Public procurement efficiency in the Slovak Republic: NUTS 3 level

Andrea TKACOVA[1], Beata GAVUROVA[2], Jaroslav BELAS[3], Peter TOTH[4], Gabriel DEMETER[5]

Abstract: At present, public procurement processes and their efficiency represent one of the key determinants of the public finance system. The article's main aim is to identify the impact of the number of bids, type of contract, use of EU funds, e-auction, quality criteria and the presence of a subcontractor in achieving the public procurement savings with emphasis on NUTS 3 level in Slovakia. There were analysed 957 contracts during the period 2016 – 2020. Robust estimation, which uses the WLS method, was applied to quantify the impact of determinants of public procurement efficiency on a level of savings. The results confirmed that an increase in the number of bids also increases the level of savings by 5 percentage points. The savings are higher by 6.6 percentage points if the contract is not funded by EU funds in comparison to contracts funded by EU funds. Also, the savings are higher by 7.4 percentage points when e-auction was not used. Once, the contract does not allow the subcontractor relationships, the savings are higher by 11.6 percentage points. If the quality criterion is not applied in the contract, then the savings are higher by 10.7 percentage points. The analysis confirmed statistically significant differences between individual regions in Slovakia. The most significant difference is evident between the Košice Region and the Bratislava Region, while the Bratislava Region achieved savings higher by more than 20 percentage points. Similarly, the Prešov Region achieved higher savings by more than 19 percentage points compared to the Košice Region.

Keywords: public procurement, savings, number of bids, linear regression, NUTS 3 level.

---

[1] PhD., Technical University of Košice, Faculty of Economics, B. Němcovej 32, Košice, Slovakia, e-mail: andrea.tkacova@tuke.sk. ORCID: 0000-0002-6025-1261

[2] Professor PhD., Faculty of Management and Economics, Tomas Bata University in Zlin, Mostni 5139, 760 01 Zlin, Czech Republic, e-mail: gavurova@utb.cz. ORCID: 0000-0002-0606-879X

[3] Professor PhD., University of Information Technology and Management in Rzeszów, ul. Sucharskiego 2, 35- 225 Rzeszów, Poland, e-mail: belas111@gmail.com. ORCID: 0000-0002-5900-997X

[4] PhD., Technical University of Košice, Faculty of Economics, B. Němcovej 32, Košice, Slovakia, e-mail: peter.toth@tuke.sk. ORCID: 0000-0002-5616-5520

[5] Student,Technical University of Košice, Faculty of Economics, B. Němcovej 32, Košice, Slovakia, e-mail: gabriel.demeter@student.tuke.sk. ORCID: 0000-0001-7671-6898

Introduction

For many municipalities in Slovakia, public procurement is associated with negative experiences due to the long and demanding procurement process. Flexible legislation in public procurement, especially in terms of emergencies, such as the COVID-19 pandemic, where the public procurement speed had become a question of life and death, has been considered very important based on the experiences from 2020 (Folliot Lalliot & Yukins, 2020; OECD, 2020). The state has to ensure transparency and efficiency of the public procurement processes at all of its levels despite a crisis. During the COVID-19 pandemic times, many countries and also lower levels of government had to face higher pressure of a high frequency of public procurements, where many issues occurred due to insufficient preparedness of municipalities.

In the case of public procurement, it is important to use all the public resources efficiently, and also, the behaviour of all of the contracting authorities and procurers needs to be responsible, ethical and without any corrupt activities (Fazekas et al. 2016; Hunsaker, 2009; Olken & Pande, 2012). Thus, it is inevitable to provide an efficiency of the public procurement that depends on institutional factors to a certain extent (Plaček et al., 2020b). The quality of the institutional environment is related to the level of political connections with the level of corruption (Boas et al., 2014; Goldman et al., 2013; Mironov & Zhuravskaya, 2016; Titl & Geys, 2019), with the level of intervention from political elites' side (Coviello & Gagliarducci, 2017; Tkachenko & Esaulov, 2020), with the public procurement system transparency (Coviello & Mariniello, 2014; DeSilva et al., 2009), with an administrative organisation of the procurement process (Baldi & Vannoni, 2017; Detkova et al., 2018; Guccio et al., 2019), with the efficiency of courts from a perspective of conflicts' resolution (Coviello et al., 2018), and with the authorities' approach to formal rules and procedures (Plaček et al., 2020a).

Different perception of efficiency by the public procurement authorities represents another problem. As the results of a natural experiment, that was connected with the COVID-19 pandemic, ineffective procurement in emergencies is caused by incompetent resource management and excessive political interference (Buor, 2019) and also by unclear regulation (Balaeva et al., 2020). Similarly, less transparent procurement methods were used during the pandemic times, while the transparency level between the countries significantly differs regardless of the epidemic size (Kubák et al., 2021; Gallego et al., 2020).

