

## ***Determinants of Public Fund's Savings Formation via Public Procurement Process***

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**Abstract:** *The aim of procurement is to achieve savings of public resources. Domestic and foreign studies point to the fact that the condition of achieving the savings is sufficient competition on the supply side. Slovakia currently belongs to the group of countries with low competition in public procurement deals. Furthermore, in this context we have compared the best practices of using public funds with regard to public procurement in the Czech Republic. The aim of this paper is to create and analyze models of the number of tenders subcontractor participation and open competition on the savings achieved in public procurement. Based on the Wilcoxon signed-rank test in the R software is demonstrated that public procurement in an average is a way to save public funds. Using linear regression in R program positive effect of the number of offers to saving process is identified. Across the investigated group as well as at dividing to limit and above the limit contracts, any further offer increased energy in average of 3%. Participation of the subcontractor has positive effect on savings in the whole study group and at above limit contracts over 1.35 million euros without value added tax. Open competition as a kind of public procurement is not statistically significant in pursuit of savings in procurement for a given sample.*

**Keywords:** *public procurement, public contract, saving, linear regression*

**JEL:** *H40, H54.*

### **Introduction**

Through the allocation of public contracts to entities in the private sector a substantial portion of public funds is being annually allocated. Public procurement represents a significant part of the demand for goods and services in the economy (OFT, 2004). Public sector as shoppers can affect the structure of supply (Fiorentino, 2006). The condition is the effective functioning of the public procurement process. Higher efficiency of public procurement can bring substantial savings in spending public funds (Špinerová, 2014). It is necessary to set clear, standardized rules and manage all process (Litră, Burlacu, 2014). Effectiveness of public procurement can be assessed by the final contract prices achieved (Pavel,

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2010), while an important prerequisite for cost reduction and eventual final price for the public sector is the existence of sufficient competition in the market. According to the European Commission (2008) competition on the supply side may be judged by the number of bidders in public procurement – the number of submitted bids/offers. European Commission (2011) in his study approximates by the number of offers the efficiency of public procurement, which is based on the assumption that a larger number of applicants enables award the contract to the tender quality for lower price. It is therefore necessary to ensure transparency in public procurement (Vlach, Ursíny, 2007; Survila et al., 2016). This requires the elimination of corruption and prevention of cartels between entities entering into the procurement process (Ciešlik, Goczek, 2015). Results of the study for the Czech shows that the problem of corruption increases with firm size (Virglerová et al., 2016). According to OECD (2005) such agreements undermine confidence in the competitiveness of procurement, not to mention the resulting unfavorable price or the quality of the delivered object in the winning bid. In cases of detected cartels they increased the market prices by several tens of percents (Zemanovičová et al., 2010). For construction work, it was up to 30-50% (Grega and Nemeč, 2015). Rose-Ackerman (2016) came to an interesting observation that when the country removes conditions of unfair competition and corruption, the results of public procurement in three offers cannot be worse than the results of public procurement in six offers. One of the key ways for resolving this problem in the procurement process is sufficient competition on the supply side, which together with other factors affect the achievement of the lowest prices. This argument is based on several scientific studies, for example Danger and Capobianco (2008), European Commission (2000), or Nemeč et al. (2005). Kuhlman and Johnson (1983), Gilley and Karels (1981) tend to believe that the direct competition has more significant influence (number of submitted tenders) than potential competition (possible entry into the industry).

Lower efficiency in public procurement causes waste, which the authors Bandiera et al. (2008) distinguish between the active and passive. Examples of active waste can be the occurrence of corrupt practices in the procurement process, while a passive source of waste may be the inability or lack of motivation of public officials to minimize costs. The results of the study carried out by the example of public procurement in Italy in 2000-2005 suggest that larger part of the inefficiency stems from passive waste – pure inefficiency, than the presence of corruption in the procurement process. On the other hand, the results of a study aimed at analyzing the state of public procurement in Slovakia declare the fact that public procurement is one of the main sources of corruption and bribery in the public sector. The reason is the lack of transparency in public procurement, shortcomings in legislation or incorrect approach in the implementation of procurement (Vlach, Nemeč, 2001). In recent years there has been a substantial modification of legislation and the introduction of e-auction, which contributed to the growth of transparency. It should show an increase in the number of tenders in public procurement and subsequently increase savings for the public sector.

Original value of this article resides in the fact that it demonstrates the positive effects of public procurement while using public funds. Moreover, by using adequate statistical tools, the article also confirms what is the level of savings, e.g. when we take into account participating of more candidates and it goes down to the qualification of such effects – savings.

