

## ***The efficiency of public procurement in the health sector – the platform on sustainable public finances***

**Beata GAVUROVA<sup>1</sup>, Matus KUBAK<sup>2</sup>, Martin MIKESKA<sup>3</sup>**

**Abstract:** *At present, public procurement processes and their efficiency represent one of the key determinants of public finance system. Many countries of the European Union work intensively on reforming public procurement processes. The main aim of public procurement is to create an open competition in order to achieve the most efficient use of public funds. The Slovak hospitals, that have been inefficiently managed in the long run, are the weakest segment of the healthcare system. Also, the public hospitals continue to generate substantial losses even if many reforms had been implemented to increase cost efficiency. However, medical debt consolidation did not help the hospitals to set optimal functioning of the economic processes in order to improve their management permanently. The primary aim of the study is to examine an impact of selected determinants on an efficiency of public procurement processes in the healthcare system of the Slovak Republic during the 2014 – 2017. The data were obtained from the registers of the Public Procurement Office of the Slovak Republic. The multinomial logistic regression was used to determine the following findings: in case of zero, or positive savings, the number of offers, year of public procurement, type of public procurement procedure, NUTS level of procurement and participation of a subcontractor in procurement process are significant categorical variables. The study results enable a creation of multi-dimensional analyses and support models in order to make effective public procurement processes in the healthcare system. Similarly, these results enable to create comparative benchmarking analyses, and may lead to a creation of new agencies and institutions.*

**Keywords:** public procurement, public contract, savings, sector efficiency, healthcare system efficiency, sustainability of public finances.

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## **Introduction**

The processes of demographic aging have put pressure on health systems and sustainability of public finances. In the health policies of the countries, the recent financial crisis and the present global epidemiological crisis caused by COVID-19 led to an intense search for the ways in the provision of an optimal healthcare in the available financial budgets of the countries (Androniceanu, 2020). The politicians and also the scientific community focus on a creation of new visions and policies that reflect on new challenges and requests. The demand structure for healthcare changes, and it is influenced by life expectancy, health behaviour, economic and social parameters of an individual, etc. The capacities in the provision of an optimal healthcare are frequently insufficient in a majority of the countries. The main reason is probably a migration of healthcare personnel, geographical availability of healthcare, and also economic parameters (Ucieklak-Jez et al. 2018). At present, the trends in the ICT technologies make healthcare significantly expensive. On the other hand, the diagnostic and the treatment processes considerably improve that may lead to cost savings of the population's healthcare (Predkiewicz et al. 2019; Huculová, 2018). In Slovakia, the share of elderly people continues to increase, and an increasing life expectancy poses some challenges to health and social care. Similarly, the working age population ratio decreases that leads to an imbalance between revenues and expenditures of the health system (Sivák et al. 2014). As the OECD report (2017) states, the expenditures of the Slovak public health are at the level of 7% of GDP and they may be compared to the neighbouring countries. However, these expenditures are lower than in a majority of other OECD countries. Health expenditure ratio, within total public expenditures, increased from 9.1% in 2000 to 13.5% in 2014. It means that health is the highest priority of a current society. Nevertheless, the pharmaceutical spending on medicinal products has been criticised. The implementation of the spending revision results within the Value for Money project from 2016 achieved savings in more than 27 million Eur in the first half of 2017, while the expected savings were 100 – 110 million Eur for entire year 2017. The following key areas of improvement were defined: decreasing expenditures on prescriptions medicines and medical devices, and decreasing costs on diagnostic imaging, which will not result in a decline of an access to healthcare, or its quality (OECD, 2017).

Public sector plays an important role in financing health services: the public sector finances more than 70% of public health expenditures in two thirds of the EU member states. However, this fact considerably threatens sustainability of public finances with regard to the process of demographic aging (EC, 2019). As Eliáš (2017) suggests the expenditures on healthcare in Slovakia threatens a long-term sustainability of public finances (EC, 2017). The European Commission states that an increase of healthcare cost-efficiency in Slovakia remains a serious issue.

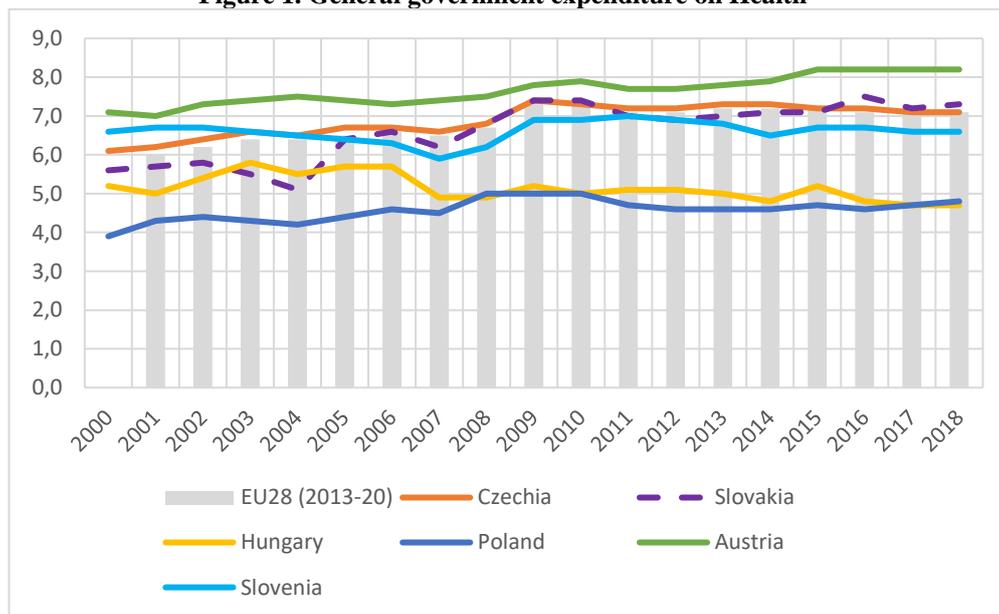
Public procurement is one of the significant areas of savings and efficiency increase in healthcare system. Its functioning is controlled by national and

