

Darko B. Vukovic*'s response to the comment on: Correlation analysis of indicators of regional competitiveness: The case of Republic of Serbia (2013)

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After the suggested criticisms on the article Correlation analysis of indicators of regional competitiveness: The

Case of the Republic of Serbia, which was published in the journal *Economic Horizons*, Volume 15, Number 3, in 2013, this text contains the answers to the remarks, with certain corrections. The article Correlation analysis of indicators of regional competitiveness: The Case of the Republic of Serbia belongs to the narrower area of the regional economy, where the statistical analysis only is used as a method of the studied problem. Therefore, the primary and largest part of the paper is devoted to the regional economy which has affected that some of the statistical procedures are excluded (bearing in mind that the statistics in this paper have a lower theoretical significance). In this text, I am going to present the

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omitted explanations or the results of the analysis (testing the significance of the correlation of the researched indicators). There are also some errors, which will be corrected.

The remark stating that the correlation analysis does not examine the frequency of the connections but rather a quantitative agreement between the phenomena is accepted. The remark for p. 201 in the second paragraph is rejected. This was about the complexity of the analysis rather than about how reliable or unreliable it is.

The correlation coefficient is an often used statistical method which determines the existence of quantitative stacking as well as the strength of stacking between variables. In the case of the existence of a linear correlation between two phenomena, it is a simple linear correlation. Pearson's coefficient of simple linear correlation is the best-known measure that expresses the degree of linear quantitative stacking between two phenomena. During the testing of the significance of this coefficient, it is assumed that the common layout of researched variables is normal. The expression of Spearman's correlation coefficient is shown in the article Correlation analysis of indicators of regional competitiveness: The Case of the Republic of Serbia, which is an error. Therefore, this remark is accepted. The following formula is used for the computation of Pearson's coefficient of the sample (which is omitted in the operation):

$$r = \frac{n \cdot \sum xy - \sum x \sum y}{\sqrt{n \sum x^2 - (\sum x)^2} \cdot \sqrt{n \sum y^2 - (\sum y)^2}}$$

The testing of Pearson's linear coefficient of correlation was carried out by using the IBM SPSS Statistics software. Version 20, which is available on the Internet (http://ibm-spss-statistics.soft32.com/download/file/id/796185/?&no_download_manager=true) was used. This computational operation is exercised by all the versions of the SPSS, so it was not considered necessary to mention which version was used. Moreover, for the purpose of this analysis, Microsoft Excel 2010 is also sufficient, which can provide an adequate testing of Pearson's linear correlation coefficient.

At the end of the article (in the Appendix), the values obtained through the survey are shown. Surveys may not include the Likert scale (the encryption of 1 to 5, although the Likert scale may include 7 modalities of answers);

they, however, may also offer a different system of answers. In this case, the survey offers a possibility of an index evaluation, as a subjective (qualitative) assessment of participants. The further processing of the data I do not want to explain since it was used for the purposes of another analysis, which is not the subject of this paper.

Further in the text, the testing of the significance of the correlation of the investigated indicators will be displayed, which testing indicates a statistically significant correlation among the greatest number of indicators.

As a relative measure of quantitative stacking between the gross domestic product (GDP) of the region and the number of companies, Pearson's correlation coefficient was used. On the basis of the obtained values of this coefficient, it was concluded that there is a high degree of direct linear correlation in the sample. In testing the significance of the obtained correlation, the obtained value is less than 0.05. This indicates that at the respective level of significance between these variables there is a statistically significant correlation (Table 1).

Table 1 The correlation of the GDP in the region with the number of companies

		Correlations	
		Regional GDP	The number of companies
Regional GDP	Pearson Correlation	1	,998**
	Sig. (2-tailed)		,002
	N	4	4
The number of companies	Pearson Correlation	,998**	1
	Sig. (2-tailed)	,002	
	N	4	4

** Correlation is significant at the 0.01 level (2-tailed)

Source: Author

A similar conclusion comes up with testing the significance of the obtained correlations in the sample

between indicators of the number of employees in region and regional GDP (Table 2). The analysis showed that there is a high correlation between regional GDP and the number of employees in a certain region.

