ANALYSIS OF PUBLIC PROCUREMENT SAVINGS IN V4

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Abstract

The countries use public procurement to acquire sources for their institutions. These mechanisms aim to secure the lowest prices for products and services in most cases while meeting all the requirements. The performance of such a mechanism can be measured by savings defined as the difference between estimated prices and winning bids. This paper analyses the public procurement environment of four different countries known as the Visegrad Group by comparing the distribution of such savings. By comparing savings from more than a million contracts in twelve years, we use boxplot analysis and statistical tests to describe differences in the performance of the public procurement environment between countries. Moreover, we also analyse how the distribution of savings changes for EU-funded public procurement contracts and contracts procured by an electronic auction mechanism.

1. Introduction

Public procurement can be determined as the "overall process of acquiring goods, civil works and services, which includes all functions from the identification of needs, selection and solicitation of sources, preparation and award of contract, and all phases of contract administration through the end of a services' contract or the useful life of an asset" (UNDP, 2010 Patrucco et. al, 2017). The countries, governments, and public administrations use public procurement as a key mechanism to obtain resources for their institution. The two main approaches frequently used to evaluate bids are the lowest bid price criterion and multi-criteria evaluation. The first type is preferred in Easter European countries and the second type in Western countries. (Ochrana and Hrnčířová, 2015). Concretely work of Nemec, Mikušová Meričková and Grega (2014) showed that Slovakia, the Czech Republic and Poland represent the countries with the significantly higher portions (around

80% per country) of public procurement competitions which use lower price bids as evaluation criteria. Such criteria aim to secure the best (lowest) price while meeting the requirements set by the procurer. Because in the market economy the price is based on supply and demand, savings as a difference between the estimated price defined by the procurer (which can be understood as a price determined by demand) and the winning bid (which can be understood as the lowest price determined by supply), could be seen as an essential performance indicator for measurement efficiency of public procurement contracts. To improve this efficiency, the key characteristics of public procurement processes, request for tenders as well as closed procurement contracts have to be studied, analysed and compared with benchmarks (such as countries with similar socio-economic backgrounds). (García Rodríguez et al. 2019). This paper tries to provide such an analysis.

2. Methodology

The research in this paper focuses on the analysis of public procurement in the Visegrad Group (V4). It will primarily investigate procurement savings across different countries of V4 and different parameters of procurements. It can be divided into two parts. Firstly, we study differences in the distribution of procurements' savings in V4 countries. This is done through the boxplot analysis and statistical tests. Also, year-by-year changes in savings from 2009 to 2020 are investigated. The second part of the research compares differences in savings based on three parameters of procurements. The first parameter is the type of supply. It determines whether the procured items are works, supplies, or services. The other two parameters are binary and define whether the procurements were EU funded or whether the electronic auction was used as a procurement mechanism. The study is based on real procurement contracts realised in four countries (V4) during the 12 years. The data were acquired from countries' datasets published in opentender.eu portal. This portal collects data from 33 jurisdictions including EU member states. The initial dataset covering data from the Czech Republic (CZ), Hungary (HU), Poland(PL) and Slovakia (SK) has more than 6 million cases. According to the methodology of data collecting, for each of surveyed countries the opentender.eu platform collects data from TED and the national procurement database. For more information, see Hruby et al. (2018). The initial database was reduced to the research sample based on a few rules. In the first reduction, we deleted all cases that were not actual contracts. Then we delete all cases which do not have the estimated value of the contract and the value of the winning bid. These two variables were essential for the determination of savings from procurement. For the purpose of this study, savings from public procurement contracts represent the difference between the estimated value and the winning bid as a percentage of the estimated value. Due to the data discrepancy, we have also deleted all cases which procure more than one lot. The final step in the creation of the research sample was the elimination of outliers. This was done using the boxplot methodology. We estimated the second (Q2) and third (Q3) quartiles and created an interquartile range (IQR) for the whole sample. Savings higher than Q3+1,5*IQR or lower than Q2-1,5*IQR were considered outliers. The final sample has 1 083 153 cases. The distribution of savings in the research sample ranges from -45% to 58% with an average of 4,8%.