international legislative. Healthcare, with regard to PP, is a very complicated sector in each country due to a need to have a special and sophisticated technology and materials (Caparelli et al. 2015). The advancements in medical science and the ageing population will intensify the need for an increased healthcare expenditure. Therefore, ensuring the stability of the system is closely related to effective PP (Seidman & Atun, 2017). Consequently, public procurement efficiency in healthcare represented the main motivation of this research in order to examine an impact of selected parameters on an efficiency of public procurement processes in the Slovak healthcare during the 2014 – 2017.

### 1. Literature review

The research also focuses on other related aspects of healthcare system that influence its efficiency and sustainability with regard to a significant interconnection between an efficiency of public procurement processes and sustainability of public finances. As it was already stated, the research of healthcare system and public finances' sustainability is a current issue in many countries and it is a part of many government strategies. Figure 1 and Figure 2 display an international comparison of researched aspects. Figure 3 and Figure 4 show a comparison of researched aspects within NUTS2 Slovakia. Figure 1 illustrates a development of expenditures on healthcare system in selected countries, and EU 28 during the 2000-2018.

**Figure 1. General government expenditure on Health**

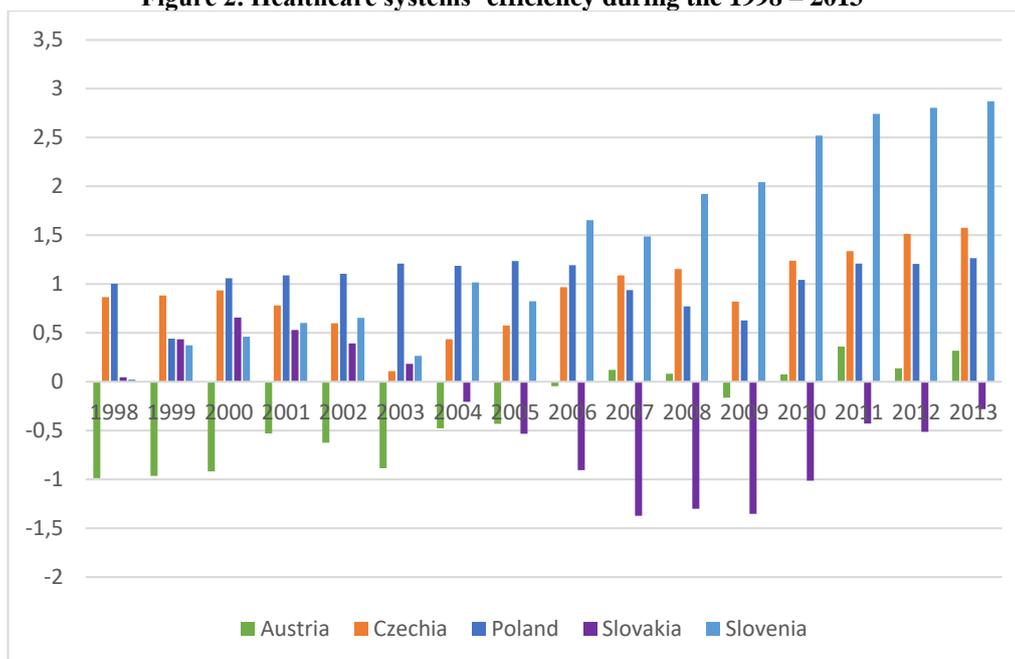


(Source: European Commission – Eurostat, 2020)

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The Slovak expenditures on healthcare system, from the point of % of GDP, are similar to those in the Czech Republic and Slovenia. However, both countries have higher efficiency of healthcare systems than Slovakia. It is almost comparable to Hungary and Poland that spend of 2 – 3% of GDP per year less on their healthcare systems. Consequently, the research focuses on a comparison of healthcare systems' efficiency in the selected countries during the 1998 – 2013 (Figure 2). However, the Slovak efficiency of healthcare has had negative values since 2004. The worst values were achieved during the 2007 – 2009, even if this negative trend lasted during an entire researched period (until 2013).