### **1. Theoretical background**

Competition on the supply side of public procurement is influenced by a variety of factors. Not all of them can be directly affected by the submitter of the public contract. We can include the structure of supply-side position in the economic cycle, and conditions in the credit market into this group of factors (Harland et al., 2013). In sectors that are associated with high costs of entry into the industry it is not possible to ensure sufficient competitive environment, which could lead to greater savings in procurement (Shrestha and Pradhananga, 2010). On the other hand, submitter has the effect of setting qualifications, the definition of the subject of performance, type of tender (open, restricted, etc.). Closely specified subject matter and too stringent demands on suppliers reduce the number of subjects that may be in the public procurement process involved (Pavel, 2010). A common problem is the participation of unqualified candidates. Therefore, public administration should evaluate candidates based on selected criteria. It is possible to use a variety of models and methods disclosed, for example Plebankiewicz (2012), Manoliadis et al. (2009) or Lam and Yu (2011). In practice, they set out the criteria under which it is possible to evaluate the ability of the supplier to perform the contract (Hatush, Skitmore, 1997).

In the studies dealing with this issue, the authors come to a single conclusion that there is inverse relationship between the number of bids and final price. In other words, growth in the number of offers has positive influence on savings in public procurement (Becerra et. al., 2016; Nipun, Kwan, 2017).

A comprehensive analysis of this issue was carried out by the European Commission (2008). It worked with data on 13370 over limit public contracts in the EU in 2004-2007. The results showed that in the process of public procurement the largest price reduction was caused by second offer, which reduced the price by 4.5%. At third and fourth contact was the reduction 1.2% in average. In 2004-2006, the authors Onur et al. (2012) analyzed public procurement in Turkey. They came to the conclusion that every other candidate involved in public procurement reduces the final price by an average of 3.9%. On average was into public procurement in these period involved 3.09 candidates.

Kuhlman and Johnson (1983) have focused on the examination of the impact of price offers for public contracts in the construction of highways in the United States (Rose, 2016). They concluded that the number of tenders reduces the final price and any further offer will lower the price by an average of 2% of the estimated one. A similar study with the same result on the final cost of public procurement can also be found at Otis, Gilley and Gordon V. Karels (1981). Gupta (2002) found that to ensure the highest competition, which would affect the price

drop 6-8 offering companies are needed. Each additional offer has no effect on the final price. His study focused on the analysis of transport infrastructure (in particular the construction of motorways) in Florida (USA) in the years 1981-1986. In the case of 2-8 tenders was the saving 12-14% on average.

Significant impacts of the high number of offers on the final price of the contract identified Gómez-Lobo and Szymanski (2001), who observed the impact of competition on the results of the application of CCT (Compulsory Competitive Tendering) in the UK. Public sector organizations are forced to compete for their work with the private sector since 1988. The most significant positive benefit for the client should be, according to their calculations the arrival of the second offer, which on average reduced the price by 12-13%.

Millet et al. (2004) consider use e-auction, which should ensure greater competition on the supply side, to be important. According to the authors, optimal number tenders would be the 5-6. At a larger number of offers there is already a decline in prices which would be desirable. If are e-auction associated with excessively large transaction costs, an exclusion of small and medium enterprises will occur, which would negatively affect the competitive environment (Krasnokutskaya, Seim, 2011).

## **2. Public procurement in Slovakia and Czech Republic**

A research study by Strand (2011) on the public procurement in EU countries showed that Slovakia is among the countries with the lowest number of offers in public procurement. The Czech Republic is in sixth place from the end. Along with the problem of corruption, the public procurement system cannot fulfill its basic principles (Greg, Nemeč, 2015). Pavel (2013) in his study pointed out that Eastern European countries have a serious problem with the number of offers entered in procurement.

Šípoš and Klátik (2013) evaluated tender in Slovakia on a sample of 6800 tenders of 3.9 billion Euros. Two thirds of these tenders are conducted via tender which is the most open procurement method and the average number of candidates for public procurement is three offerings. In 2009, there were an average of 2.3 deals and in 2011 3.6 offers (Šípoš, 2012). Results of the study showed that increasing number of offers has the effect of reducing the final price, but saving on two bids was greater than the savings in three or four offers. In the case of Slovakia, the analysis of the impact of offers savings in the procurement was the study object of Greg and Nemeč (2015), who investigated 27000 cases of public procurement in the years 2009–2013 and concluded that the number of offers has implications for savings in public procurement.