3. The research

As was mentioned in the previous part, research in this paper analyses the performance of the public procurement environment in four different EU countries. The research sample includes real procurements contracts from countries of Visegrad Group and it is covering 12 years period from 2009 to 2020. The performance is measured by variable savings, which represent a percentage

difference between the winning price and the estimated price of the contract. The motivation for this approach is to describe the differences in the distribution of savings from public procurement between countries. To characterize the distribution of public procurement's savings for each country, we use boxplot analysis, which is presented in Figure 1.

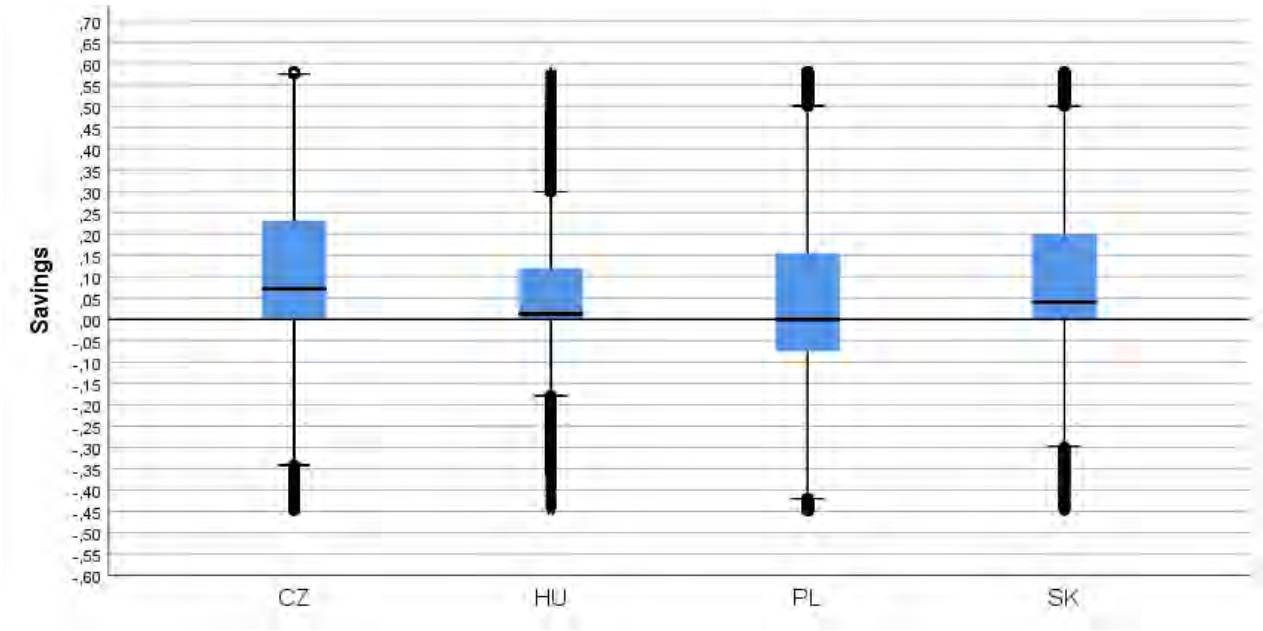

Figure 1: Boxplot analysis of the distribution of public procurement savings of V4 countries

As can be seen in Figure 1, there are differences in distributions of savings from one country to another. The lowest median of savings was found in Poland. The median value of procurement savings was zero. A slightly higher median value of 1% was found in Hungarian data. The median value of public procurement savings found in the Slovakian dataset was 4%. The highest median value was 7% and it was found in the Czechian dataset. The boxplot analysis also showed that apart from Poland in all other countries no more than 25% of contracts in the dataset have negative or zero savings. In the case of Poland quarter of contracts in the dataset have savings lower than -8%, which means that 25% of contracts have a winning price more than 8% higher than was estimated by the procurer. Moreover, zero median means that half of the analyzed contracts have negative or zero savings. The positions of the boxes in boxplots suggest that the highest savings can be found in Slovak and Czech datasets. The results showed that a quarter of analyzed contracts achieved more than 23% (in the case of the Czech Republic) and more than 20% (in the case of Slovakia) savings per contract.

To confirm that differences between savings are statistically significant, we used the Kruskal-Wallis test which on the significance level of α= 5% tests the null hypothesis The distribution of Savings is the same across categories of Country. The results of the test are presented in Table 1.