**Figure 2. Healthcare systems' efficiency during the 1998 – 2013**



(Source: Černěňko et al. 2016)

Similarly, the Institute for Financial Policy study determined the same results of the Slovak healthcare system inefficiency. Also, the Institute for Financial Policy considers three main areas as the basis of the Slovak healthcare system inefficiency: health insurance companies, hospitals and medicinal products. Its study called, 'Less Health for More Money' (MF, 2012), especially displays the differences in the adjusted treatment costs, high administrative expenses and annuities that result from an insufficient consideration of a different illness of an insured person. The findings suggest that two private insurance companies, Dôvera and Union, had statistically lower costs on a single patient than a state - owned insurance company in 2010. In case of Dôvera, the monthly costs for individual health insurance were lower of 4.2 Eur, while in case of Union, these were lower of

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3.2 Eur ((7.2% Dôvera, 5.6% Union out of total average costs for individual health insurance per month in Slovakia). The study also indicates that these means may be transformed into a form of unauthorised annuities due to low competition in a particular sector and market position of the insurance companies (IFP, 2012). These negative economic parameters are closely connected to the expenditures on medical goods, including medicinal products. As it was already stated in the Introduction of this study, the European Commission considers an increase of cost – efficiency as the primary issue of healthcare system in Slovakia. Table 1 provides an overview of the highest expenditures on medical goods, including medicinal products in Slovakia since 2008.

**Table 1. The expenses on medical goods, including medicinal products  
(USD, PPP, per capita)**

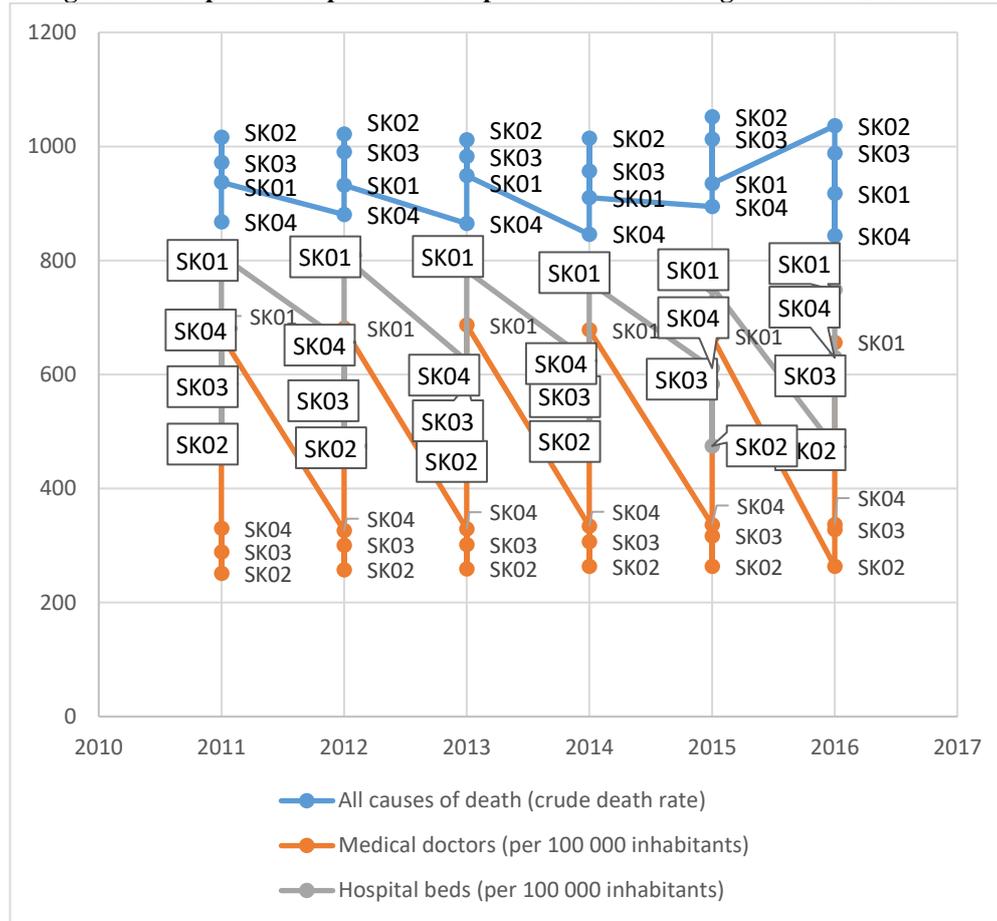
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SK	219	234	258	312	346	406	452	506	581	642	709	731	711	714	741	682
V3	258	270	308	300	338	360	390	406	403	425	467	461	496	487	478	483
EU 28	343	369	401	417	444	452	473	501	528	551	589	592	599	589	604	611
EU 15	383	409	441	472	496	516	536	568	598	628	665	669	668	650	661	669
OECD	331	357	395	418	450	459	481	510	535	568	604	615	624	622	646	643

(Source: OECD - Health expenditure and financing, 2017)

The economic parameters of the Slovak healthcare system are not the same. Similarly, in Slovakia, the geographical availability of healthcare is not the same, which is also determined by many socio-economic and demographic aspects. The demographic structure of the country represents a significant parameter that influences an availability of healthcare, and a demand for it. This fact influences a different capacity of expenditures on healthcare in the individual regions. Therefore, a complex sustainability of healthcare system requires optimal usage of healthcare infrastructure and more efficient healthcare and diagnostic processes.

Figure 3 provides an overview of selected parameters of the Slovak healthcare system that are structured according to NUTS2. Slovakia is divided into four main units of NUTS2: Bratislava Region (SK01 – Bratislava Region), Western Slovakia (SK02 – Trnava, Trenčín, Nitra Regions), Middle Slovakia (SK03 – Žilina and Banská Bystrica Regions) and Eastern Slovakia (SK04 – Prešov and Košice Regions).