Analysis of the influence of selected factors on the final price in public procurement in transport infrastructure in Slovakia and the Czech Republic is the study object of Pavel (2009, 2010) from Transparency International. He examines in his study the effect of offers, the participation of the subcontractor, the method of public procurement, the growth of the industry and time to the final cost of public procurement. In addition, he monitors the impact of the selection criteria for

the sheer number offers. Pavel explains that the growth in supply increases the likelihood that a new more efficient company will appear, which thanks to its lower costs will be able to offer a lower price. More offers thus pushing the price down while also preventing the formation of cartels. In the case of Slovakia 100 contracts was watched while based on the polynomial model it has been shown, that any further offer causes savings in the procurement of an average of 4.8% (Pavel, 2009). In the case of the Czech Republic, 202 contracts were watched and on average there was a saving of 3.27% (Pavel, 2008). The second option is squeezing the margins of existing producers down. His econometric analysis excluded the correlation between the number of bids and contract size. Therefore, it is not true that large orders can be done only by a small number of subjects. In the case of other than an open contract, so, a public tender, there is a decline in the number of offers. The presence of subcontractor causes an increase in the final price from the estimated one. In the case of Slovakia, this was an increase from 9.8 to 11.6%, thus having a negative impact on the creation of savings. Pavel explains it by the fact, that the subcontractor is usually also a construction company, which due to subcontracting relationship could not enter the competition. This led to a restriction of competition on the supply side, with a negative impact on the price (Pavel, 2009). Pavel (2010, 2013) came to the conclusion that the restricted procedure causes a decrease in savings by an average of 11-19% for the Czech transport infrastructure. In the case of Slovak transport infrastructure this variable has not been examined (Pavel, 2009, Hrdlička, 2009). Pavel and also Hrdlička examine selected contracts also via distribution into below and above limit companies. Hanak and Muchová (2015) examined 256 contracts in the construction and transport infrastructure in the Czech Republic in 2014-2015.

The research presented in this paper examined the number of offers in a relation to the type of subject matter of the tender and the difference in tender prices (award vs. expected prices). A disparity in the number of offers between contracts for transport infrastructure and contracts for public buildings and facilities was found, which, however, does not have a significant impact on the level of competition. This research has also revealed a positive moderate correlation between the number of offers and the amount of relative price decrement measured between award and expected prices. It can therefore be concluded that the number of offers in a tender plays a huge role in the context of the overall efficiency of the project. Contracting authorities should encourage active participation of the largest possible number of bidders in the tender while maintaining sufficient qualification requirements. This type of approach could lead to a greater probability of achieving lower award prices. On the other hand, suppliers should be aware of the anticipated competition in the tender and adjust their bid prices accordingly to increase their chances of winning the contract.

Zachar and Dančíková (2012) developed the analysis of procurement of Slovak hospitals in 2009-2012 which found that in 54.6% of tender was the offer submitted by only one candidate. For comparison, in other sectors outside of health care, the proportion of tenders will be shown with only one bidder, i.e. with one of the offer by more than 40% lower than in the hospitals. On the other hand, the

share of contracts with 5 or more candidates featured in sectors others than healthcare was almost 18%, while hospital tenders were only slightly more than 6%. The average number of offers in hospital tenders is 1.7. In other sectors of the Slovak economy it was on average during the same period, less than 3 bids for tender. This means that in public procurement is the health sector exposed to lower intensity of competition between suppliers, which may be caused by closely specified subject matter. In the Czech Republic competition between suppliers in the health sector is two times higher.

### 3. Objective and methodology

The aim of this paper is to compile models of effect of selected variables on the ratio of the final price and the estimated one at public procurement in Slovakia for the period 2010-2016. The sample required for analysis consists of 500 public procurement contracts in Slovakia from the period January 2010 - December 2016. These contracts are published in the Journal of electronic public procurement. Contracts are then divided into so-called below the limit and above the limit ones, where the criterion is median of the estimated price of the total sample. Based on the median, representing the value of 1.35 million Euros net orders were divided into two subsets. The first subset of below the limit contracts comprised 246 contracts with a value below 1.35 million Euros without VAT. The second set consisted of 254 contracts with a value of 1.35 million Euros without VAT. The reason for the division of the group into two samples is that the selected variables can have a different impact on the final rate and the estimated value depending on the size of the contract.

The monitored variables are participation of subcontractor, type of public procurement, (open - tender, closed - other than open procedures), and in particular the number of tenders which are in various contracts involved in the procurement process. Table 1 shows the basic characteristics of the selected sample by the monitored criteria.

