

Spatial Analysis of Russian University Excellence Centers and Calculation of Regional University Competitiveness

Vladimir Moskovkin
Department of World Economy
Belgorod State National Research University
 Belgorod, Russia
 moskovkin@bsu.edu.ru

Liu Yawei
Belgorod State National Research University
 Belgorod, Russia
 angellywei@bsu.edu.ru

Zhang He
Department of World Economy
Belgorod State National Research University
 Belgorod, Russia
 1098006@bsu.edu.ru

Elena Pupynina
Department of English Philology and Intercultural Communication
Belgorod State National Research University
 Belgorod, Russia
 pupynina@bsu.edu.ru

Abstract— Fifty one Russian universities that entered at least one of the rankings such as QS or THE in past three years were identified. These universities were grouped according to 23 regions of Russia. We counted the number of universities in each region and calculated their aggregate positioning in each of the rankings under study. Using the methodology of calculating the integral indicators of regional university competitiveness suggested in the previous works by the authors these indicators were calculated in three variants for each ranking. It led to identifying five leading regions or university excellence centers. They are Moscow, Saint Petersburg, Tomsk Oblast, Republic of Tatarstan, and Novosibirsk Oblast. Pairwise correlation was observed between all the values of six integral indicators. The suggested methodology can be used for spatial analysis of university competitiveness in regions of any country and in any set of countries.

Keywords— *spatial analysis, world university rankings, Russian universities, regional university competitiveness, integral indicator, THE, QS.*

I. INTRODUCTION

Since Project 5-100 was launched there has been interest for monitoring the position of the leading Russian Universities in three global rankings such as QS, THE, and ARWU. Our queries on the terms “проект 5-100” and “project 5-100”, which were coined not long ago, in the exact phrase line on Google Scholar Advanced Search page brought 500 and 100 articles, respectively. It should be noted that the actual number of results returned for these search queries was five- and six-digit figures, respectively. They required detailed analysis that led to the narrower number of articles.

In this large number of works we identify those ones that are most important for our research. They are critical, analytical and constructive articles. We review them in chronological order.

The earliest work is the article by Ye. V. Harchenko, Ye. V. Spitsyn and L. A. Voytash published in 2013. The authors put the following research question: Why are there so few leading Russian universities in global university rankings? Analyzing different methodological approaches to ranking universities the authors come to the conclusion that it is possible that methods of assessing performance, ranking and collecting data are not adjusted to the Russian context. The authors classify the rankings by types, structure and information sources and conclude that the ranking may change dependent on what specific aspect for assessment is chosen. It raises an important issue of assessment sensitiveness to the change in weight coefficients of ranking indicators. In view of this, the authors describe an interesting experiment conducted by V. Kitashv. The shift of initial figures for academic reputation, employer reputation, faculty/student ratio, citations per faculty (40%, 10%, 20%, 20%) to other specially chosen coefficients (5%, 35%, 45%, 5%) gives Russian universities much better result. Thus, Lomonosov Moscow State University would have 44th position (instead of 116th), Bauman Moscow State Technical University would have 108th position (instead of 352nd) [2].

In this respect the authors of article [1] write that “the aim of entering the ranking may be achieved without any additional organization or financial costs but by changing the point of view on what a leading university is.” It means that rankings are quite subjective because it is difficult to define

which indicators are more important for assessment. The authors also come to the conclusion that to have better positions in the world rankings universities should have special purpose programs for improving pertinent business processes [1].

Among works for 2014 we identify four articles that are most important for the whole period under examination (2013 – 2018) from our perspective. In our opinion, the best work is the article by S. S. Donetskaya from Novosibirsk State University published in the first issue of the journal “*Vyshee obrazovaniye v Rossii*” (=The Higher Education in Russia) [3]. It presents the table showing positions of 11 leading Russian universities in ARWU, THE and QS in 2012 and 2013. It also has the table demonstrating positions of 10 out of these 11 universities in QS in 2007 and 2013 with scores for 6 QS rankings indicators. In the same table the author shows mean values of each indicator for TOP-100 universities in QS rankings, for the universities holding positions from 101 to 200 and from 201 to 300. The table demonstrates that our leading universities, except Lomonosov Moscow State University and St Petersburg University, have much lower positions in comparison with mean values of the universities taking positions from 201 to 300. They are not so much behind these universities in international student indicator. We are the world leaders only in faculty/student ratio.