Figure 3. Comparison of public health parameters according to NUTS2 Slovakia



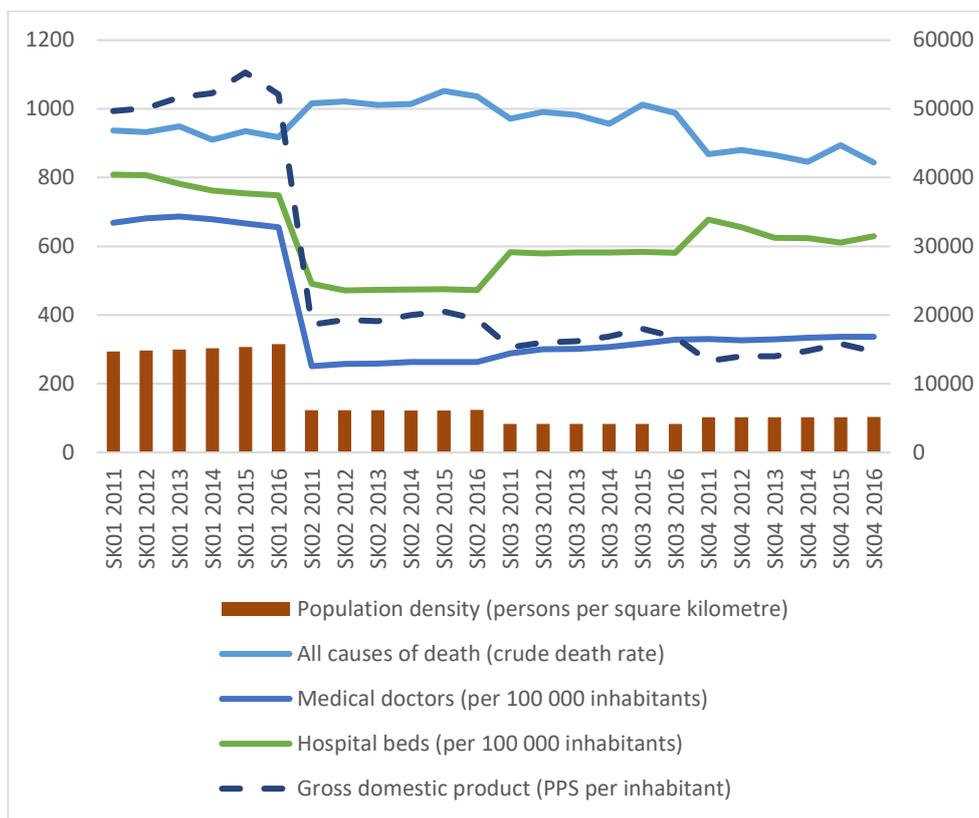
(Source: European Commission – Eurostat, 2016)

Western Slovakia, SK02, has the lowest number of physicians on a long-term basis, and simultaneously, this region has the highest mortality rate. On the other hand, Bratislava has the highest number of physicians and also the highest number of beds per 100.000 people. However, this region does not achieve the lowest mortality rate. Eastern Slovakia, SK04, achieves the lowest mortality rate with a relatively high number of physicians and number of beds per capita (this region takes the second position after Bratislava Region). Middle Slovakia, SK03, has the second lowest number of physicians and beds per 100.000 people, and the second highest mortality rate on a long-term basis. Picture 4 illustrates a relationship of population and economic performance to the number of physicians, beds and mortality rate in Slovakia. Western Slovakia took the last position in the number of beds with the second highest population rate, while Middle Slovakia keeps its constant number of beds. However, in Eastern Slovakia, there appears a

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reduction of beds. A slight increase in the number of physicians per 100.000 people may be observed in Middle and Eastern Slovakia. The three regions of NUTS2 lag behind Bratislava Region in terms of economic efficiency by more than 2/3 of economic efficiency. It may be stated that there prevail significant regional disparities in healthcare and economic parameters of a country based on the given facts.

**Figure 4. Selected healthcare and economic parameters in Slovakia divided according to NUTS2 (2016)**



(Source: European Commission – Eurostat, 2016)

The indicators of population density and GDP per capita at PPP provide an interesting comparison. Bratislava has the highest population density and GDP per capita. It is considered as the largest financial centre in Slovakia, which is also emphasized by an increasing population rate together with an increasing GDP until 2016. The second strongest region in terms of industrial production is NUTS2, Western Slovakia. The automotive industry, that has been facing many negative trends related to a manufacturing structure and trends in an entire automotive sector since 2016, is a dominant part of this region. However, the regional disparities may

be deepened even by the crisis of the COVID – 19 pandemic. Similarly, the differences among NUTS2 regions are significant from the point of public procurement and tender procedures. Total annual expenditures on healthcare, that presented 5.6% of GDP (4443 mil. Eur) in 2017, were analysed in order to identify possible savings of healthcare costs (Černěnko et al., 2016). Consequently, the possible savings could be used for an effective functioning of healthcare system. However, it is difficult for the Slovak public healthcare to reach the same level as the rest of V4 countries. Slovakia, during the given years, achieved a mortality rate higher of 18% in average than the Czech Republic, Hungary and Poland in spite of the fact that the Slovak Republic spends more than any of the V4 countries on healthcare system. The study of the Slovak healthcare efficiency analysis that was performed on the basis of ‘Less Health for More Money’ document (Filko, Mach, & Zajíček, 2012) also states that if the Slovak healthcare was set more effectively, at the average level of OECD countries at least, it could either save almost 8% of costs at current life expectancy, or on contrary, it could increase life expectancy per capita of almost 3 months, while maintaining current expenditures on healthcare (Černěnko et al., 2016). As a consequence of this fact, this study focuses on a research of the determinants’ impact on an efficiency of public procurement processes in the Slovak healthcare system.