**Table 1. Basic characteristics of the sample**

Factor		All contracts	Below limit contracts	Above limit contracts
No. of offers	1	35.47 %	33.73 %	37.2 %
	2	19.64 %	17.67 %	21.6 %
	3	17.43 %	21.29 %	13.6 %
	4	8.82 %	9.23 %	8.4 %
	5	6.64 %	5.22 %	8.0 %
	6 and more	12.01 %	12.86 %	11.2 %
Participation of the subcontractor	yes	75.55 %	81.14 %	70.0 %
	no	24.45 %	18.86 %	30.0 %
Type of public procurement	open	66.33 %	74.70 %	58.0 %
	closed	33.67 %	25.30 %	42.0 %

*(Source: authors' own processing)*

Based on data from Table 1 it is clear that the largest number of public procurement (35.47%) was realized by the attendance of only one offer. In the case of contracts below the limit that was 33.73% and an above limit contracts 37.2%. Two bids were received for the 19.64% of all monitored contracts. Overall, as more than half of public procurement was carried out in the presence of one or two offers. This is true in the above limit and below the limit contracts. The participation of subcontractor was present in 75.55% of cases. The subcontractor was present slightly more (81.14%) in below limit contracts than in above limit ones (70%). The open competition was used in the case of 66.33% of public procurement. It was used 16.7% more in below limit contracts.

On the platform of outputs from the available research studies we are in the context of fulfilling the objective of our study that is set into these hypotheses:

**H1:** Public procurement has a positive effect on saving of public funds.

**H2:** As the number of offers on average grows the ratio of the final and the estimated price of selected contacts in public procurement decreases.

**H3:** Participation of the subcontractor has an impact on the growth rate of final and estimated price of selected contracts in public procurement.

**H4:** The open competition has an impact on the fall of the final and the estimated price of selected contracts in public procurement.

**H5:** Number of offers, participation and openness of the contract has different implications on the ratio of final and estimated price at below limit and above limit contracts.

Hypotheses relate to the ratio of the final and estimated price. This ratio is desirable to reduce, because if the ratio is lower, more savings occur in public procurement. In H2 an assumption is established that the growth in the number of offers will affect the growth of savings in public procurement as proven by several studies. Based on the study of Pavel (2009) we assume that the participation of subcontractor makes the final price higher and will have a negative impact on the creation of savings. This finding was reflected in the H3. The H4 assumes that open competition will have a positive impact on the creation of savings. In an open procedure the announcer announces a competition for an unlimited number of candidates. This should lead to more offers and consequently to greater savings in procurement. Based on the differences between below and above limit contracts seen in Table 1 the H5 was constructed which foresees different impact of selected variables to create savings in these groups of orders. To verify H1 Wilcoxon signed-rank test is used in program R. To test the effect of selected variables in hypotheses H2–H5 on the ratio of the final and the estimated price linear regression again in R program is used, which verifies the presence of heteroskedasticity, autocorrelation, multicollinearity, as well as whether the residues of the normal distribution model. First it tested the impact of variables on the full set of 500 contracts and then the two samples according to the reference value of 1.35 million Euros without VAT. The statistical significance is decided by the p-value. We consider 95% ( $\alpha = 0.05$ ) as standard level of significance of the tests.

#### 4. Analysis and results

Analytical part was constructed into two continuous lines. We were interested in the quantification of savings in procurement at below limit and above limit contracts, as well as the impact of selected factors on the creation of savings.

##### 4.1. Savings in public procurement

The aim of public procurement is the creation of savings which means, that the result should be the final price lower than the estimated one. The results of achieving savings in the study group are shown in Table 2.

**Table 2. Savings in public procurement**

Criterion		All	Below limit	Above limit
<b>Saving</b>	<b>Total saving</b>	<b>60.60 %</b>	<b>59.77 %</b>	<b>61.32 %</b>
	subcontractor	29.47 %	23.53 %	35.57 %
	no subcontractor	70.53 %	76.47 %	64.43 %
	open competition	74.50 %	84.97 %	63.76 %
	other type of	25.50 %	15.03 %	36.24 %
<b>Overprice</b>	<b>Total overprice</b>	<b>11.20 %</b>	<b>12.89 %</b>	<b>9.46 %</b>
	subcontractor	23.21 %	18.18 %	30.43 %
	no subcontractor	76.79 %	81.82 %	69.57 %
	open competition	66.07 %	81.81 %	43.48 %
	other type of	33.93 %	18.19 %	56.52 %
<b>Unchanged price</b>	<b>Total unchanged</b>	<b>28.20 %</b>	<b>27.34 %</b>	<b>29.22 %</b>
	subcontractor	14.18 %	8.57 %	19.72 %
	no subcontractor	85.82 %	91.43 %	80.28 %
	open competition	48.94 %	48.57 %	49.30 %
	other type of	51.06 %	51.43 %	50.70 %
<b>Relative average saving</b>		<b>8.98 %</b>	<b>9.17 %</b>	<b>8.79 %</b>