Sufficient competition in the market is a significant determinant of public procurement (Vítek & Meričková (2005), Nemec et al. (2020). Growth of the number of bids increases the level of savings achieved. However, there is a certain number of bids, where this growth is slower (Iimi, 2006; Gineitiene & Šerpytis, 2011; Ilke et al., 2012; Soukupová et al., 2018; Plaček et al., 2020a).

Džupka et al. (2020) examined other significant determinants of the savings creation within MEAT (the most economically advantageous bid) in the countries of Central Europe. If a subject of the public procurement is not co-funded by EU funds, then the savings are higher than in those cases, when it is the opposite. The savings are

smaller if an open type of procurement is used rather than a closed procurement. If a contract relates to only one contractor, the savings are higher than in other cases. A higher number of total bids and a higher number of bids from small and medium-sized enterprises mean higher savings.

In Slovakia, the most significant problem in achieving savings in public procurement is low competition. The main aim of the article is to identify the impact of the number of bids, and other selected determinants that help in achieving savings in public procurement with emphasis on NUTS 3 level regions.

1. Theoretical Background

The number of bids in public procurement is impacted by numerous factors. However, the public procurer is not able to influence all of them. Here belong: competitive structure on the supply side, stage of an economic cycle, and/or credit market conditions. It is not possible to ensure a sufficiently competitive environment that would lead to higher savings in public procurement in those sectors that relate to high input costs (Shrestha & Pradhananga, 2010). Participation of unqualified candidates is a frequent problem. Consequently, public administration should evaluate candidates based on specific criteria. Possibly, such candidates could be evaluated based on models and methods that are presented by Plebankiewicz (2012), Manoliadis et al. (2009) and Lam & Yu (2011).

Plaček et al. (2020a) dealt with overpricing in public procurement in the EU countries with low performance. The authors examined a large sample of public procurement in 11 countries in Middle and Eastern Europe. Hierarchical regression was used to analyse those factors that influence open bidding. The results indicate that institutional factors have a greater impact on overcharging than the individual decision-making of contracting authorities. Finally, the authors determined that in the Czech Republic, there absents a public policy on this subject. Also, it is important to improve the results of public procurement by engaging all actors in this process: officers, politicians, and the public.

One of the most important sources of possible savings in public procurement is the use of e-Procurement. Its innovative form has the potential to decrease transaction costs, and to decrease risk of an information asymmetry and a moral hazard (for instance, Nemec & Meričková, 2013; Jovanovič et al., 2013; Murray Švidroňová & Mikuš, 2015; Hronec et al., 2008; Mikušová Meričková & Stejskal, 2014; Halásková & Halásková, 2015; Švidroňová & Nemec 2016).

Similarly, there are many beneficial studies in the case of Slovak and Czech public procurement. Pavel (2013) concluded that the countries of Eastern Europe have a serious problem with the number of bids in the public procurement process.

Soudek and Skuhrovec (2013) analysed the market prices for the supply of electricity and gas in the Czech Republic. The authors determined that the expected price in a tender was usually overstated. In the case of open bidding, there was achieved the saving of approximately 7 % as in other methods. In the case of electric energy, the final price was reduced by 1 % for each candidate. However, an impact on gas was

negligible. E-auctions reduced the price of a subsequent 6 %. The average number of candidates, in terms of electricity, was four and in terms of gas, it was 3.3 candidates.

Šípoš and Klátik (2013) evaluated the public procurement in Slovakia on the sample of 6800 tenders of 3.9 billion EUR. Open bidding is considered the most open method of procurement and two-thirds of these tenders were performed via the open bidding procedure. Three tenders represented an average number of candidates for public procurement. In 2009, there were 2.3 bids on average, and in 2011, there were 3.6 bids (Šípoš, 2012). The results of the study showed that an increasing number of bids has an impact on a final price decrease, but the savings in two bids was higher than in three or four bids. Mikušová-Meričková and Nemec (2013) confirmed that the final prices decrease with the growth of bids when using open bidding procedures. However, the study of waste management contracts in the Czech Republic did not confirm this trend (Soukopová & Malý, 2012; Soukopová et al., 2018). If there was only one candidate in certain sub-regions, the prices were not significantly higher than in similar areas with a larger number of candidates.

Grega and Nemec (2015) examined 27 000 cases of public procurement from 2009 – to 2013, and also the authors concluded that the number of bids has an impact on savings in public procurement. Each next bid represents savings of an average of 2.63 %. In the case of the public procurement of the projects funded by the EU, funds were savings lower on average by 1.54%. Subsequently, Grega et al. (2019) added to their findings that the use of the lowest price criterium is very complicated. The authors confirmed the positive impact of e-auctions. However, the authors emphasized their high costs in comparison to other countries.

In the case of Slovakia, the differences in competitiveness depending on the monitored sector were determined. It was proved that the sector, such as public health, has been struggling with a low number of candidates for a long period. It is frequently caused by a very specific subject of the contract (Zachar & Dančíková 2012; Gavurová et al., 2020; Nemec et al., 2020). The tender rate with 5 and more candidates represented about 6 %, while in other sectors, it was on average 18%. Hanák and Muchová (2015) confirmed that the growth in bids causes growth of achieved savings in the sector of the construction and transport infrastructure in the Czech Republic from 2014 – to 2015.