The situation described makes it difficult for the leading Russian universities to enter ARWU TOP-100 by 2020. The exception is Lomonosov Moscow State University, which has hold its position in TOP-100 since 2004.

It is important to take notice of several other essential conclusions made in work [3].

1. For seven years (between 2007 and 2013) the leading Russian universities did not improve their positions in the world rankings while many foreign universities managed to do it. The examples of universities that jumped to much better positions in QS rankings are Sungkyunkwan University (South Korea), Al-Farabi Kazakh National University, Eurasian National University.

2. To enter THE Top-100 it is necessary to raise citation rate to 7-8 citations per article. It is this citation rate that the faculty of Delft University of Technology had. This university had 77th position in THE rankings in 2012 and had minimum citation rate per article among TOP-100 universities. At the same time all the 15 Russian universities that received subsidies, except National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), have much lower figures in this indicator ranging from 1.1 (Tomsk State University) to 3.7 (Novosibirsk State University).

3. For the period from 2008 to 2012 each of fifteen Russian universities published no more than 3000 papers while Delft University of Technology published four times as many papers. Harvard University, the leader of publication activities, published more than 39100 papers.

4. Conclusions 2 and 3 show that the main problem of the Russian universities is low publication activities and citation rates. The solution to the problem might be new lines of fundamental and applied research in the leading Russian universities. It is also important to enhance cooperation with institutions of the Russian Academy of Sciences. Only three

universities, the Moscow Institute of Physics and Technology, Novosibirsk State University, Lobachevsky State University of Nizhni Novgorod, have such close cooperation with RAN.

5. Russian universities should do away with narrow-mindedness in research and development and with research done according to the requirements of the State Commission for Academic Degrees and Titles to gain promotion, as paper [4] states. That is why it is important to foster collaboration with foreign universities and to answer research questions that are interesting for the world research community.

6. Universities should develop programs to encourage publication activities in different forms ranging from reimbursement of publication expenses to various bonuses, differentiation in allocating teaching workload depending on research activities.

7. The main condition for enhancing research activities is their proper financing. According to paper [5], financing of research in Russia is from three to four times lower than in developed countries. It is important to continue financing research after 2020.

8. Out of 15 universities that received subsidies three universities, MEPhI, the Moscow Institute of Physics and Technology, Novosibirsk State University, have competitive advantages in a few world rankings indicators (in no more than two out of 5-6 indicators).

Another paper of 2014 that has analytical character is the article by D. G. Rodionov et al published in “*Vestnik Leningradskogo Gosudarstvennogo Universiteta imeni A. S. Pushkina*” (=Bulletin of Pushkin Leningradsky State University) [6].

In this work, similarly to paper [3] the authors study QS rankings positions of the Russian universities together with scores. At the beginning of the article the authors focus on indicators from 2011 to 2013 for six leading Russian universities (Lomonosov Moscow State University, St Petersburg University, Bauman Moscow State Technical University, Novosibirsk State University, Moscow State Institute of International Relations, RUDN University). The position of Lomonosov Moscow State University lowered from 112 to 120. However, the total score, paradoxically, rose from 61.3 in 2011 to 63.9 in 2013. University Alberta (Canada) held 100th position in the rankings with total score 64.0. In 2012 this position was occupied by University of California.

It shows how intense the competitive pressure is in the competition produced by rankings. The authors of paper [6] define threshold score in QS rankings to enter TOP-100, TOP-200, TOP-400. They also calculate threshold score growth rate for the period of two years. The growth rate ranges from 6 % for QS TOP-100 to 13 % for QS TOP-400. It should be noted that for the universities holding positions from 101 to 200 this approach is more logical than calculating mean value of the score for QS TOP-100 as it is done in paper [3].