*(Source: authors' own processing)*

Table 2 clearly shows that there is inefficiency in the Slovak public procurement. The reason is the existence of contracts that ultimately ended up as overpriced and formed 11.2% throughout the sample. Regardless of the sample size is a negative phenomenon that is manifested in excessive waste of public resources. Up to 28.2% of contracts ended without saving, which due to costs related to the provision of public procurement can also be assessed as ineffective. Overall, only about 40% of orders from the group represented increased costs for the public sector, which showed either overprice or zero savings in procurement. In case of above limit contracts there was 1.5% more contracts with savings. About 3.43% more contracts were overpriced at below limit contracts and by 1.88% more contracts were unchanged at a price at below limit contracts. Savings were

frequently achieved without the participation of the subcontractor (70.53%). Likewise, also overpriced and procurement with an unchanged price was more than the 76% achieved without subcontractor. This therefore means that based on Table 2 we cannot identify the impact of the participation of subcontractor in the creation of savings. It is necessary to check the influence of linear regression. Open procedure occurred in 74% of procurement with a savings and in 66% of procurement with overprice. It is necessary to verify the impact of open competition through a linear regression in R program.

To test H1 statistical testing of the means of compliance was carried with the Wilcoxon signed-rank test in program R. The test is used for the entire sample of contracts as well as below limit and above limit contracts. The test results are presented in Table 3, the statistical significance was distinguished by stars, based on p-value test (\*\*\* 0,001; \*\* 0,01; \* 0,05).

**Table 3. Results of the Wilcoxon signed-rank test**

<b>Wilcoxon signed-rank test</b>	<b>The null hypothesis</b>	<b>Alternative hypothesis</b>	<b>All contracts</b>	<b>Below limit contracts</b>	<b>Above limit contracts</b>
<b>Double sided test</b>	There are no differences in the estimated and the final price	There are differences in the estimated and the final price	$<2.2 \cdot 10^{-16}$ ***	$7.24 \cdot 10^{-13}$ ***	$<2.2 \cdot 10^{-16}$ ***
<b>One-sided test</b>	There are no differences in the estimated and the final price	The introduction of public procurement leads to savings	$<2.2 \cdot 10^{-16}$ ***	$1.49 \cdot 10^{-12}$ ***	$<2.2 \cdot 10^{-16}$ ***

*(Source: authors' own processing)*

Based on the test results we can say with certainty, that given the value of p, which is in all cases, even when double sided and one-sided tests at a value less than the value of 0.05 – we accept the hypothesis that there is a real savings in procurement in all three samples, so we can accept H1.

#### **4.2. The influence of selected factors on the formation of savings in public procurement**

In program R the effect of selected variables (number of offers, subcontractors' participation and influence of open competition) was tested on the ratio of the final and estimated price (in %). First effect has been tested in a wide

set of 500 samples at a significance level of 0.05. The results of the linear regression are shown in Table 4.

**Table 4. The results of linear regression for all contracts**

<b>Dependent variable</b>	<b>The final price as a % of the estimated price</b>	
<b>Explanatory variables</b>	<b>Effect</b>	<b>Statistical significance</b>
Constant	103.167	< 2e-16
Number of offers	-2.9703	4.17e-14
Participation of the subcontractor	-4.4142	0.0341
Open competition	-3.5146	0.0704
R <sup>2</sup>	0.2605	

*(Source: authors' own processing)*

The model shows that the growth in the number of offers on average decreases the ratio of the final and the estimated value of public contracts, which is confirmed by H2. Each additional offer causes a decrease in the final price as % of the estimated price by an average of 2.9703%. It is more precisely seen in Table 3, which represents the average decline in the final price to the expected price at various numbers of tenders.