2. Methodology

The sample consists of 957 Slovak public procurement contracts from January 2016 to December 2020, which are available in the Public Procurement e-Journal, and which were used for analysis purposes. It is a set of contracts that were published for all eight Slovak regions during this period i.e. NUTS 3 level.

The study examines the impact of selected variables on savings size in the public procurement, which is defined as follows (1):

$$Savings\ achieved = \frac{Estimated\ price - Final\ price}{Estmated\ price} \qquad (1)$$

The following explanatory variables were selected based on the information available from the analysed contracts and the scientific studies on public procurement: number of bids, type of contract (goods, services, building works), type of public procurement method, use of e-auction, EU funds financing, presence of a subcontractor, quality criterium, and region. The size of a contract was also taken into consideration based on the estimated price of a contract as a subsequent explanatory variable. Table 1 provides an overview of the variables' characteristics.

Table 1. Summary of variables

Variable	Type	Description
Savings	Real numbers	Percentage of savings
Procurement method	Binary	0 – tender, 1 - negotiation
Procurement subject	Categorical	G – Goods, S – Services, BW – Building works
EU Funds	Binary	0 – yes, 1 – no
Bids	Real numbers	Number of bids
Subcontractor	Binary	0 – allowed, 1 – not allowed
Region	Categorical	Each value for each region in Slovakia
Quality criteria	Binary	0 – quality criteria applied, 1 – quality criteria not applied
Auction	Binary	0 – e-Auction applied, 1 – e-Auction not applied
Estimated value	Real numbers	Estimated value by procurer

The regression model consists of data obtained and it examines the impact of selected factors on the public procurement savings. The regression model is defined as follows (2):

$$Savings = Procedure\ Type + Contract\ Type + EU\ Funds + E - Auction +$$
$$+ Number\ of\ Bids + Number\ of\ Bids^2 + Estimated\ Price + Estimated\ Price^2 +$$
$$+ Subcontractor + Quality\ Criterium + Region \qquad (2)$$

The OLS method (Ordinary Least Squares) was used to estimate the regression coefficients and this method assumes that some conditions, which will be tested, will also be met. The Breusch-Pagan test is used to test the heteroscedasticity presence, while the Durbin-Watson test is used to test autocorrelation in the residuals. Also, the Jarque-Ber test verifies the fact that the model's residuals emerge from a normal distribution. Multi-collinearity is tested by a variance inflation factor (VIF). Robust estimation using the WLS (Weighted least squares) estimation of regression coefficients will be used if the conditions of the OLS method use are met (Ruppert & Wand, 1994).

3. Analysis and Results

The size of achieved savings defined by relation (1) represents an explanatory variable of the model. The histogram of the savings variable (Figure 1) shows a significant number of contracts with zero savings in all of the Slovak regions during the monitored period. However, the phenomenon is not negative as it shows a clear limitation of a contract's value that was equal to a bid price. The predominant right side of the histogram illustrates those contracts with achieved savings that prevail rather than those, where a contract was overpriced. On the other hand, the public procurements with a low number of candidates are predominantly represented in the case of the number of bids, which is the most frequently monitored determinant of savings creation. There are frequently one or even three bids.

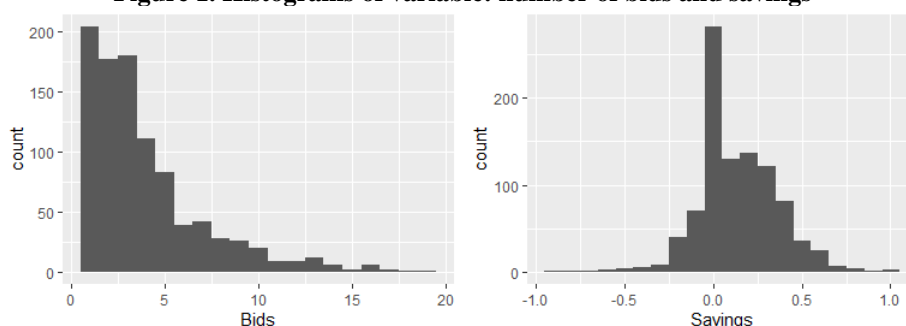**Figure 1. Histograms of variable: number of bids and savings**

Table 2 provides a more detailed overview of achieved average savings and an average number of bids in the Slovak regions.