## **2. Data and Methodology**

The main aim of this study is to examine an impact of selected determinants on an efficiency of public procurement processes in the Slovak healthcare system during the 2014 – 2017. The database includes data from the reports of the Public Procurement Office of the Slovak Republic. The data used in this study had the following structure:

- Real savings: A real saving is a qualitative variable that determines the interval in which the savings ranged. The savings are expressed as the difference between the estimated price of the goods to be purchased and the final price of the goods to be purchased. Real savings are positive if the estimated price of the goods to be purchased is more than the final price of the goods to be purchased. Real savings are null if the estimated price of the goods to be purchased is equal to the final price of the goods being purchased. Real savings are negative if the estimated price of the goods to be purchased is less than the final price of the goods being purchased. All prices were without VAT. We divided the real percentage savings into 13 intervals, where the median value is zero saving. The intervals are as follows: 50-, (-41; -50), (-31; -40), (-21; -30), (-11; -20), (-1; -10), 0, (1; 10), (11; 20), (21; 30), (31; 40), (41; 50), 50+. In The majority of observations are for zero savings, 33.6%, then for savings of (1; 10) %, 31.5% of observations are for (11; 20) % savings, 11.5% of observations are for (10; 20) % savings and 7.2% of observations are for negative saving from interval (-1; -10).

- Type of procurement. There were only two types of procurement in our dataset. The tender in 88.2% of cases and the Competitive procedure with negotiation in 11.8% of cases. The type of procurement is a categorical variable.

- Year. Year is a categorical variable indicating the year in which the procurement was made. In our analysis we have data from 4 years, 2014-2017. It can be said that from a time point of view, the data are evenly distributed, even if in 2017 only 15.4% of procurements took place.

- Type of procurement. There were only two types of procurement in our dataset. The tender in 88.2% of cases and the competitive procedure with negotiation in 11.8% of cases. The type of procurement is a categorical variable.

- NUTS code. The NUTS code categorical variable indicating the level of common classification of territorial units where procurement took place. 5.6% of procurements took place at NUTS 1 level, 16.8% at NUTS 2 level and 77.5% at NUTS 3 level.

- Number of bids: the number of bids is a scale variable of 1 to 10 and indicates how many bids were received during the bidding process. Most observations are for one, two and three offers (39.3%, 22.5%, 25.0%).

- Subcontracting, a categorical variable indicating whether subcontractors also participated in the supply of the procured goods. In 4.1% of cases, yes, in 84.1% of cases no, and in 11.8% of cases we do have information whether there was subcontractor in process of procurement.

- Quality criterion. A categorical variable that indicates whether the quality of goods procured has been taken into account in the procurement process. In 84.7% of cases, the quality criterion was not taken into account and in 15.3% we do not know whether or not the quality has been taken into account.

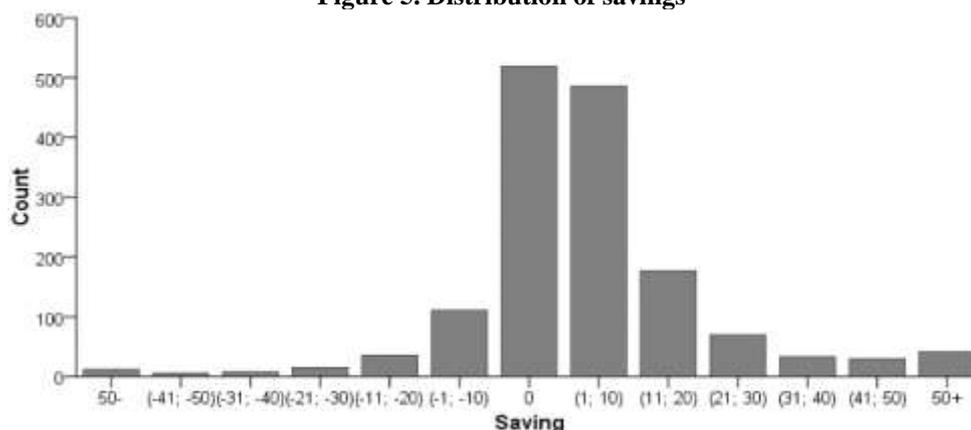
- EU funds. A categorical variable with a dichotomous scale indicating whether or not the funds from EU were used in procurement process. In 4.1%, goods procured with money from the EU were purchased, in 95.9% were not.

- Electronic auction: Trichotomy categorical variable informing whether the procurement was secured using an electronic auction. In 85.8%, the procurement was secured using an electronic auction, in 0.5% no, and in 13.7% of cases we have no information about it.

