Their distribution is displayed a Boxplot in Figure 1.

Figure 1 Box plot unadjusted values



Source: Own processing in SPSS.

More than 9% of coefficients of variation were due to a remote distance from the upper quartile excluded. 3796 tenders, 957 Sealed bids and 2839 English reverse auctions were qualified for statistical testing.

4.2 Shapiro-Wilk normality test

Verification of the values normality was performed by the Shapiro-Wilk normality test. Value of the test criterion W for each tender method is shown in Table 2 below.

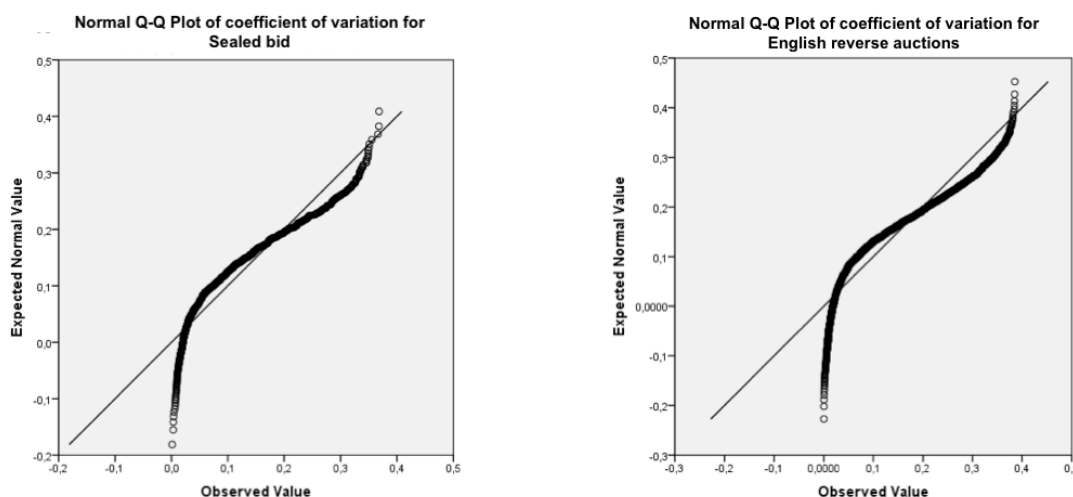
Table 2 Shapiro-Wilk test

	W	p-value
Sealed bid	0,896	0,000
English reverse auction	0,884	0,000

Source: Own processing.

Even though the values for the test criterion W are close to 1, by comparing the p-value 0,000 with significance level of 5% it is possible to reject the null hypothesis about the probability distribution values according to a normal Gaussian distribution. The test confirmed the assumption that the distribution of coefficients of variation for both tender methods is not normal. This result confirms the Q-Q plots in Figure 2.

Figure 2 Q-Q plot adjusted values



Source: Own processing in SPSS.

The Q-Q plots show the expected distribution of values (straight line) and their actual distribution (curve). Because the curve does not match the line, the distribution of coefficients of variation for Sealed bid and English reverse auctions is not normal.

4.3 Mann-Whitney test

Because of result of the Shapiro-Wilk test the selection of a non-parametric test for conformance test of the data sets was appropriate. The values of the test statistics U for the Mann-Whitney test for each of the methods are shown in Table 3.

Table 3 Mann-Whitney test

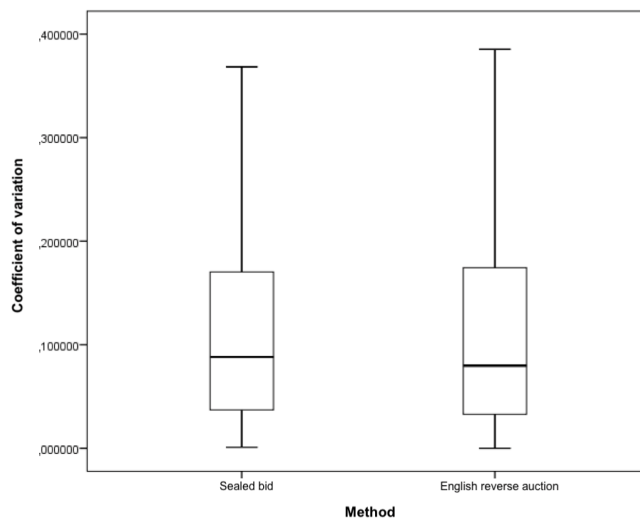
	U
U ₁ (Sum of the ranks for Sealed bid)	1857516,00
U ₂ (Sum of the ranks for English reverse auction)	5349190,00

Source: Own processing.