Table 1: The results of the statistical test comparing distributions of V4's countries' savings

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Savings is the same across categories of Country.	Independent-Samples Kruskal-Wallis Test	,000	Reject the null hypothesis.
Asymptotic significances are displayed. The significance level is 05.				

The results of the Kruskal-Wallis test presented in Table 2, suggest that at significance level α= 5% we can reject the null hypothesis of the same distribution of saving from Public procurement

contracts across different countries of V4. Moreover, the pairwise comparison showed that the null hypothesis of the same distribution of Savings was rejected at significance level α= 5%, for any pair of countries.

The next part of the research provides a more detailed analysis of the public procurement environment of the Visegrad group by focusing on year by year comparison of the distribution of savings. The boxplot analysis of such a comparison is presented in Figure 2. The motivation behind this investigation is to determine whether the distribution of savings in surveyed countries changes through the years.

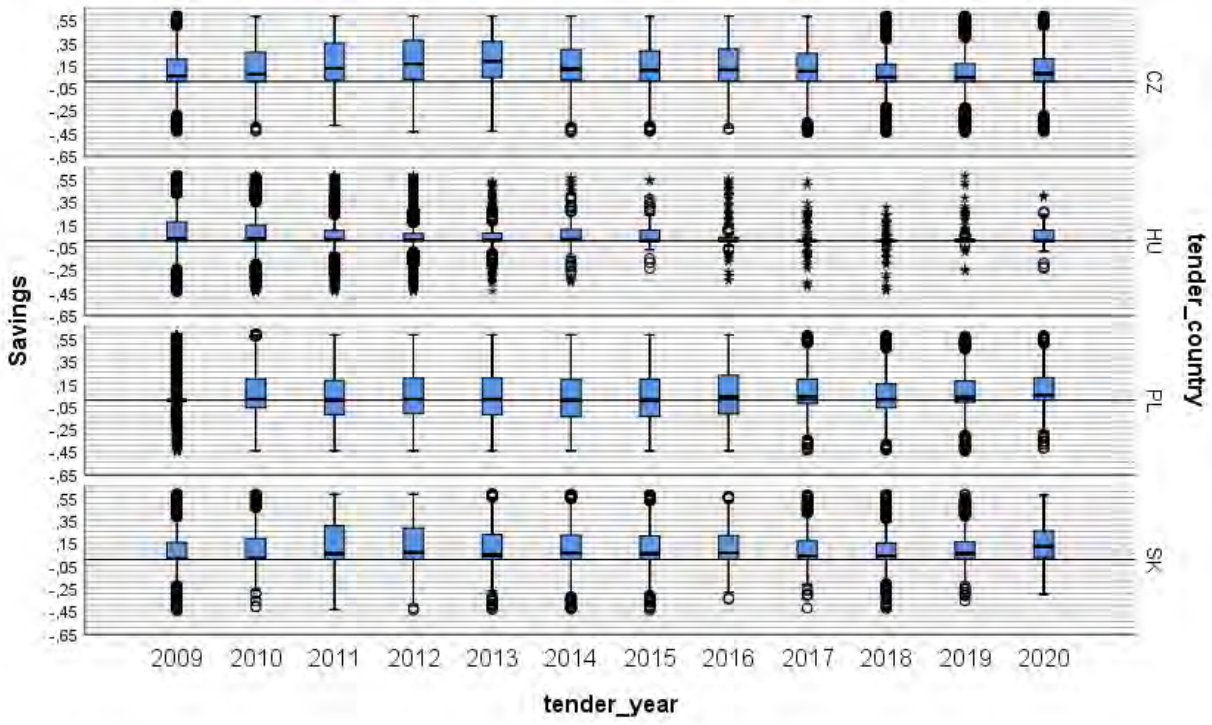

Figure 2: Boxplot analysis of yearly distributions of V4 countries' savings

As can be seen in Figure 2, the variability of the savings from public procurement is significantly changing over the 12 years. The boxplot analysis suggests that the highest variability of savings can be found in the six years from 2010 to 2016 for all surveyed countries. Moreover, it is very hard, to recognize any trend country-wise, because the medians of savings increase, decline, or stay the same from one year to another in random order. On the other hand, boxplots of savings showed that in the last two years (2019-2020) proportion of contracts with negative savings was less than 25% finally for all four countries. It should be also noted that during the year of lockdowns median savings from public procurement in Slovakia increased by more than 100%. During the 11 years before 2020, the median of savings in Slovakia does not overcome 6% but in 2020 median was 12%. Similar results can be found in Poland. Before 2020 the highest median of savings was 3%. The median of savings in 2020 was 5%. The differences between the savings in 2020 and savings in the previous years are not so significant for the other two countries.