Article [6] also states that the threshold score to enter QS TOP-100 may amount to 70 or more if two-year growth rate of 6 % remains unchanged up to 2020. 23 universities could gain the score of more than 90 in 2013. 93 universities could reach more than 90.

Analysing the scores of the Russian universities the authors of paper [6] conclude that only Lomonosov Moscow State University managed to get closer to TOP-100, St Petersburg University received only 45.9. The authors also used linear extrapolation of position dynamics in QS rankings up to 2020 for the universities under study except Lomonosov Moscow State University and showed that the universities had chances to enter the tail of TOP-200. It implies that to solve the task of entering QS TOP-100 leading Russian universities should accelerate growth rate of their positions in the rankings.

The authors justly note that the reason for a big jump in the rankings made by China (it gained the second position after the USA in publication activities) is incentive policies implemented by university administration concerning articles in journals indexed by Scopus and Web of Science. Another factor is that in China Elsevier publishes more than 50 journals in English. The authors believe that there is a need for such measures in Russia [6].

Another article that attracted our attention is paper by M. I. Meleshkin [7]. The author analyses in detail citation rate of papers written by faculty of Lomonosov Moscow State University, St Petersburg University, Novosibirsk State University and MEPhI on the basis of InCites. He also analyses citations of researchers from eight countries on the basis of SCImago Journal and Country Rank in the context of progress in QS rankings. The author analyzes the first 15 global universities as well as Lomonosov Moscow State University and St Petersburg University and concludes that Lomonosov Moscow State University, St Petersburg University, Novosibirsk State University and MEPhI have the highest chances to enter THE TOP-100 by 2020.

The author comes to the important, though well-known, conclusion that progress in the world university rankings mostly depends on foreign authorship collaboration and citation growth. It is important to stress that foreign authorship collaboration leads to citation growth. The author also describes risks coming from the change in methodology of global rankings [7].

Out of papers for 2014 we mark out A. L. Arefev's work [8]. The important conclusions from it are the following:

1. The British and American universities domination in the world university rankings makes it difficult for the Russian universities to drive them out of their dominant positions.

2. Since academic institutions produce most of important research results, integration of resources of higher education institutions and the Russian Academy of Sciences is an effective way of improving global competitiveness of the Russian universities.

Indeed, global university rankings and publish-or-perish culture with its scientometric indicators in Web of Science and Scopus appeared in the West. If we add language and financial advantages of the British and American universities, we see the futility of trying to compete with them, it is a waste of money. Number one concern should not be rankings with number of articles and citations but high quality fundamental and applied research.

As far as the second conclusion in paper [8] is concerned, at the beginning of January 2019 the Russian Federation

government resolved that the Russian Academy of Sciences should be responsible for research at universities.

This statement is in accord with the comment in the paper by E. S. Vorobeva and I. V. Krakovetskaya [9]: "The straightforward competition with the world university rankings leaders is unproductive. There are country specific areas of expertise. It is impractical for the leaders in specific fields to aim at general university rankings."

A. I. Balashov and V. M. Husainova [10] also criticize the leading Russian universities that chase global university rankings aiming at performative results at the expense of qualitative development of higher education: "...in spite of the fact that universities choose the right lines of growth and make some progress, interim results of implementing Project 5-100 do not show qualitative improvements in the system of higher education in Russia, they show effectiveness of some university management models aimed at indicators reporting." With reference to this criticism L. D. Taradina [11] expresses doubt about the idea of competitiveness in the mission of nowadays universities. The author thinks that rankings chase sets strict limits that prevent universities from setting priorities on their own and restrict opportunities for their academic development. N. M. Kozhevnikov [12] points out that participation of the leading Russian universities in global QS, THE and ARWU rankings may result in the loss of administration autonomy in the research and academic system. P. S. Avetisyan and G. Je. Galikyan [13] underline that reforms in Eurasian universities aimed at raising their positions in global rankings systems do not always promote the efficiency of their work.

The closer the date of completing Project 5-100 was the more skeptical experts became about the possibility for five leading Russian universities to enter TOP-100 of three global university rankings. For instance, pointing to considerably large amount of financing of the project (P86.5 bln or \$1.67 bln) G. A. Kliucharev and A. V. Neverov [14] refer to expert polls according to which most of experts doubt that the main goal of the project may be achieved. Now the end of 2020 shows that the goal of the project has not been attained although its implementation has boosted competitiveness of the leading Russian universities.