Test criterion U for the Mann-Whitney test is the lower value in the Table 3, $U_1 = 1857516,00$. This value is compared with a critical value of the Mann-Whitney test 1317819,99 for data sets with 957 and 2839 values and the 5% significance level. The value of the test criterion U_1 is greater than the critical value of the Mann-Whitney test, therefore it is possible to accept the null hypothesis of equality of the probability distribution of both files. This conclusion is also supported by the result of two-sided test, which test value 0,166 is greater than the level of significance of 5%.

It means that among the distribution of coefficients of variation Sealed bid and English reverse auction there is no statistically significant difference. The result of statistical test confirms the box plots in Figure 3.

Figure 3: Box plot adjusted values



Source: Own processing in SPSS

The box plots show the distribution of coefficients of variation for the Sealed bid and English reverse auction. Optically it is apparent that the distribution of values is similar.

4.4 Discussion

An assumption of difference in the sellers' behaviour in Sealed bid and English reverse auction is the conclusion of the theoretical part. Variation of bids in Sealed bid should be lower than the variation of initial bids in English reverse auction. The variation is represented by the coefficient of variance. Sellers in Sealed bid should submit their best possible bid, because of no additional information that could have any influence on the bid. Sellers in English reverse auction should overvalue their initial bid, because of improvement option and an option to see additional information during the auction. Because the bid submission is individual, the overvaluation in English reverse auction should be also individual and therefore also different.

The above-mentioned assumptions about differences in the behaviour of sellers bidding in Sealed bid and English reverse auction were not confirmed by results of their verification in this paper. The distribution of the probability of their coefficients of variation is not different. This implies that there is no statistical difference in the structure of the submitted bids in Sealed bid and the initial bids in the English reverse auctions on the level of significance 5%.

Based on the results of statistical testing following consideration can be assumed. If the structure of submitted bids for both of these methods is identical, the price level of bids could be identical too. It will mean that the sellers submit the prices in Sealed bid on the same price level as the initial bids in the English reverse auction. That would mean that any improvement of the best initial bid in the auction would be a saving for the purchaser in comparison to the Sealed bid.

If the above mentioned consideration was valid, it would be more efficient for purchasers to use English reverse auctions than Sealed bid, because every change of the best initial bid would mean a better price than the one which would have been achieved in Sealed bid. The economic effect of purchase would be increased.

CONCLUSION

The paper verifies assumptions of sellers' bidding strategies in two negotiation methods of purchasing, a Sealed bid and an English reverse auction. The verification applies a methodology that compares different purchasing tenders.

Sealed bid is characterized by bidding secret which means there is no additional information published to the seller. Sealed bid assumes the participating suppliers want to win

the tender, because there is no added value of participation in the tender. That is why it is assumed the sellers submit the best bids they can.

English reverse auction starts with the initial seller bid, which can be improved during the auction after publishing additional information. The sellers are motivated to overvalue the initial bid or/and to participate in the tender with the aim to get the additional information but not to win.

The null hypothesis says the coefficients of variation of sellers' bids in Sealed bid is the same as the coefficients of variation of sellers' initial bids in English reverse auction. The alternative hypothesis says the coefficients of variation of sellers' bids in Sealed bid differ from the coefficients of variation of sellers' initial bids in English reverse auction.

Hypothesis testing was performed using the Mann-Whitney nonparametric test on the level of significance 5%. 3796 tenders adjusted of outliers, 957 Sealed bids and 2839 English reverse auctions were used as input data for statistical testing.

The result of the statistical testing is the acceptance of null hypothesis of Mann-Whitney test at a significance level of 5%. This means rejection of the main assumptions of the sellers' bidding strategies for both tender methods. The coefficient of variation of the initial bids in English reverse auction is similar to the coefficient of variation of submitted bids in Sealed bid. Similar distribution could mean same price level of the bids. That means that any change of the best initial bid during the auction creates profit for the purchaser in comparison to the Sealed bid.

To prove this consideration will be aim of the further research is needed. The results of this further research can lead to the specification of conditions for the use of selected tender methods. Analysing the bidding strategy of the winners of the English reverse auction, observing bid changes in the auction, etc. are another possible research directions.

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