The next step in the research was the analysis of savings based on the supply type. The motivation for this kind of investigation is to determine whether distributions of savings change significantly based on the country of public procurement. The results, in the form of boxplot analysis, can be found in Figure 3.

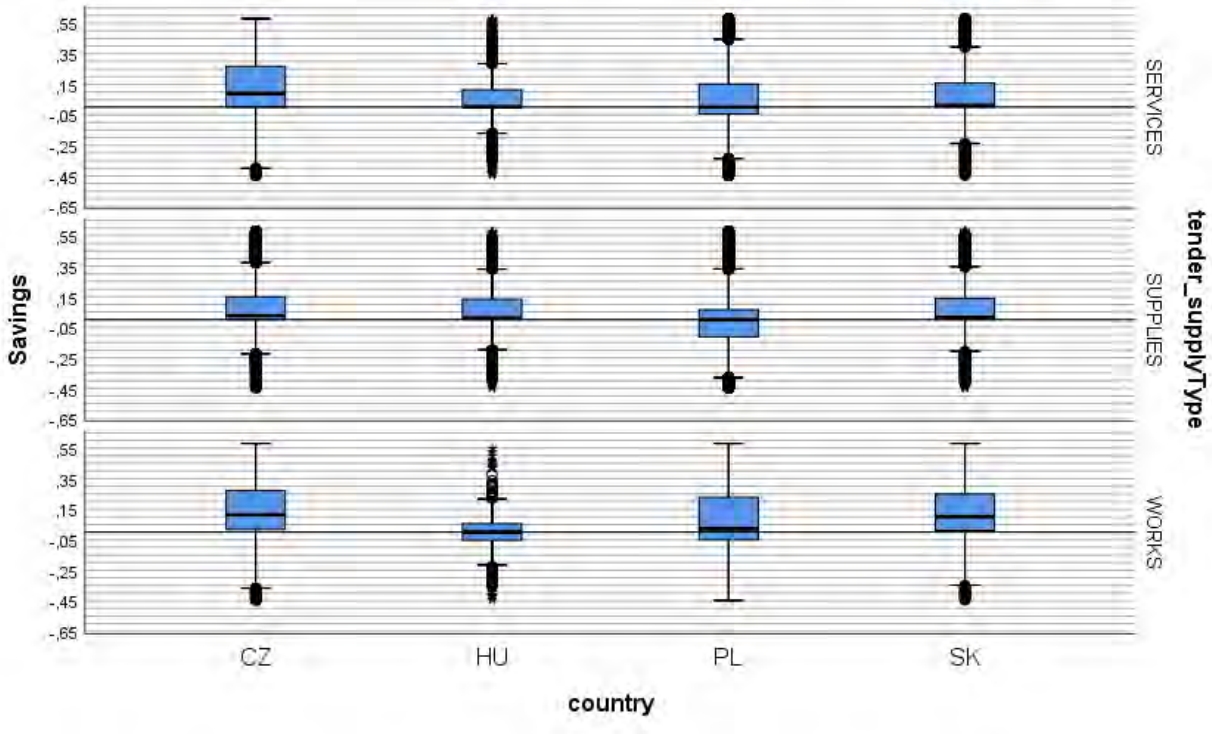

Figure 3: Boxplot analysis of savings based on country and supply type

The boxplot analysis presented in Figure 3, showed differences in the distribution of savings between countries. The statistical significance of differences was also confirmed by the independent sample Kruskal-Wallis Tests, which at a significance level of 5% reject the null hypothesis that the distributions of Savings are the same across categories of Country for all the types of supply, services, supplies, and works. All the tested hypotheses have p-values <0,001. Pairwise comparisons of the countries showed that for supplies and works statistical differences in distributions of savings were not confirmed in Slovakian and Czech data, because the null hypothesis in these cases could not be rejected at a 5% significance level (p-values>0,05). Another type of analysis consists of testing the differences in distributions of savings between types of supply for each country alone. The null hypothesis stating that the distribution of savings is the same across categories of supply type was rejected at a 5% level of significance (p-values <0,001) for each of the four tested countries. Detailed, pairwise comparisons of supply types showed that in the cases of Slovakia and Hungary the statistically significant differences cannot be confirmed for pair services and supplies because the null hypothesis in these cases could not be rejected at a 5% significance level (p-values>0,05).