The further testing of the sample showed that investment in capital assets have a medium positive correlation ($r = 0.726$). The growth of investments is positively correlated with GDP growth, but not to the extent that they have companies and the number of employees. The indicator related to the number of entrepreneurs in the region is slightly correlated with regional GDP ($r = 0.391$). This means that there is less quantitative stacking between these indicators. Correlation analysis of these indicators showed logical and expected results.

By testing the significance of correlations in the employment sample, the conclusion is that there is a statistically significant positive correlation with indicator budgetary expenditures in education (Table 3). This relationship indicates that there is a high statistical significance of the quantitative stacking between employment (the number of employees in region) and government invests in education (budgetary expenditures in education).

Table 2 The correlation of the GDP in the region with the number of employees in the region

		Correlations	
		Regional GDP	The number of employees in region
Regional GDP	Pearson Correlation	1	,981*
	Sig. (2-tailed)		,019
	N	4	4
The number of employees in region	Pearson Correlation	,981*	1
	Sig. (2-tailed)	,019	
	N	4	4

** Correlation is significant at the 0.05 level (2-tailed)

Source: Author

Table 3 The correlation of the number of employees and budgetary expenditures in education

Correlations			
		The number of employees in region	Budgetary expenditures in education
The number of employees in region	Pearson Correlation	1	,988*
	Sig. (2-tailed)		,012
	N	4	4
Budgetary expenditures in education	Pearson Correlation	,988*	1
	Sig. (2-tailed)	,012	
	N	4	4

** Correlation is significant at the 0.05 level (2-tailed)

Source: Author

On the other hand, there was a slightly positive correlation between an investment in education and employment growth ($r = 0.631$); by testing this correlation, however, it was confirmed that it is not statistically significant - $p > 0.05$ (Table 4).

Table 4 The correlation of investments in education and the number of employees in region

Correlations			
		Investments in education	The number of employees in region
Investments in education	Pearson Correlation	1	,631
	Sig. (2-tailed)		,369
	N	4	4
The number of employees in region	Pearson Correlation	,631	1
	Sig. (2-tailed)	,369	
	N	4	4

Source: Author

By analyzing the quantitative stacking in the sample between the indicators of employment with indicators of working age population ($r = -0.177$) and population with higher education ($r = -0.197$), it has been shown that coefficients were strongly negative.

Tables 5, 6 and 7 show that the correlation between the business environment indicators indicates the expected results. In fact, with the significance level of 0.01, statistically significant quantitative stackings between the extent of the clusters and the quality of the state services as well as between the quality of the state services and the attractiveness of the business environment have been proven.

Table 5 The correlation of the the extent of clusters and quality of state services

Correlations			
		The extent of clusters	The quality of state services
The extent of clusters	Pearson Correlation	1	,994**
	Sig. (2-tailed)		,006
	N	4	4
The quality of state services	Pearson Correlation	,994**	1
	Sig. (2-tailed)	,006	
	N	4	4

** Correlation is significant at the 0.01 level (2-tailed)

Source: Author

The same conclusion is reached in the case of the analysis of correlation between the attractiveness of the business environment and the extent of clusters (Table 7).

Table 6 The correlation of the quality of the state services and the attractiveness of the business environment

Correlations			
		The quality of state services	The attractiveness of the business environment
The quality of state services	Pearson Correlation	1	,996**
	Sig. (2-tailed)		,004
	N	4	4
The attractiveness of the business environment	Pearson Correlation	,996**	1
	Sig. (2-tailed)	,004	
	N	4	4

** Correlation is significant at the 0.01 level (2-tailed)

Source: Author

Table 7 The correlation of the attractiveness of the business environment and the extent of clusters