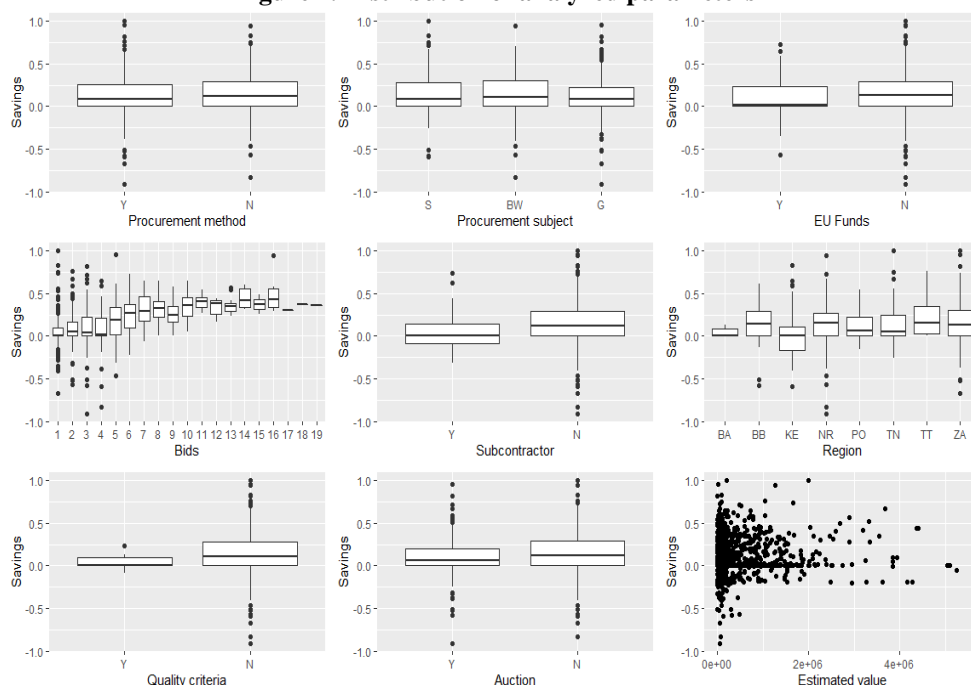**Table 2. Average number of bids and average savings in the regions**

Region	Average number of bids	Average savings	Percentage of contracts with one bid	Average savings in contracts with one bid
BA	2.8	10.36%	48.21%	4.02%
TT	4.9	19.90%	30.55%	4.40%
TN	3.4	12.10%	16.66%	8.67%
NR	4.3	14.55%	16.06%	3.56%
ZA	4.1	14.84%	18.05%	5.00%
BB	3.5	8.69%	17.89%	14.75%
PO	3.3	11.49%	34.09%	10.28%
KE	3.5	2.18%	26.47%	-0.91%
Total	**3.8**	**12.46%**	**22.72%**	**4.58%**

Note: BA – Bratislava Region, TT – Trnava Region, TN – Trenčín Region, NR – Nitra Region, ZA – Žilina Region, BB – Banská Bystrica Region, PO – Prešov Region, KE – Košice Region.

The average number of bids in all of the Slovak regions during the monitored period was, in total, at the level of 3.8, while the lowest competitiveness was in Bratislava Region on average out of all of the Slovak regions (only 2.8 of a bid). On the contrary, the highest competitiveness was in the Trnava Region (4.9 of a bid). Average achieved savings in the public procurement achieved 12.46% out of which only 2.18% was represented by Košice Region and 19.90% was represented by the Trnava Region. The contracts with one bid represented 22.72% out of all of the contracts and on average, there were savings at the level of 4.58%. In the Bratislava Region, there appeared contracts with one candidate (in the case of 48%), where average savings were 4.02%. In Nitra Region, there were approximately 16% of such contracts with savings of 3.56%. In Banská Bystrica Region, the achieved average savings were 14.75% in the case of one candidate, while on the contrary, in Košice Region, there was achieved a contract overpricing of approximately 1% as opposed to the estimated price in the case of one candidate.

Figure 2 illustrates a relationship between explanatory variables to the response variable.

Figure 2. Distribution of analyzed parameters

Based on Figure 2, it may be assumed that if open bidding is used as the public procurement method, the median value of achieved savings is lower than in other types of methods. The highest median value of savings was achieved in terms of building works from the perspective of a contract type. Those contracts, that were funded by EU funds, achieved a lower median value of the savings than the contracts,

where EU funds were not applied. It may be concluded that the higher the number of bids the greater the size of the median savings when analysing the median savings according to the number of bids. The presence of a subcontractor causes lower median savings than in the case of contracts with a subcontractor. The highest value of the median savings was in the Trnava Region, and the lowest was in the Košice Region out of all of the regions. The contracts with a quality criterium achieved lower median savings than the contracts without this type of a criterium. Also, a lower median value of the savings was achieved in e-auction rather than in public procurement, which was realized without e-auction. The high variability of a relationship between the estimated and final value of a contract was determined.

Figure 2 illustrates the preliminary findings that were subject to further statistical research by the regression model. Robust estimation using the WLS method was applied as the conditions for using the OLS method of the regression coefficients estimation were not met. Table 3 provides an overview of the estimated regression coefficients and p-value.