The fourth type of analysis compares savings from public procurements contracts which were EU funded with savings from the contracts that were not. The motivation for this kind of research was to determine public procurement contracts that are funded from EU funds tend to have a different distribution of savings that public procurement contracts that are not. Boxplot analysis is presented in Figure 4.

The positions of boxplots and medians in Figure 4 suggest that the situation with parameters describing whether the contract is EU-funded is unique for each country. Czech Republic data shows that the distribution of savings from public procurement contracts does not seem to be different for EU-funded contracts and contracts that are not EU funded. This is also confirmed by the statistical test presented in Table 2.

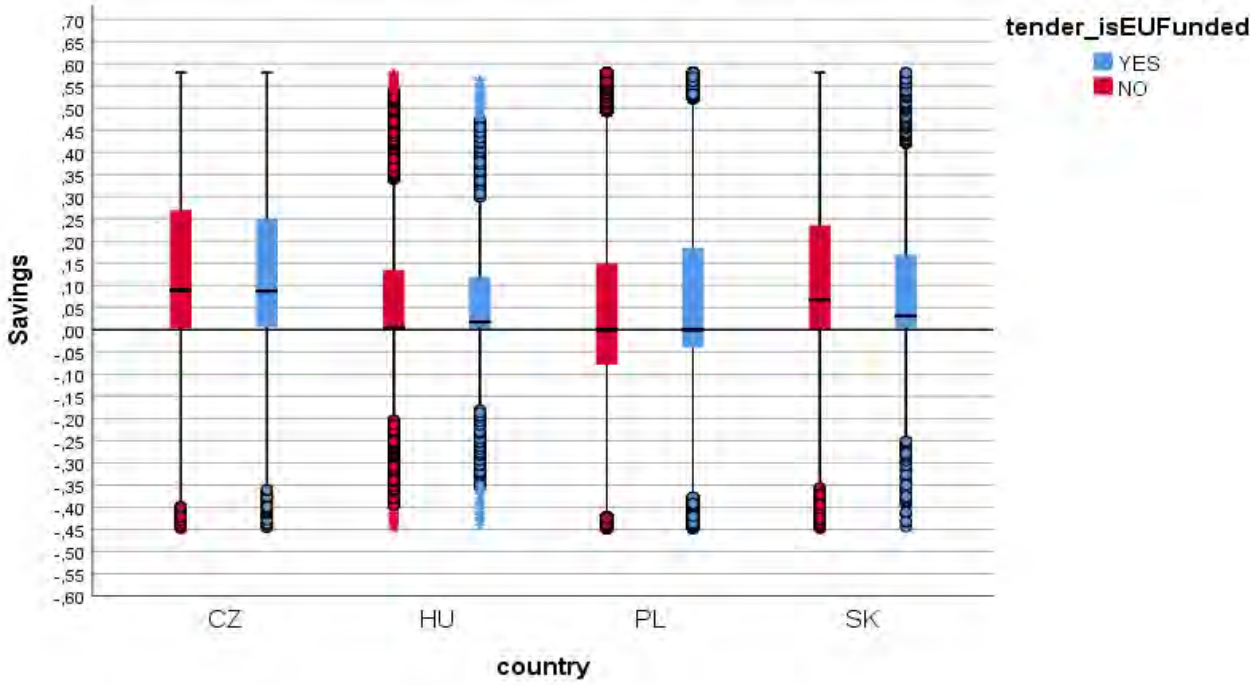

Figure 4: Boxplot analysis of savings based on country and source of funding

Based on the same table, it can be assumed that, for all other countries, the differences in savings between previously described groups of contracts are statistically significant at a 5% significance level. The position of median showed that in term of Slovakia, EU-funded public procurement contracts tend to have lower savings and the variability of savings is also smaller than it is in contracts which are not funded by the EU. In Hungary, EU-funded public procurement contracts seem to have higher savings than contracts that are not funded by the EU. In terms of Poland, the position of boxplots shows that public procurement contracts which are not funded by the EU seem to have a higher ratio of savings that are negative than the contracts that are funded by the EU.