**Table 5. Impact of the number of offers on the share of final and estimated price for all monitored contracts**

<b>No. of offers</b>	<b>The average final price decline to the estimated price</b>	<b>Change</b>
1	2.391 %	-
2	4.795 %	2.404 %
3	6.891 %	2.096 %
4	13.871 %	6.980 %
5	16.064 %	2.193 %
6	17.811 %	1.747 %
7 and more	15.301 %	-2.510 %

*(Source: authors' own processing)*

Table 5 points to the fact that any further offer brings in average a greater saving in procurement. This effect is being depleted at sixth bid. The largest increase in savings is recorded entering the fourth offer, which produces an average increase in savings by 6.9% compared with saving when there are three candidates. The results of Table 4 reject H3, which claims that participation of subcontractors has an impact on the growth rate of final and estimated value. Based on the results of the linear regression performed on a sample of 500 contracts it has been shown to reduce the rate of final and estimated price by 4.942% in average. This therefore means that the involvement of subcontractors increases savings in procurement in a given sample. The open competition was by the given a model identified as

statistically significant, which means that we cannot neither accept nor reject H4 in the sample.

**4.3. The influence of selected factors on the formation of savings in below the limit and over limit contracts**

Below limit contracts are defined as those, which have the estimated price at lower level than 1.35 million Euros without VAT. It is the number of 246 contracts from the original sample from the years 2010–2016. Results of the linear regression are shown in Table 6.

**Table 6. Results of linear regression, the below limit contracts**

<b>Dependent variable</b>	<b>The final price as a % of the estimated price</b>	
<b>Explanatory variables</b>	<b>Effect</b>	<b>Statistical significance</b>
Constant	103.048	< 2e-16 ***
Number of offers	-3.0511	1.64e-08 ***
Participation of the subcontractor	-2.741	0.303
Open competition	-3.2651	0.183
R <sup>2</sup>	0.2859	

*(Source: authors' own processing)*

At below limit contracts only the effect of offers' number on the resulting ratio of the final and estimated price has been shown. Every extra offer, on average, reduced the rate by 3.05%. This means that with every additional offer grow the savings in procurement by 3% in average. Participation of a subcontractor or an open competition were not statistically significant in the sample. Above limit contracts consist of a set of contracts in the number or 254, the estimated cost was over 1.35 million Euros without VAT. Results of linear regression of the above limit contracts are visible in Table 7.

**Table 7. Results of linear regression, the above limit contracts**

<b>Dependent variable</b>	<b>The final price as a % of the estimated price</b>	
<b>Explanatory variables</b>	<b>Effect</b>	<b>Statistical significance</b>
Constant	103.2602	< 2e-16 ***
Number of offers	-2.9976	2.73e-07 ***
Participation of the subcontractor	-6.736	0.0489 *
Open competition	-3.3356	0.2972
R <sup>2</sup>	0.2338	

*(Source: authors' own processing)*

In the case of this sample is once again confirmed the influence of the ratio of final and estimated price. Each additional offer at above limit contracts causes

an average decrease in the ratio by 2.99%. Participation of subcontractor has been proven to be significant. Participation of the subcontractor on average reduces the ratio of the final and estimated price by 6.73%, with a positive impact on the creation of savings. The open competition was not statistically significant variable, again. After comparing the effect of selected variables at below the limit and above limit contracts we can accept H5. At below and also above limit contracts every additional offer caused a decrease in the final price as a % of the estimated one by 3% on average. Open competition was not statistically significant. H5 has to be rejected because of the fact that below limit contracts has the attendance of subcontractor as a statistically not significant variable, while at the above limit contracts the attendance of subcontractor causes a rise in savings by 6.7% on average. At both types of contracts an average fall in the rate of final and estimated price has been studied at different number of offers, which is presented in Table 8.

**Table 8. Impact of the number of offers on the share of final and estimated price at below and above limit contracts**

No. of offers	Below limit contracts		Above limit contracts	
	Average drop of the final price to the estimated price in %	Change	Average drop of the final price to the estimated price in %	Change
1	-0.013%	-	<b>4.670 %</b>	-
2	4.92%	4.933%	<b>4.685 %</b>	<b>0.015 %</b>
3	10.16%	5.24%	<b>1.810 %</b>	<b>-2.875 %</b>
4	18.24%	8.08%	<b>9.440 %</b>	<b>7.63 %</b>
5	17.18%	-1.06%	<b>15.040 %</b>	<b>5.60 %</b>
6	18.21%	1.03%	<b>16.070 %</b>	<b>1.03 %</b>
7 and more	16.37%	1.84%	<b>13.040 %</b>	<b>-3.03 %</b>