Unfortunately, in the clusters of publications that the search engine returned there was only one paper [15] presenting comprehensive research and no other similar papers, which would describe positioning of all the leading Russian Universities in the three rankings mentioned above dynamically for a long period of time. In paper [15] such dynamics is shown and analyzed for the period from 2012 to 2017 concerning 52 Russian Universities that entered QS, THE or ARWU at least once during this period.

Knowing distribution of the leading Russian Universities in the rankings in recent years it is possible to group them out according to regions, aggregate their ranks (positions in the rankings) and arrive at the concept of regional university competitiveness at the global level as we investigate capital and regional universities in the global rankings. This methodology was proposed in paper [16] to explore Universities in the Central Federal District of the Russian Federation as they were ranked in Webometrics Ranking, by Expert RA and by Interfax. The same methodology is employed in this paper to study Russian Universities that enter three leading world university rankings.

We take into account universities found in at least one of three rankings such as QS, THE or ARWU. We call regions where such universities are located university excellence centers. The degree of excellence is measured by calculating aggregate positioning of universities in these rankings for the whole period under study with account of the number of universities in the region. These excellence centers are naturally prospective innovation-driven growth poles of the regions they are located in. They can become real growth poles if it is possible for regions to create real innovation clusters on the basis of universities that enter the world rankings and to provide their cooperation with regional universities, local industry and regional authorities.

II. METHODOLOGY

To conduct spatial analysis, we detect university excellence centers using QS and THE rankings as only four Russian universities enter ARWU [15]. The study of the leading Russian universities that entered the two rankings for past three years resulted in identifying 20 university excellence centers or Russian regions (Table 1). Competitiveness of universities in these centers or regions is measured with vector quantity (n_i, R_i) , where n_i is the number of universities in i region, R_i is averaged rank of the universities that are located in i region [16].

TABLE I Distribution of the leading Russian universities by QS and THE rankings over the past three years