Correlations			
		The attractiveness of the business environment	The extent of clusters
The attractiveness of the business environment	Pearson Correlation	1	1,000**
	Sig. (2-tailed)		,000
	N	4	4
The extent of clusters	Pearson Correlation	1,000**	1
	Sig. (2-tailed)	,000	
	N	4	4

** Correlation is significant at the 0.01 level (2-tailed)

Source: Author

The high value of the coefficient in the observed sample also indicate connectivity of air transportation with foreign countries and the independence of the judiciary, but testing has shown that the correlation was not statistically significant - $p > 0.05$. Almost all innovation indicators showed high positive values of the Pearson coefficient of the sample (over 0.9), except indicators the number of registered patents and published scientific research papers, which have weak positive correlation. The high degree of positive correlation between regional BDP and the extent of clusters is confirmed as statistically significant (Table 8).

Table 8 The correlation of the GDP in the region with the extent of the clusters

Correlations			
		Regional GDP	The extent of clusters
Regional GDP	Pearson Correlation	1	,999**
	Sig. (2-tailed)		,001
	N	4	4
The extent of clusters	Pearson Correlation	,999**	1
	Sig. (2-tailed)	,001	
	N	4	4

** Correlation is significant at the 0.05 level (2-tailed).

Source: Author

Finally, the significance of the correlation between tourism and the specific indicators of the infrastructure is tested. In this sense, no statistically significant correlation between tourism and the largest number of the indicators of the infrastructure has been proven. The only statistically significant correlation, based on

the sample data, has been proven to exist among the indicators of investments in water supply, investments in water supply and waste water management and the amount of hazardous waste in the region (Table 9).

Table 9 The correlation of investments in water supply and waste water management with the amount of hazardous waste in the region

Correlations			
		Investments in water supply and waste water management	The amount of hazardous waste in the region
Investments in water supply and waste water management	Pearson Correlation	1	,975**
	Sig. (2-tailed)		,003
	N	4	4
The amount of hazardous waste in the region	Pearson Correlation	,975**	1
	Sig. (2-tailed)	,003	
	N	4	4

** Correlation is significant at the 0.05 level (2-tailed).

Source: Author

Based on the results of testing the significance of the correlation of the researched indicators, the validity of the article Correlation analysis of indicators of regional competitiveness: The Case of the Republic of Serbia, which was published in the journal *Economic Horizons*, Volume 15, Number 3, in 2013, can be verified.

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Odziv Darka B. Vukovića* na komentar članka: Korelaciona analiza indikatora regionalne konkurentnosti: Primer Republike Srbije (2013)

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Nakon upućenih kritika na rad Korelaciona analiza indikatora regionalne konkurentnosti: Primer Republike Srbije, koji je publikovan u časopisu *Ekonomski horizonti*, Volumen 15, Sveska 3, Godište 2013, u ovom tekstu se nalaze odgovori na primedbe sa određenim korekcijama. Rad Korelaciona analiza indikatora regionalne konkurentnosti: Primer Republike Srbije pripada užoj oblasti regionalne ekonomije, gde je statistička analiza korišćena samo kao metod istraživanja problema. Zbog toga, primaran i najveći deo rada je posvećen regionalnoj ekonomiji, što je uticalo da pojedini statistički postupci budu izostavljeni (imajući u vidu da u ovom radu imaju manji teorijski značaj). U ovom tekstu, predstavicu izostavljena objašnjenja ili rezultate analize (testiranje značajnosti korelacije istraživanih indikatora). Takođe,

postoje i određene greške, koje će ovom prilikom biti ispravljene.

Primedba da korelaciona analiza ne ispituje učestalost i zavisnost veza već kvantitativno slaganje između pojava, se prihvata, ali ne i primedba za str. 201, u drugom pasusu. Ovde se govorilo o složenosti analize, a ne o tome koliko je ona pouzdana ili nepouzdana.