*(Source: authors' own processing)*

After comparing the effect of selected variables at below limit and above limit contracts there are significant differences. At one offer, at below limit contracts by 0.013% on average was reached an overprice. It is a number close to zero, which refers to high inefficiency of public procurement in a particular group. This means that the lack of competition on the supply side directly results in zero savings in procurement at below the limit contracts. At above limit contracts a saving of 4.67% on average was reached at one offer. At below limit contracts was the largest savings achieved at 4 offers; at above limit ones at 5 offers. The largest increase in savings was achieved in supply growth from three to four in both cases. At below limit contracts the effect of savings' growth depletes at four contracts. At above limit contracts is at three bids achieved on average smaller saving than when there are two offers, which can be a sign of cartel agreements, since for four and more offerings are average savings considerably higher than in the three offer case.

## 5. Discussions

The aim of public procurement is to achieve savings. Using the Wilcoxon signed-rank test in the program R, we managed to prove that in the case of the set of all monitored contracts as well as contracts above and below 1.35 million Euros without VAT saving are being created on average in public procurement. Overall, however, only 40% of the study sample consisted of contracts with the effect of overprice or zero savings. This means that the Slovak public procurement system is not fully effective. The problem may be for example a badly set estimated price, which may be set lower than the actual cost of the contract. However, it may be a consequence of the severe disturbances of the public sector, such as corruption and the formation of cartels, which cause limited competition on the supply side. A sign of a cartel is that in the case of above limit contracts the average savings at three offers were lower by 2.8% than in case of two bids. Šípoš and Klátok (2013) have come to similar results whose study has shown that savings in three or four bids were lower than the savings in the two bids. It is interesting to compare those findings with a study of Rose-Ackerman (2016). He came to the realization that if conditions of unfair competition and corruption in the country are removed, the results of public procurement in three offers' situation cannot be worse than the results of public procurement in six offers' situation. By the analysis of selected contracts was in the case of the entire sample of 500 contracts as well as at below and above limit contracts demonstrated that at three contracts significantly lower savings were achieved than in the case of six contracts. According to the statements of Rose-Ackerman we should assume that in Slovakia there are conditions for unfair competition and corruption. On the other hand, if we demand growth of savings with the growth of offers, that cannot be achieved in practice.

In testing the effect of selected variables using a linear model in the R software on a sample of 500 contracts it has been shown that any further offer has a negative effect on the price of an average of 2.9% of the estimated one, thus saving on this percentage, on average, increases with each additional bidder. Saving an average of 3% was reached even when there were below limit and above limit contracts. For comparison, Nemeč and Grega (2015) in their study declared that in Slovakia, with each additional offer savings increase an average of 2.63%. The results of our analysis showed that competition on the supply side has a positive effect on savings in public procurement. The highest average savings throughout the investigated group was achieved at six offers' situation – 16.6%. It means that the growth of offers will not make the savings permanently grow; this effect is exhaustible just after sixth offer. The largest increase in average savings was at four offers by 6.9% compared with the three offers.

The studies of Czech experts Hrdlička (2009) and Pavel (2009) in the field of transport infrastructure pointed out that the participation of a subcontractor causes a decrease in savings. Our linear regression model applied to a selected sample demonstrated the exact opposite. In all contracts the presence of a subcontractor increased the size savings by an average of 4.4%. In the case of

above limit contracts an increase in savings by an average of 6.7% was declared. When contracts are below limit, the presence of subcontractor has been demonstrated as not statistically significant.

Effect of open competition on the resulting savings in procurement has not been examined in other studies. The linear models created in this paper pointed out that the effect of open competition is statistically not significant in any sample.

Conclusions drawn in this study are influenced by the chosen sample of public procurement contracts. Other study sample would bring slightly different results mainly on the impact of subcontractor and open competition. Those can also vary depending on the industry that would be chosen for the analysis. However, it is also possible to draw general conclusions arising from the definition of efficiency of public procurement. Based on the conducted study, it can be argued that in Slovakia there is a weak competition on the supply side of public procurement and public procurement consequently does not work effectively. A clear proof of this is the existence of contracts which terminate overpriced or with zero savings. That in turn causes wastage of public funds. In this paper, we pointed out the possible existence of cartels, especially in the case of above limit contracts. This argument, however, needs to be in the future further analyzed.

However, for comparison it is necessary to include also some of the main conclusions from the experience of the Czech Republic. For example, we choose those that have been used and presented during projects implemented in the Czech Republic (Deloitte Advisory, 2012), or directly from the project EFIN – Effective institutions for the Ministry of Education during the period 2009-2013 (MŠMT, 2017).