Table 2: The results of the statistical test comparing distributions of V4's countries' savings based on the source of funding

Hypotheses Test Summary				
	Null Hypothesis	Test	Sig.	Decision
CZ	The distribution of Savings is the same across categories of tender_isEUFunded.	Independent-Samples Mann-Whitney U Test	0,792	Retain the null hypothesis.
HU	The distribution of Savings is the same across categories of tender_isEUFunded.	Independent-Samples Mann-Whitney U Test	0,001	Reject the null hypothesis.
PL	The distribution of Savings is the same across categories of tender_isEUFunded.	Independent-Samples Mann-Whitney U Test	0	Reject the null hypothesis.
SK	The distribution of Savings is the same across categories of tender_isEUFunded.	Independent-Samples Mann-Whitney U Test	0	Reject the null hypothesis.
Asymptotic significances are displayed. The significance level is 05.				

The last part of the research is analysing differences in savings from public procurement based on the use of electronic auctions as a procurement mechanism. The motivation behind this type of research is to determine whether the use of electronic auctions has an impact on savings from public procurement contracts. The boxplot analysis of the distribution of savings is presented in Figure 5.

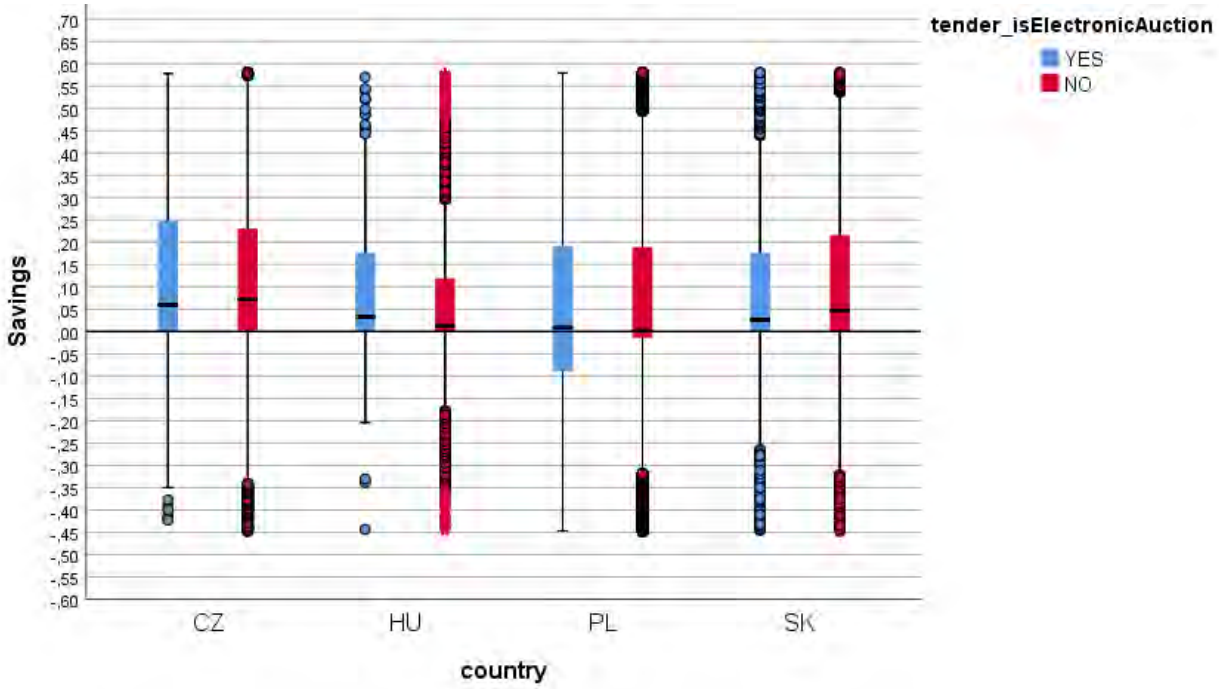

Figure 5: Boxplot analysis of savings based on country and type of procurement mechanism