Korelaciona analiza je često upotrebljavan statistički metod pomoću kojeg se utvrđuje postojanje kvantitativnog slaganja, kao i jačina tog slaganja između promenljivih pojava. U slučaju postojanja linearne korelacije između dve pojave, reč je o prostoj linearnoj korelaciji. Pirsonov koeficijent proste linearne korelacije je najpoznatija mera kojom se izražava stepen linearnog kvantitativnog slaganja između dve pojave. Prilikom testiranja značajnosti ovog koeficijenta, pretpostavka je, da je zajednički raspored proučavanih varijabli normalan. U radu Korelaciona analiza indikatora regionalne konkurentnosti: Primer Republike Srbije, prikazan je izraz Spirmanovog koeficijenta korelacije, što predstavlja grešku, pa se ova primedba u potpunosti prihvata. Za izračunavanje Pirsonovog koeficijenta u uzorku koristi se sledeća formula, koja je u radu izostavljena:

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$$r = \frac{n \cdot \sum xy - \sum x \sum y}{\sqrt{n \sum x^2 - (\sum x)^2} \cdot \sqrt{n \sum y^2 - (\sum y)^2}}$$

Testiranje Pirsonovog koeficijenta linearne korelacije obavljeno je uz pomoć softvera IBM SPSS Statistics. Korišćena je verzija 20, koja je dostupna na internetu (http://ibm-spss-statistics.soft32.com/download/file/id/796185/?&no_download_manager=true). Ovu računsku operaciju obavlja sve verzije SPSS, pa se nije smatralo neophodnim spominjati koja se verzija koristila. Štaviše, za potrebu ove analize dovoljan je i program Microsoft Excel 2010, koji, takođe, može pružiti adekvatno testiranje Pirsonovog koeficijenta linearne korelacije.

Na kraju rada, u Dodatku, prikazane su i vrednosti koje su dobijene putem ankete. Anketa ne mora uključivati Likertovu skalu (šifriranje od 1 do 5, mada Likertova skala može uključivati i 7 modaliteta odgovora), već može ponuditi i drugačiji sistem odgovora. U ovom slučaju, anketa je nudila mogućnost vrednovanja indeksa, kao subjektivne (kvalitativne) ocene ispitanika. Dalji tok obrade podataka ne bih objašnjavao, jer je korišćen za svrhu druge analize, koja nije predmet ovog rada.

U nastavku teksta biće prikazano testiranje značajnosti korelacije istraživanih indikatora, koja pokazuje, da između najvećeg broja indikatora postoji statistički značajna korelacija.

Kaorelativnamerakvantitativnogslaganjaizmeđubrutodomaćeg proizvoda (BDP) regiona i broja privrednih društava, korišćen je Pirsonov koeficijent korelacije. Na osnovu dobijene vrednosti ovog koeficijenta ($r = 0.998$) zaključeno je, da u uzorku postoji izuzetno visok stepen direktne linearne korelacije. Pri testiraju značajnosti dobijene korelacione veze, dobijena p - vrednost manja je od 0.05, što ukazuje da na odabranom nivou značajnosti između navedenih varijabli postoji statistički značajna korelacija (Tabela 1).

Do sličnog zaključka, dolazi se i testiranjem značajnosti dobijenog kvantitativnog slaganja u uzorku između indikatora broj zaposlenosti u regionu i indikatora BDP regiona (Tabela 2). Analiza je pokazala, da postoji visoka korelacija između BDP-a i broja zaposlenih u nekom regionu.

Tabela 1 Korelaciona analiza između BDP-a regiona i broja privrednih društava u regionu

		Correlations	
		Bruto domaći proizvod regiona	Broj privrednih društava u regionu
Bruto domaći proizvod regiona	Pearson Correlation	1	,998**
	Sig. (2-tailed)		,002
	N	4	4
Broj privrednih društava u regionu	Pearson Correlation	,998**	1
	Sig. (2-tailed)	,002	
	N	4	4