### **3. Results and discussion**

Distribution of savings are shown on Figure 1. We can see that majority out of 1545 procurements included in our database are in intervals of 0 savings, (1; 10) savings, (11; 20) savings and (-1; -10) savings. We can also conclude, that in procurement processes we observe more often positive than negative savings. Moreover, we conclude that our dataset is normally distributed.

Figure 5. Distribution of savings



(Source: Our determinations)

Table 2 contains information about type of procurement and interval amount of saving. We can see, that majority of procurements were done via public tenders. We can conclude again, that majority of procurements resulted to 0 savings, (1; 10) savings, (11; 20) savings and (-1; -10) savings.

Table 2. Type of procurement/Saving

		Type of procurement	
		Public tender	Negotiated procedure
		Count	Count
Saving	50-	12	0
	(-41; -50)	6	0
	(-31; -40)	8	0
	(-21; -30)	14	1
	(-11; -20)	34	2
	(-1; -10)	98	13
	0	461	58
	(1; 10)	424	62
	(11; 20)	152	25
	(21; 30)	61	9
	(31; 40)	28	5
	(41; 50)	28	2
50+	37	5	

(Source: Our determinations)

Table 2 contains information about type of saving (positive, zero, negative) in relation of type of procurement and number of offers. We see that only about 12% of procurements were done by negotiated procedure and that 54% of procurements generated positive savings, 33,5% of procurements generated zero savings and 12,5% of procurements generated negative savings.

Table 3. Type of saving/type of procurement

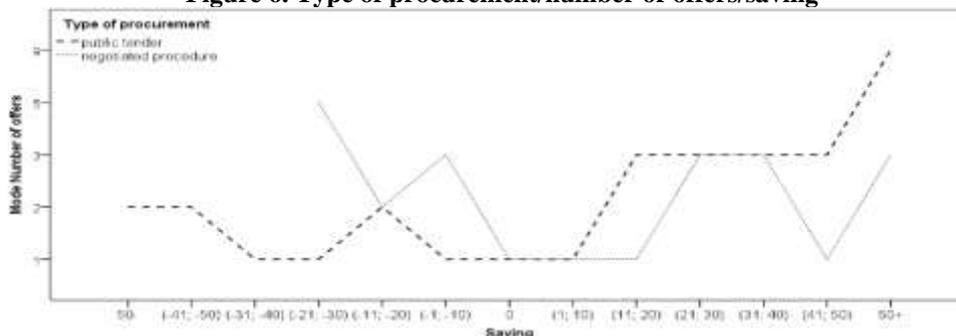
Saving	Type of procurement	Number of offers										Total			
		1	2	3	4	5	6	7	8	9	10				
negative	public tender	55	53	47	9	5	1	1	1						172
	negotiated procedure	1	5	8	1	1	0	0	0						16
	Total	56	58	55	10	6	1	1	1						188
zero	public tender	289	96	45	13	4	1								461
	negotiated procedure	38	8	8	3	1	0								58
	Total	327	104	53	16	5	1								519
positive	public tender	192	160	249	71	29	6	10	5	8					730
	negotiated procedure	32	26	30	13	3	3	1	0	0					108
	Total	224	186	279	84	32	9	11	5	8					838
Total	public tender	536	309	341	93	38	8	11	6	8	13				1363
	negotiated procedure	71	39	46	17	5	3	1	0	0	0				182
	Total	607	348	387	110	43	11	12	6	8	13				1545

(Source: Our determinations)

Figure 6 depicts the modal number of offers to saving according to type of procurement. We see that in case of public tenders, the saving increase by number of offers. On the other hand, in case of negotiated procedure the pattern is not as

clear as in case of public tenders. Moreover, we can conclude, that on average, in case of negotiated procedure, the saving are decreasing with number of offers.

**Figure 6. Type of procurement/number of offers/saving**



(Source: Our determinations)

In our analysis we focus on the type of savings that was achieved during the procurement process. There are three types of savings possible, thus positive, null and negative savings. In the case of multinomial regression analysis, we have a trichotomic dependent variable and thus 3 possible states of a dependent variable: negative savings, zero savings, positive savings. In Table 4 we have information on the suitability of the model under consideration. In the model significance column, we have a p-value equal to 0.000 what indicates that at least one regression coefficient in the regression we are considering is different from zero, and thus the model under consideration is better than a model containing only an intercept.

**Table 4. Model Fitting Information**

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	2946,850	243,617	28	,000
Final	2703,234			

(Source: Our determinations)

Table 5 shows the results of multinomial logistic regression. The contrast value of the dependent variable are negative savings, that is, when the difference between the expected price excluding the final price was negative.

In the case of zero savings in public procurement in healthcare sector, and thus when the estimated cost of the procured goods is equal to the final price, the results are presented below.

With the increase in the number of bids, there is a likelihood of zero savings compared to negative savings by 24.1% smaller.

Compared to 2017, it was by 80.9% in 2014, 64.2% in 2015 and 60.6% in 2016, smaller chance that public procurement savings will be zero compared to the chance of being negative.

Regarding the type of the procurement, the probability of zero savings in the case of a public tender is by 95.6% smaller compared to the negotiated procedure and in relation to negative savings.