This project is directly focused on the promotion and development of effective management principles and especially on economic and supportive processes in tertiary education institutions (high schools and colleges) and public research institutions or other research organizations in the Czech Republic. The project has emphasized the principles and activities that have been successfully implemented in similar institutions in the Czech Republic and abroad as well as in other sectors in the Czech Republic (business, public, non-profit sector, etc.).

It seems that the basic processes and approaches to savings and to implementation of tenders in the area of public procurements are basically the same even when compared to more segments of the national economy. For example, we can talk about public administration and regional development and the tertiary sector including public higher education and public research institutions or construction of transport infrastructure as it was demonstrated in the investigation realized within a lot of projects. There exist the same principles and features of public procurement from the perspective of public procurement in general. Furthermore, frequent errors in procurement procedures (discrimination, division of orders, qualifications, etc.) are also either the same or very similar. And after all, the same are also the consequences of infringement of the law (Deloitte Advisory, 2012).

The project EFIN (MŠMT, 2017) monitored the rate of formalization of rules in terms of allocation of funds according to the centres (which generally correspond to the breakdown of institutions by their parts), nature of the activity (main or supplementary activity or economic and non-economic activity) or according to the type of items (e.g. public procurement, projects, grants or overheads). What is necessary to implement from the point of view of public procurements? The process of acquiring assets (current and capital) and services is absolutely crucial and must be standardized. It must be formally described in the institution (e.g. a directive on public procurement). The institution must set also standardized rules for the process of acquiring the property and the procedure leading to the acquisition of assets must be set, too. Rules for the realization of public procurement include establishment of a procedure for realizing of tenders according to its subject and their estimated value along with a list of documents for archiving. The institution must also compare the prices of so called internal and external services (internal services are described as spending on service done by the internal personnel of the institution whereas external services are spending on services done by external bodies). The process of comparing and assessment of economic benefits of internal and external services is usually a part of market research before the realization of public procurement or it can be provided based on ad-hoc requirements.

Another important parameter for maintaining the efficiency of public procurement is publication in the central register of contracts. The publication is required by the law. Even for the needs of the institutions, it is important to have their own central register of contractual relations with binding structure. It has to include following parts: category of the contract, contract type, name of the external supplier, name of the contract / description of the subject, contract price, cost centre, the duration of its validity, the expected date of expiration of the contract. It is important to include not only the contacts but also any additions or acceptance protocols. For a standard overview, the evidence must demonstrate what is the subject of a public procurement, definition of this subject, the type of procurement procedure, the estimated price and timing during the contract (launching and termination) and the person in charge.

## **6. Conclusions**

The issue of public procurement is devoted to several authors who consistently argue that to achieve savings in procurement it is necessary to ensure sufficient competition on the supply side. This is possible only by removing the corruption and avoiding cartels. From the current OECD studies, however, is shown that Slovakia has a relatively small number of offers engaging in procurement resulting in little or any savings in public procurement.

In this paper, we focused on public procurement in Slovakia in 2010-2016, we further examined using linear regression. To monitor sample we managed to prove that public procurement has an average positive impact on the creation of

savings, although there are contracts with overprice, resp. zero savings. We confirmed by recent studies, declaring the fact that the growth in the number of offers, on average, reduces the final cost of procurement contracts compared to the expected price. This means that competition on the supply side has a positive effect on the growth of savings in public procurement. However, we were unable to demonstrate the impact of open competition, resp. the impact of this variable was statistically insignificant. Linear regression model showed that a subcontractor has on average a positive impact on the creation of savings in public procurement.

Major changes need to be done in public procurement in Slovakia that would minimize the number of offers with overprice or no savings. It is necessary to verify in detail whether the estimated price of contracts is actually the result of market price resp. if the lowest price criterion is the most suitable criterion in public procurement. It is necessary to strengthen the fight against corruption and cartels in public procurement.

In order to increase efficiency of public procurement in the monitored institutions in the Czech Republic, the practice proved to use electronic tools in the form of electronic marketplace and dynamic purchasing system for commodities that were entered in this way. Benefits that were recorded in the analyzed projects in the Czech Republic were generated from the implementation of the principles of effective management. These principles have led to an increase in the effectiveness of activities and services provided by the institutions and also it has led to an increase in the efficiency of funding and resources. Implementation and outcomes described in this article (concerning the Czech Republic) has served to strengthen the competitiveness of these institutions in national, European and global context.

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