** Correlation is significant at the 0.01 level (2-tailed)

Izvor: Autor

Tabela 2 Korelaciona analiza između BDP-a regiona i broja zaposlenih u regionu

		Correlations	
		Bruto domaći proizvod regiona	Broj zaposlenih u regionu
Bruto domaći proizvod regiona	Pearson Correlation	1	,981*
	Sig. (2-tailed)		,019
	N	4	4
Broj zaposlenih u regionu	Pearson Correlation	,981*	1
	Sig. (2-tailed)	,019	
	N	4	4

** Correlation is significant at the 0.05 level (2-tailed)

Izvor: Autor

Dalje ispitivanje u uzorku je pokazalo, da investicije u osnovna sredstva imaju srednje-pozitivnu korelaciju ($r = 0.726$). Rast investicija pozitivno je korelisan sa rastom BDP-a, ali ne u meri koju imaju privredna

društva i broj zaposlenih. Indikator koji se odnosi na broj preduzetnika u regionu slabo je korelisan sa indikatorom BDP-a ($r = 0.391$) što znači da postoji manje kvantitativno slaganje između ovih indikatora. Korelaciona analiza navedenih indikatora pokazala je logičke, očekivane rezultate.

Kada je u pitanju indikator zaposlenosti, testiranjem značajnosti iz uzorka, zaključak je da postoji statistički značajna pozitivna korelacija sa indikatorom budžetski rashodi u obrazovanje (Tabela 3). Ova veza govori, da postoji visoka statistička značajnost kvantitativnog slaganja između zaposlenosti (broj zaposlenih u regionu) i ulaganja države u obrazovanje (budžetski rashodi u obrazovanje).

S druge strane, postoji nešto manja pozitivna korelacija između investicija u obrazovanje i rasta zaposlenosti u uzorku, ali je testiranjem te korelacione veze potvrđeno da ona nije statistički značajna - $p > 0.05$ (Tabela 4).

Ispitivanjem kvantitativnog slaganja u uzorku između indikatora zaposlenosti sa indikatorima stanovništvo radnog uzrasta ($r = - 0.177$) i visoko obrazovano stanovništvo ($r = - 0.197$), pokazalo se da su koeficijenti negativni, veoma niskog stepena.

Tabela 3 Korelaciona analiza između BDP-a regiona i budžetskih rashoda u obrazovanje

Correlations			
		Broj zaposlenih u regionu	Budžetski rashodi u obrazovanje
Broj zaposlenih u regionu	Pearson Correlation	1	,988*
	Sig. (2-tailed)		,012
	N	4	4
Budžetski rashodi u obrazovanje	Pearson Correlation	,988*	1
	Sig. (2-tailed)	,012	
	N	4	4

** Correlation is significant at the 0.05 level (2-tailed)

Izvor: Autor

Tabela 4 Korelaciona analiza između investicija u obrazovanje i broja zaposlenih u regionu

Correlations			
		Investicije u obrazovanje	Broj zaposlenih u regionu
Investicije u obrazovanje	Pearson Correlation	1	,631
	Sig. (2-tailed)		,369
	N	4	4
Broj zaposlenih u regionu	Pearson Correlation	,631	1
	Sig. (2-tailed)	,369	
	N	4	4

Izvor: Autor

Tabele 5, 6 i 7 pokazuju da je sprovedena korelaciona analiza između indikatora poslovnog okruženja pokazala očekivane rezultate.

Tabela 5 Korelaciona analiza između raširenosti klastera i kvaliteta usluga države

Correlations			
		Raširenost klastera	Kvalitet usluge države
Raširenost klastera	Pearson Correlation	1	,994**
	Sig. (2-tailed)		,006
	N	4	4
Kvalitet usluga države	Pearson Correlation	,994**	1
	Sig. (2-tailed)	,006	
	N	4	4

** Correlation is significant at the 0.01 level (2-tailed)

Izvor: Autor

Naime, sa nivoom značajnosti od 0.01, dokazano je postojanje statistički značajnog kvantitativnog slaganja između raširenosti klastera i kvaliteta usluga države,

kao i između kvaliteta usluga države i atraktivnosti poslovnog ambijenta.