Table 3. Estimated coefficients of regression model

Variable	Estimate	p-value
Intercept	-0.419	0.000
Type of method N	0.000	0.994
Type of contract SP	-0.093	0.000
Type of contract T	-0.006	0.806
EU funds N	0.066	0.000
E-auction N	0.074	0.000
Number of bids	0.051	0.000
I(number of bids)^2	-0.001	0.000
Estimated	0.000	0.003
I(estimated)^2	0.000	0.000
Subcontractor N	0.116	0.000
Quality criterium N	0.107	0.000
BA Region	0.202	0.019
BB Region	0.156	0.000
NR Region	0.072	0.045
PO Region	0.189	0.000
TN Region	0.123	0.000
TT Region	0.159	0.000
ZA Region	0.123	0.000

Table 3 displays almost all variables at the significance level of 0.05 that are statistically significant. However, there is an exception. There does not exist a statistically significant difference between the savings rate in the case of use or non-use of open bidding (Type of method N). In the case of the contracts on the procurement of goods (Type of contract T), the savings do not statistically and significantly differ from the contracts on the procurement of services. The savings are lower by approximately 9 percentage points, in the case of the procurement of

building works (Type of contract SP) in comparison to the type of contracts on the procurement of services. If a contract is not funded by EU funds (EU funds N), the savings are higher by 6.6 percentage points in comparison to the contracts funded by EU funds. In such cases, when e-auction was not used, higher savings were achieved (of 7.4 percentage points). An increase in the number of bids of one also increases the savings by approximately 5 percentage points. Similarly, a coefficient of the quadratic term of the number of bids is statistically significant. However, its impact on the savings is a mall concerning the size of the estimated coefficient. There is a similar relation between an estimated price and the square of the estimated price, where a model confirmed the statistical significance of these indicators. However, the size of the estimated coefficient is close to zero. If there are no sub-contracting relationships, then savings are 11.6 percentage points. If the contract does not use a quality criterium, then savings are higher by 10.7 percentage points. The analysis also confirmed a statistically significant difference between individual regions in Slovakia. The highest difference was achieved between the Košice Region and the Bratislava region, wherein the Bratislava Region, the achieved savings were higher by more than 20 percentage points. A similar situation is in the Prešov Region, where savings were higher by almost 19 percentage points than in the Košice Region. The determination R^2 coefficient is 0.411.

4. Discussions and conclusions

Public procurement represents an important tool in achieving savings in the public sector. Once the public procurement criteria are adequately set, all of the public administration levels may efficiently purchase necessary goods, services, and building work. The main aim of the article was to analyse the impact of selected variables on achieving savings in public procurement on the NUTS 3 level during the period 2016 – 2020.

The first and fundamental issue of monitoring and efficiency of public procurement is the sole definition of the savings and its analysis. Generally, the highest savings is considered as a relationship between an estimated and final price of a contract. Such a perspective may be misleading as the final savings depend on the ability of the public sector to adequately estimate an estimated contract's value. An estimated price, which is incorrectly set, may distort the final savings, and/or may identify a contract's overpricing. It is also confirmed by a wide variance of achieved savings, where there were identified such cases that had their savings higher by more than 50 %, or their contract was overpriced. The first recommendation to be implemented is an optimization of a relationship between an estimated and a final price, i.e. an increased emphasis on a calculation of an estimated price and a better analysis of a market, while it is being set.

The principal issue of public procurement in the Slovak public sector was low competitiveness on the bid's side (Švidroňová & Nemec, 2016; Grega et al. 2019; Gavurová et al., 2020; Nemec et al., 2020). The analysis on the NUTS 3 level proved that on average, the number of candidates is around 3.8, while there is a significant

difference in the average achieved savings between regions and also in the number of contracts with one bid. The highest average savings (19.90%) were achieved in Trnava Region, while the lowest savings (2.18%) were achieved in Košice Region. In Bratislava Region, the rate of contracts with one bid was 48.21 % out of the total number of contracts with average savings of 4.02 %. The lowest percentage of the contracts with one bid was in Nitra Region (16.06 %) with an average savings of 8.67 %. In the Košice Region, there was evident a negative impact of one candidate's presence, where such non-existence of competitiveness caused contracts' overpricing of almost 1%. Similarly, the model's results confirmed statistically significant differences between individual regions in Slovakia. The largest difference was achieved between Košice Region and Bratislava Region, while in Bratislava Region, the savings were higher by more than 20 percentage points. Similarly, in Prešov Region, the savings were higher by almost 19 percentage points in comparison to Košice Region.