The results presented in Figure 5 show that the use electronic of auctions does not have the same uniform impact on the distribution of savings from public procurement contracts. First of all, it should be noted that based on the results of hypotheses testing presented in Table 3, there are statistically significant differences (at a significance level of 5%) in the distribution of savings between the public procurement contracts that use electronic auction mechanism and public procurement contracts that do not use it. The position of the mean suggests that in the case of Slovakia and the Czech Republic savings from public procurement contracts procured by electronic auction seem to be lower than savings from public procurement contracts which do not use this mechanism. In Hungary and Poland, the situation is the opposite and procurement with the use of electronic auction seems to provide higher savings. The data also showed that the majority of public procurement contracts, which have negative savings were procured using an electronic auction mechanism.

Table 3: The results of the statistical test comparing distributions of V4's countries' savings based on the type of procurement mechanism

Hypotheses Test Summary				
	Null Hypothesis	Test	Sig.	Decision
CZ	The distribution of Savings is the same across categories of tender_isElectronicAuction.	Independent-Samples Mann-Whitney U Test	0,045	Reject the null hypothesis.
HU	The distribution of Savings is the same across categories of tender_isElectronicAuction.	Independent-Samples Mann-Whitney U Test	0,004	Reject the null hypothesis.
PL	The distribution of Savings is the same across categories of tender_isElectronicAuction.	Independent-Samples Mann-Whitney U Test	0	Reject the null hypothesis.
SK	The distribution of Savings is the same across categories of tender_isElectronicAuction.	Independent-Samples Mann-Whitney U Test	0	Reject the null hypothesis.
Asymptotic significances are displayed. The significance level is 05.				

4. Conclusion

The research in this paper is based on an analysis of real procurements contracts from four countries of Visegrad Group. By comparing savings from more than a million contracts in twelve years, we use boxplot analysis and statistical tests to describe differences in performance of the public procurement environment between countries of the Visegrad Group. Results showed that there are statistically significant differences in the distribution of savings from one country to another. The highest savings can be found in the Czech Republic, the lowest in Poland. Besides Polland, all other three countries, have according to our data, a proportion of contracts with negative savings lower than 25%. The comparison of distributions of savings from one year to another seems to be random do not show any trend for all reviewed countries. In terms of the type of supply, analyses showed significant differences in distribution savings across countries for all types of supplies. On the other hand, the test did not confirm significant differences in savings between the Czech and Slovak datasets when comparing types of supply such as supplies and works. From the perspectives of countries, in the Hungarian and the Slovakian dataset we could not find statistically significant differences between the distribution of savings among supply-type services and supply-type supplies. The research also provides some ambiguous results, regarding the impact of the use of electronic auction mechanisms on savings from public procurement contracts. The impact seems to differ from one country to another.

5. Acknowledgement

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6. References

García Rodríguez, Manuel J., et al. Public procurement announcements in spain: regulations, data analysis, and award price estimator using machine learning. Complexity, 2019, 2019.

Hrubý, Jan, Pošepný, Tomáš, Krafka, Jakub, Toth, Bence, Skuhrovec, Jiři The Digital Whistleblower: Fiscal Transparency, Risk Assessment and the Impact of Good Governance Policies Assessed Work Package: 2 - Data Collection and Cleaning, 2018 Avaliable at: http://digiwhist.eu/wp-content/uploads/2018/03/D2.8-revised-version-FINAL.pdf

Nemec, Juraj; Mikušová Meričková, Beáta; Grega, Matúš. Contracting, outsourcing, procurement: selected factors limiting their success in the CEE region. 2014.

Ochrana, František; Hrnčířová, Kristýna. Does the lowest bid price evaluation criterion make for a more efficient public procurement selection criterion? (Case of the Czech Republic). NISPAcee Journal of Public Administration and Policy, 2015, 8.1: 41-59.

Patrucco, Andrea Stefano; Luzzini, Davide; Ronchi, Stefano. Research perspectives on public procurement: Content analysis of 14 years of publications in the journal of public procurement. Journal of Public Procurement, 2017.

UNDP (2010). Public Procurement Capacity Development Guide. New York: United Nations Development Programme.