Concerning NUTS level, there is a chance that the savings will be zero compared to the negative savings in the case of NUTS 1 by 3,339 times and in the case of NUTS 2 by 2.18 times bigger than in the case of the NUTS 3 level.

If we do not know whether the quality criterion has been monitored in procurement process, there is a chance that there will be zero savings compared to negative savings by 63% smaller than in the case of when quality criterion is monitored.

If a subcontractor did not participate in the procurement process, there is a chance that there will be zero savings compared to the negative savings by 3.72 times greater than in the case that we have no information whether there was subcontractor present in the procurement process.

In the case of positive public procurement savings, the conclusions against negative savings are presented below.

As the number of offers increases, the chance that the savings will be positive is by 15.3% bigger relative to negative savings.

In 2014 and 2015, the chances of making positive savings compared to 2017 were by 65.5% and 50.2% relative to negative savings.

Concerning the type of the procedure, there is a likelihood of positive savings in case of public tender by 96.8% smaller than in the case of negotiated procedure and in relation to negative savings. Regarding the NUTS level, there is a chance that savings will be positive by 54% greater on NUTS 2 level than in case of NUTS 3 level and relative to negative savings. If we do not know whether the quality criterion has been monitored, there is a chance that there will be positive savings compared to negative savings by 86.6% smaller than if the quality criterion is not monitored.

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Table 5. Multinomial logistic regression

saving *		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
zero	Intercept	3,931	,623	39,763	1	,000			
	Number of bids	-,275	,074	13,966	1	,000	,759	,657	,877
	[Year=2014]	-	,314	27,735	1	,000	,191	,103	,354
	[Year=2015]	-	,333	9,479	1	,002	,358	,186	,689
	[Year=2016]	-,931	,338	7,575	1	,006	,394	,203	,765
	[Year=2017]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[Procurement=public tender]	-	,948	10,833	1	,001	,044	,007	,283
	[Procurement=negotiated]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[NUTS=1]	1,222	,470	6,762	1	,009	3,393	1,351	8,522
	[NUTS=2]	,778	,257	9,180	1	,002	2,176	1,316	3,599
	[NUTS=3]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[Quality criterion=NA]	-,994	,399	6,199	1	,013	,370	,169	,809
	[Quality criterion=NO]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[EU funds=YES]	-,207	,394	,275	1	,600	,813	,376	1,760
	[EU funds=NO]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[Electronic auction=YES]	,301	,539	,311	1	,577	1,351	,469	3,890
	[Electronic auction=NO]	-,013	1,394	,000	1	,992	,987	,064	15,154
	[Electronic auction=NA]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[Subcontractor=YES]	,503	,894	,317	1	,573	1,654	,287	9,533
	[Subcontractor=NO]	1,315	,815	2,603	1	,107	3,724	,754	18,393
[Subcontractor=NA]	0 <sup>a</sup>	-	-	0	-	-	-	-	
positive	Intercept	4,459	,582	58,729	1	,000			
	Number of bids	,142	,058	5,959	1	,015	1,153	1,028	1,292
	[Year=2014]	-	,305	12,220	1	,000	,345	,190	,626
	[Year=2015]	-,697	,327	4,526	1	,033	,498	,262	,947
	[Year=2016]	-,007	,323	,000	1	,983	,993	,527	1,872
	[Year=2017]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[Procurement=public tender]	-	,877	15,412	1	,000	,032	,006	,178
	[Procurement=negotiated]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[NUTS=1]	,137	,486	,080	1	,777	1,147	,442	2,976
	[NUTS=2]	,433	,253	2,933	1	,087	1,542	,939	2,530
	[NUTS=3]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[Quality criterion=NA]	-	,383	27,558	1	,000	,134	,063	,284
	[Quality criterion=NO]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[EU funds=YES]	-,521	,370	1,984	1	,159	,594	,288	1,226
	[EU funds=NO]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[Electronic auction=YES]	,116	,512	,051	1	,821	1,123	,412	3,064
	[Electronic auction=NO]	-	1,676	1,880	1	,170	,101	,004	2,683
	[Electronic auction=NA]	0 <sup>a</sup>	-	-	0	-	-	-	-
	[Subcontractor=YES]	-,043	,780	,003	1	,956	,957	,208	4,416
	[Subcontractor=NO]	,549	,703	,609	1	,435	1,731	,436	6,864
[Subcontractor=NA]	0 <sup>a</sup>	-	-	0	-	-	-	-	

a. The reference category is: negative saving.

(Source: Our determinations)

#### **4. Discussion and conclusions**

Many conclusions may be formulated from the analyses' results.

*In case of zero savings:* it is less probable that the zero savings will achieve 24.1% as opposed to negative savings if the number of offers increases. The probability was lower of 80.9% in 2014, of 64.2% in 2015 and of 60% in 2016 as opposed to 2017, and that the savings of public procurement will be zero as opposed to the probability that the savings will be negative.

*In case of a parameter 'type of procedure',* the probability is lower of 95.6% that zero savings will be achieved in case of a public tender when comparing it with a negotiated procedure and in a relation to zero savings.

*In case of 'NUTS level',* the probability is higher 3.339 times (NUTS 1) and 2.18 times (NUTS 2) than in the case of NUTS 3 that the savings will be zero as opposed to negative savings.