The regression linear model proved a positive impact of the number of bids on the final value of a contract, where each subsequent bid increases the savings by approximately 5%. Many previous studies, that appeal to the necessity of increased competitiveness in the environment of Slovak public procurement, confirmed this fact (Mikušová-Meričková & Nemec, 2013; Grega & Nemec, 2015; Gavurová et al., 2020). In the case of EU funds, which are used to fund the contract, there was proved that if a contract is not funded by EU funds, the savings are higher by 6.6 percentage points in comparison to those contracts that were funded by EU funds. Also, the studies by Grega and Nemec (2015) and Džupka et al. (2020) confirm a decrease in savings when EU funds are used. There are many other studies, which confirm the positive impact of e-auction use in achieving savings in public procurement (Nemec & Meričková, 2013; Jovanovič et al., 2013; Murray Švidroňová & Mikuš, 2015; Hronec et al., 2008; Mikušová Meričková & Stejskal, 2014; Halásková & Halásková, 2015; Murray Švidroňová & Nemec, 2016). However, the analysis of the contracts on the NUTS 3 level proved that savings were higher by 7.4 percentage points when e-auction was not used.The subcontractor's presence was considered a factor that decreases the savings. In the case that contract does not allow sub-contractual relationships, then savings were higher by 11.6 percentage points. It is difficult to realize contracts without any presence of a subcontractor, especially in contracts with a high value and with building works, as such contracts may decrease the savings. The model's results confirmed this fact. The savings are lower by 9 percentage points in the procurement of building works in comparison to those contracts, where the procurement subject is services.

Many specialists and researchers in the public procurement area emphasize the necessity to move one's focus from strict regulation of procurement methods in the stage of contracts' allocation to efficiency in the stage of a contract's realization (see for instance Moszoro et al., 2016; Tkachenko et al., 2018). Also, the study by Balaeva et al. (2020) confirms this fact, while the authors saw the main problem of effective procurement in the quality of delivered goods and/or services, and also in the timeliness of a contract's performance.

Quality criterium represents such determinant that has an impact on achieving the savings. It may be assumed that once a quality criterium is added, it will harm achieving the savings. However, it may increase the benefit of public goods. The regression linear model confirmed that if a contract does not use a quality criterium, then savings are higher by 10.7 percentage points.

However, a significant impact of the public procurement method, which was used, was not confirmed by the model. Also, there were no proven statistical differences in open bidding and/or any other method that was used. The conclusions by the authors, Mikušová-Meričková and Nemec (2013) and Džupka et al. (2020), who stated that open bidding contributes to achieving higher savings, were not confirmed. The regression linear model identified the fundamental determinants of public procurement efficiency on the NUTS 3 level. Correct setting of an estimated value of a contract, which may subsequently cause an incorrect economic interpretation of the savings and/or overpriced, is observed as a significant problem. Also, the contracts' analysis confirmed this issue. Consequently, it is necessary to increase the qualification of employees in the public sector, which would improve their analytical skills in setting the estimated value of a contract. Similarly, it is important to focus on the use of the correct setting of e-auction parameters. Scientific studies confirm its positive impact on achieving savings, while the model's results proved the opposite result based on the Slovak regions' example. It is also important to create such conditions that would enable an increase in competitiveness on a bid's side, which would subsequently lead to higher savings in the public sector.

Authors Contributions
The authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

Conflict of Interest
The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

Balaeva, O., Yakovlev, A., Rodionova, Y. and Esaulov, D. (2020). Public procurement transaction costs: a country-level assessment, *Public Money & Management*, 10(1), 1-20. https://doi.org/10.1080/09540962.2020.1831170.
Baldi, S. Vannoni, D. (2017). The impact of centralization on pharmaceutical procurement prices: The role of institutional quality and corruption. *Regional Studies,* 51(3), 426-438. https://doi.org/10.1080/00343404.2015.1101517

Boas, T. C., Hidalgo, F. D., and Richardson, N. P. (2014). The spoils of victory: Campaign donations and government contracts in Brazil. *The Journal of Politics,* 76(2), 415-429. https://doi.org/10.1017/S002238161300145X

Buor, J. K. (2019). Appraising the interactions between public-sector procurement policy and disaster preparedness. *International Journal of Disaster Risk Reduction, 36*, 1-11. https://doi.org/10.1016/J.IJDRR.2019.101120

Coviello, D. Gagliarducci, S. (2017). Tenure in office and public procurement. *American Economic Journal: Economic Policy,* 9(3), 59-105. https://doi.org/10.1257/pol.20150426

Coviello, D. Mariniello, M. (2014). Publicity requirements in public procurement: Evidence from a regression discontinuity design. *Journal of Public Economics,* 109, 76-100. https://doi.org/10.1016/j.jpubeco.2013.10.008

Coviello, D., Moretti, L., Spagnolo, G. and Valbonesi, P. (2018). Court efficiency and procurement performance. *The Scandinavian Journal of Economics, 120*(3), 826-858. https://doi.org/10.1111/sjoe.12225

Detkova, P., Podkolzina, E. and Tkachenko, A. (2018). Corruption, centralization and competition: Evidence from Russian public procurement. *International Journal of Public Administration,* 41(5/6), 414-434. https://doi.org/10.1080/01900692.2018.1426014

Džupka, P., Kubák, M., and Nemec, P. (2020). Sustainable Public Procurement in Central European Countries. Can It Also Bring Savings? *Sustainability*,12(21), 1-13 https://doi.org/10.3390/su12219241

Fazekas, M., Toth, I. J. and King, P. L. (2016). An objective corruption risk index using public procurement data. *European Journal on Criminal Policy and Research*, 22(3), 369-397. https://doi.org/10.1007/s10610-016-9308-z

Folliot Lalliot, L., and Yukins, C. R. (2020). COVID-19: Lessons learned in public procurement. Time for a new normal? *Concurrences, 3*, 46-58.