Tabela 6 Korelaciona analiza između kvaliteta usluga države i atraktivnosti poslovnog ambijenta

		Correlations	
		Kvalitet usluge države	Atraktivnost poslovnog ambijenta
Kvalitet usluge države	Pearson Correlation	1	,996**
	Sig. (2-tailed)		,004
	N	4	4
Atraktivnost poslovnog ambijenta	Pearson Correlation	,996**	1
	Sig. (2-tailed)	,004	
	N	4	4

** Correlation is significant at the 0.01 level (2-tailed)

Izvor: Autor

Do istog zaključka se dolazi i u slučaju analize korelacije između atraktivnosti poslovnog ambijenta i raširenosti klastera (Tabela 7)

Tabela 7 Korelaciona analiza između atraktivnosti poslovnog ambijenta i raširenosti klastera

		Correlations	
		Atraktivnost poslovnog ambijenta	Raširenost klastera
Atraktivnost poslovnog ambijenta	Pearson Correlation	1	1,000**
	Sig. (2-tailed)		,000
	N	4	4
Raširenost klastera	Pearson Correlation	1,000**	1
	Sig. (2-tailed)	,000	
	N	4	4

** Correlation is significant at the 0.01 level (2-tailed)

Izvor: Autor

Visoku vrednost koeficijenta u posmatranom uzorku pokazuju i vazdušni saobraćaj sa inostranstvom i nezavisnost sudstva, ali testiranjem se pokazalo da korelacija nije statistički značajna - $p > 0.05$. Gotovo svi indikatori inovacija su pokazali visoke pozitivne vrednosti Pirsonovog koeficijenta u uzorku (preko 0.9), osim indikatora broj prijavljenih patenata i objavljeni naučno-istraživački radovi koji imaju slabiju pozitivnu korelaciju. Visok stepen pozitivne korelacije između BDP regiona i raširenosti klastera potvrđen je kao statistički značajan (Tabela 8).

Tabela 8 Korelaciona analiza između BDP regiona i raširenosti klastera

		Correlations	
		Bruto domaći proizvod regiona	Raširenost klastera
Bruto domaći proizvod regiona	Pearson Correlation	1	,999**
	Sig. (2-tailed)		,001
	N	4	4
Raširenost klastera	Pearson Correlation	,999**	1
	Sig. (2-tailed)	,001	
	N	4	4

** Correlation is significant at the 0.05 level (2-tailed).

Izvor: Autor

Na kraju, testirana je značajnost dobijene korelacije između turizma i pojedinih indikatora infrastrukture. U tom smislu, nije dokazano postojanje statistički značajne korelacije između turizma i najvećeg broja pomenutih indikatora infrastrukture. Jedina statistički značajna korelacija, na osnovu podataka uzorka, pokazala se između indikatora investicije u vodosnabdevanje i upravljanje otpadnim vodama i količine opasnog otpada u regionu (Tabela 9).

Tabela 9 Korelaciona analiza između investicija u vodosnabdevanje i upravljanje otpadnim vodama i količine opasnog otpada u regionu

Correlations

		Investicije u vodosnabdevanje i upravljanje otpadnim vodama	Količina opasnog otpada u regionu
Investicije u vodosnabdevanje i upravljanje otpadnim vodama	Pearson Correlation	1	,975**
	Sig. (2-tailed)		,003
	N	4	4
Količina opasnog otpada u regionu	Pearson Correlation	,975**	1
	Sig. (2-tailed)	,003	
	N	4	4

** Correlation is significant at the 0.05 level (2-tailed)

Izvor: Autor

Na osnovu dobijenih rezultata testiranja značajnosti korelacije istraživanih indikatora, može se potvrditi validnost istraživanja u radu Korelaciona analiza indikatora regionalne konkurentnosti: Primer Republike Srbije, koji je publikovan u *Ekonomskim horizontima*, Volumen 15, Sveska 3, Godište 2013.

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