If there is no knowledge that a quality criterium was observed, the probability that zero savings will be achieved as opposed to negative savings is lower of 63% than in case of a quality criterium which was not observed.

If a subcontractor did not participate at public procurement process than the probability of zero savings in comparison to negative savings is 3.72 times higher than in case of no knowledge if a subcontractor participated at public procurement.

In case of positive savings in public procurement, the conclusions related to negative savings are as follows:

1. The probability that the savings will be positive of 15.3% increases with an increasing number of offers. Lower number of candidates means a limited competition and an assumption of higher prices. If there were more candidates in tenders of healthcare facilities, the hospitals would save more funds.

2. The probability of positive savings creation was lower of 65.5% (2014) and of 50.2% (2015) in a comparison to 2017.

3. In case of '*type of procedure*', the probability that positive savings will be achieved in case of public tender is lower of 96.8% in comparison to a negotiated procedure and in a relation to zero savings.

4. In case of '*NUTS level*', the probability that positive savings will be achieved as opposed to negative savings in NUTS 2 is higher of 54% than in NUTS 3.

5. If there is no knowledge of a quality criterium observation, the probability that positive savings will be achieved as opposed to negative savings is lower of 86.6% than in case of a not observed quality criterium.

Low average number of submitted offers in the hospitals' trends and low competition may have various reasons. A specificity of medical goods, that have a limited number of suppliers, is one of those reasons. Zachar a Dančíková (2012) state that there exist such cases in private and public sector of the Slovak Republic and the Czech Republic where hospital directors regularly choose from two to four offers, while in the Slovak public hospitals, there is only one supplier in a

competition in comparable tenders. Higher number of offers lead to higher competition among suppliers and also to lower prices as opposed to their contracting authorities at the level foreseen. Therefore, it is important to examine the determinants of public procurement efficiency and search for possibilities to create appropriate conditions for transparent competition, and to create monitoring and controlling mechanisms within and among the countries. It would enable to evaluate present regulatory measures in the sector of public procurement and to set new tendencies. The authors, Placek et al. (2019), who analyse Factors of Overpricing in Public Procurement for Low-performing EU Countries in their study, emphasize an importance of this issue. The results of this study show that institutional factors have a greater impact on overpricing than individual decisions by the contracting authority. This knowledge creates a space for further researches and comparative analyses. However, the study was limited by a fact that some variables were insufficiently represented in this research. Here especially belongs an observation of the following variables: *Quality Criterium, EU Funds, Electronic Auction, Participation of Subcontractor*.

The present situation and the development of demographic indicators suggest trends in healthcare expenditures' increase as a consequence of a population's demographic aging, and also a technological development. There is a need for a creation of crisis scenarios for healthcare systems' sustainability and also public finances caused by unexpected impacts of the COVID – 19 pandemic. An increase of healthcare system cost-efficiency is a long-term and very complex process that needs to be properly set by each country up in its particular economic conditions, political situation, etc. It is inevitable to prioritize selected areas by a budget in a relation to demographic trends, mortality and morbidity structure, and also to prepare an optimal environment for subjects' functioning in healthcare system. The system of purchasing goods and services, and also construction works by means of health facilities will always create a large space for more effective use of public resources. Public procurement sector represents a complex area of health economics especially due to its specificities. Consequently, an importance of regular monitoring and analysis of these factors with a primary aim to reveal possibilities of improvement of these processes is required in order to increase healthcare system efficiency. The main aim of this study is to examine an impact of selected parameters on an efficiency of public procurement processes in the healthcare system of the Slovak Republic during the 2014 – 2017. The analyses' results show that a number of offers, year of public procurement, type of public procurement procedure, NUTS level of procurement, and a participation of a subcontractor in public procurement process are statistically significant explaining quantities in case of zero, and/or positive savings in public procurement of healthcare system. It was determined, that at NUTS 1 level, the savings achieved by public procurement are higher than at NUTS 2 and NUTS 3 levels, based on public procurement parameters research from a perspective of geographical structure of Slovakia. Thus, public procurement centralization has a positive impact on a size of achieved saving.

These findings provide a valuable platform for a creation of relevant policies, and also for the creators of strategic plans. The present technological trends in healthcare indicate that public procurement processes will be more complex as they will require an implementation of many other criteria into the preparation phases of public procurement, which are related to innovative technologies and their results. However, it makes pressure on a development of new technologies, a realisation of multi-dimensional analyses of public procurement, and a provision of a systematic evaluation of new technologies' impacts on procurement processes and their results. Similarly, it will be necessary to complementarily create and improve a database in order to build strategic decisions and policies on the basis of quality and representative data. The attention is currently drawn to a new role of a patient in this area – a patient as an equal partner in the decision-making processes. The Slovak healthcare system needs clearly measurable targets set in health that will be achieved by means of health and medical indicators, and measures of financial efficiency. Consequently, it will be possible to set quality benchmarking indicators and to compare these indicators with foreign countries in order to constantly improve healthcare processes and provide sustainable healthcare system. The results of this study enable to create numerous support models for public procurement efficiency in healthcare system, and simultaneously, to create benchmarks for comparative analyses. Last but not least, these results may also support a creation of new agencies and institutions.

#### **Authors Contributions**

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

#### **Conflict of Interest Statement**

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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