Gallego, J. A., Prem, M. and Vargas, J. F. (2020). Corruption in the times of pandemia. Working papers 43, Red Investigadores de Economía.

Gavurová, B., Kubák, M. and Mikeska, M. (2020). The efficiency of public procurement in the health sector – the platform on sustainable public finances. *Administratie si Management Public*, 35, 21-39. https://doi.org/10.24818/amp/2020.35-02

Gineitiene, Z. Šerpytis, K. (2011). The Impact of Competition and Purchase Volume on the Price in Public Procurement Tenders. *Socialinin mokslu studijos*, 3(2), 473-485.

Goldman, E., Rocholl, J. and So, J. (2013). Politically connected boards of directors and the allocation of procurement contracts. *Review of Finance,* 17(5), 1-32. https://doi.org/10.1093/rof/rfs039

Grega, M., Nemec, J. (2015). Factors Influencing Final Price of Public Procurement: Evidence from Slovakia. *Procedia Economics and Finance*, (25), pp. 543-551. https://doi.org/10.1016/S2212-5671(15)00768-6

Grega, M., Orviska, M., Nemec, J., and Lawson, C. (2019). Factors determining the efficiency of Slovak public procurement. *The NISPAcee journal of public administration and policy,* 12 (1), 43-68. https://doi.org/10.2478/nispa-2019-0002

Guccio, C., Lisi, D. and Rizzo, I. (2019). When the purchasing officer looks the other way: On the waste effects of debauched local environment in public works execution. *Economics of Governance,* 20(3), 205–236. https://doi.org/10.1007/s10101-019-00223-5

Halásková, M., Halásková, R. (2015). Fiscal Decentralisation and Provision of Local Public Services in Selected EU Countries. *Lex localis- Journal of Local Self – Government*, 13(3), pp. 595-613. https://doi.org/10.4335/13.3.595-613(2015)

Hanák, T., Muchová, P. (2015). Impact of Competition on Prices in Public Sector Procurement. *Procedia Computer Science*, (64), 729-735. https://doi.org/10.1016/j.procs.2015.08.601

Hronec, Š., Mericková, B., and Marcineková, Z. (2008). The Medicine Education Investment Evaluation Methods, E+ M Ekonomie a Management, (2), 89-98

Hunsaker, K. (2009). Ethics in public procurement: buying public trust. *Journal of Public Procurement*, 9(3/4), 411-418. https://doi.org/10.1108/JOPP-09-03-04-2009-B004

Iimi, A. (2006). Auction Reforms for Effective Official Development Assistance. *Review of Industrial Organization,* 28(2), 109 – 128. https://doi.org/10.1007/s11151-006-0012-x

Ilke, O., Rasim, O., and Bedri, K. (2012). Public Procurement Auctions and Competition in Turkey. *Review of Industrial Organization* 40(3), 207-223. https://doi.org/10.1007/s11151-011-9299-3

Kubák, M., Nemec, P., and Vološin, M. (2021). On the Competition and Transparency in Public Procurement During COVID – 19 Pandemic in European Union. *SSRN*. http://dx.doi.org/10.2139/ssrn.3812924

Lam, K. C., Yu, C. Y. (2011). A multiple kernel learning-based decision support model for contractor pre-qualification. *Automation in Construction, 20*(5), 531-536. https://doi.org/10.1016/j.autcon.2010.11.019

Manoliadis, O. G., Pantouvakis, J. P., and Christodoulou, S. E. (2009). Improving qualifications-based selection by use of the fuzzy Delphi method. *Construction Management and Economics,* 27(4), 373-384. https://doi.org/10.1080/01446190902758993

Mikušová-Meričková, B., Nemec, J. (2013). Contract Management and its Impact on Contracting Public Services: Slovak Republic. *Journal of Economics*, 61(7), 690-699

Mikušová-Meričková, B., Nemec, J. (2013). Factors Determining the Success of Contracting Local Public Services: Waste Collection and Waste Disposal, Management of Cemeteries in Slovakia. *Lex Localis – Journal of Local Self-Government* 11(3), 375 – 385. https://doi.org/10.4335/11.3.375-385(2013)

Mikušová-Meričková, B., Stejskal, J. (2014). Hodnota statku kolektívní spotřeby, *Politická ekonomie*, 62(2), 216-231. https://doi.org/10.18267/j.polek.947

Mironov, M., Zhuravskaya, E. (2016). Corruption in procurement and the political cycle in tunneling: Evidence from financial transactions data. *American Economic Journal: Economic Policy, 8*(2), 287-321. https://doi.org/10.1257/pol.20140188

Moszoro, M., Spiller, P. T., and Stolorz, S. (2016). Rigidity of public contracts. *Journal of Empirical Legal Studies, 13*(3), 396-427. https://doi.org/10.1111/jels.12119

Murray Švidronova, M., Nemec, J. (2016). E-Procurement in Self-Governing Regions in Slovakia., *Lex Localis-Journal of Local Self-Government*, Vol 14, No 3, 323-337. https://doi.org/10.4335/14.3.321-335(2016)

Murray Švidronova, M., Mikus, T. (2015). E-procurement as the ICT innovation in the public service Management: Case of Slovakia. *Journal of Public Procurenent*, 15(3), 317-340. https://doi.org/10.1108/JOPP-15-03-2015-B003

Nemec J., Grega, M., Horehájová, M., and Kubák, M. (2020). Efficiency of Public Procurement in the Slovak Health Care. *Český finanční a účetní časopis,* 2020(1), 27-39. https://doi.org/10.18267/j.cfuc.542

Nemec, J., Meričková, B., and Vitek, L. (2005). Contracting-out at local government level: Theory and selected evidence from the Czech and Slovak republics. *Public Management Review, 7*(4), 637-647. https://doi.org/10.1080/14719030500362900

Nemec, J., Šumpíková, M., Klazar, S., and Grega, M. (2014). *Efficiency versus economy in public procurement.* In T. Löster, and T. Pavelka (Eds.), Conference proceedings: The 8th international days of statistics and economics, 1054-1063. Praha: Melandrium

Nemec, J., Šumpíková, M., Orviská, M., Bušina, F., and Grega, M. (2016). *Transaction costs in the public procurement: Selected findings in czech and lovak conditions.* In T. Loster, & T. Pavelka (Eds.), Proceedings of the 10th international days of statistics and economics, 1749-1758. Melandrium: Praha.

OECD (2020). *Stocktaking report on immediate public procurement and infrastructure responses to COVID-19.* OECD.

Olken, B. A., Pande, R. (2012). Corruption in developing countries. *Annual Review of Economics, 4*(1), 479-509. https://doi.org/10.3386/w17398

Pavel, J. (2013). *Veřejné zakázky a efektivnost.* Praha: Ecopress, p. 123.

Plaček, M., Nemec, J., Ochrana, F., Schmidt, M., and Půček, M. (2020a). Analysis of factors of overpricing in public procurement: A study for low-performing EU countries. *International Journal of Public Administration, 43*(4), 350-360. https://doi.org/10.1080/01900692.2019.1636393

Plaček, M., Nemec, J., Pucek J. M., Ochrana, F., and Schmidt, M. (2020b). The factors causing delays in public procurement: The Czech Republic versus the UK. *Public Money & Management*, 40(2), 131-139. https://doi.org/10.1080/09540962.2019.1651034.

Plebankiewicz, E. (2012). A fuzzy sets based contractor prequalification procedure. *Automation in Construction*, 22, 433-443. https://doi.org/10.1016/j.autcon.2011.11.003

Ruppert, D., Wand, M. P. (1994). Multivariate locally weighted least squares regression. *The annals of statistics*, 1346-1370. https://doi.org/10.1214/aos/1176325632

Shrestha, P., Pradhananga, N. (2010). Correlating bid price with the number of bidders and final construction cost of public street projects. *Transportation Research Record: Journal of the Transportation Research Board*, (2151), 3-10. https://doi.org/10.3141/2151-01

Soudek, J., Skuhrovec, J. (2013). P*ublic procurement of homogeneous goods: The Czech Republic case study*. IES Working Paper 05/2013. IES FSV.

Soukopová, J., Malý, I. (2012). *Vliv konkurence na výši výdajú na nakládaní s odpady obcí Jihomoravského kraje.* Waste Forum. Praha: CEMC, 173-183.

Soukopová, J., Mikušová-Meričková, B,. and Nemec, J. (2018). The Efficiency of Local Service Delivery: The Czech Republic and Slovakia. In I. Koprič, H. Wollmann and G. Marcou (ed.). *Evaluating Reforms of Local Public and Social Services in Europe*. London: Palgrave McMillan, 151-170.

Šípoš, G. (2012). *Analýza kvality verejného obstarávania na Slovensku v rokoch 2009-2011.* Transparency International Slovensko.

Šípoš, G., Klátik, P. (2013). *Kvalita verejného obstarávania na Slovensku v roku 2012.* Transparency International Slovensko.

Tkachenko, A., Esaulov, D. (2020). Autocratic governors in public procurement. *European Journal of Political Economy, 61*(C), https://doi.org/10.1016/j.ejpoleco.2019.101825

Zachar, D., Dančíková, Z. (2012). *Analýza verejného obstarávania nemocníc v rokoch 2009-2012: Intenzita súťaže v tendroch je nízka.* INEKO, Transparency International Slovensko.