№	Region	City	University	QS			THE				
				2018 (2018-2019)	2019 (2019-2020)	2020 (2020-2021)	2018 (2018-2019)	2019 (2019-2020)	2020 (2020-2021)		
1	Moscow	Moscow	Higher School of Economics	343	322	298	801-350	251-300	251-300		
		Moscow	Moscow Institute of Physics and Technology	312	302	281	251-300	201-250	201-250		
		Moscow	I.M. Sechenov First Moscow State Medical University (Sechenov University)				1001+	1001+	1001+		
		Moscow	The Peoples' Friendship University of Russia	446	392	326	601-800	800-1000	800-1000		
		Moscow	The National University of Science and Technology "MISIS"	476	451	428		601-800	601-800		
		Moscow	National Research Nuclear University MEPHI	329	329	314	651-400	401-500	401-500		
		Moscow	Pirogov Russian National Research Medical University				1001+	1001+	1001+		
		Moscow	Moscow Aviation Institute				1001+	1001+	1001+		
		Moscow	National Research University of Electronic Technology				1001+	1001+	1001+		
		Moscow	National University of Oil and Gas «Gubkin University»				1001+	1001+	1001+		
		Moscow	Moscow Power Engineering Institute				1001+	1001+	1001+		
		Moscow	Bauman Moscow State Technical University	299	284	282	801-1000	801-1000	401-500		
		Moscow	Moscow State Institute of International Relations	355	366	348					
		Moscow	Plekhanov Russian University of Economics	801-1000	751-800	751-800					
		Moscow	Lomonosov Moscow State University	90	84	74	199	189	174		
		Moscow	MIREA - Russian Technological University				1001+	1001+	1001+		
		Moscow	Russian Presidential Academy of National Economy and Public Administration				801-1000				
		2	St. Petersburg	St. Petersburg	ITMO University	511-520	436	360	501-600	401-500	501-600
				St. Petersburg	Saint Petersburg Electrotechnical University "LETI"				701-750	1001+	1001+
				St. Petersburg	Peter the Great St. Petersburg Polytechnic University	404	439	401	501-800	501-600	501-350
St. Petersburg	Saint - Petersburg Mining University							801-1000	401-500		
St. Petersburg	St. Petersburg University			235	234	225	501-600	501-800	501-800		
3	Tomsk Oblast	Tomsk	Tomsk Polytechnic University	373	387	401	501-600	501-800	801-1000		
		Tomsk	Tomsk State University	277	268	250	501-600	501-600	501-600		
		Tomsk	Tomsk State University of Control Systems and Radioelectronics						1001+		
4	Republic of Tatarstan	Kazan	Kazan Federal University	439	392	370	601-800	601-800	601-800		
		Kazan	Kazan National Research Technical University named after A. N. Tupolev – KAI						1001+		
		Kazan	Kazan National Research Technological University				1001+	1001+	1001+		
5	Novosibirsk Oblast	Novosibirsk	Novosibirsk State University	244	231	228	501-600	501-600	501-800		
		Novosibirsk	Novosibirsk State Technical University	801-1000	801-1000	801-1000	801-1000	1001+	1001+		
6	Perm Krai	Perm	Perm State University				801-1000	1001+	1001+		
		Perm	Perm National Research Polytechnic University				1001	1001+	1001+		
7	Samara Oblast	Samara	Samara University	701-750	651-700	591-600	801-1000	1001+	1001+		
		Samara	Samara State Technical University						1001+		
8	Republic Bashkortostan	Ufa	Bashkir State University					1001+	1001+		
		Ufa	Ufa State Aviation Technical University (USATU)					1001+	1001+		
9	Altai Krai	Barnaul	Altai State University	601-650		571-580					
10	Belgorod Oblast	Belgorod	Belgorod State University				801-100	1001+			
11	Volgograd Oblast	Volgograd	Volgograd State Technical University				1001+	1001+			
12	Voronezh	Voronezh	Voronezh State University	801-1000	801-1000		1001+	1001+			
13	Sverdlovsk Oblast	Ekaterinburg	Ural Federal University named after the first President of Russia B. N. Yeltsin	412	364	331	1001+	1001+			
14	Irkutsk Oblast	Irkutsk	Irkutsk State University					1001+			
15	Kaliningrad oblast	Kaliningrad	Immanuel Kant Baltic Federal University					1001+			
16	Krasnoyarsk Krai	Krasnoyarsk	Siberian Federal University	801-1000			1001+	1001+			
17	Nizhny Novgorod Oblast	Nizhny Novgorod	Lobachevsky State University of Nizhny Novgorod	601-650	601-650	601-650	1001+	1001+			
18	Rostov Oblast	Rostov-on-Don	Southern Federal University	531-540	541-550	591-600	1001+	1001+			
19	Saratov Oblast	Saratov	Saratov State University	501-510	521-530	521-530	1001+	1001+			
20	Chelyabinsk Oblast	Chelyabinsk	South Ural State University	801-1000	801-1000	801-1000		1001+			
21	Republic Saha	Yakutsk	M. K. Ammosov North-Eastern Federal University					1001+			
22	Primorsky Krai	Vladivostok	Far Eastern Federal University	541-550	531-540	493	1001+	1001+			
23	Omsk Oblast	Omsk	Omsk State Technical University					1001+			

Since there is little correlation between QS and THE in the whole subset of the selected universities, which is shown by Table 1, R_i is calculated for each ranking separately as an arithmetic mean value of all the universities in i region. For interval estimates the midpoint of an interval is determined. For 1001+ ranks in THE ranking 1001 is taken for simplification. For instance, calculation of R_2 (Saint Petersburg) in QS requires summing all the ranks of the universities located in Saint Petersburg and dividing the resulting sum by the number of such universities: $R_2 = (515 + 436 + 360 + 725 + 404 + 439 + 401 + 235 + 234 + 225)/10 = 397.4$.

Paper [16] suggested three variants of calculating the integral indicator of regional university competitiveness on the basis of vector quantity (n_i, R_i) . Two variants present

multiplicative calculation, the third variant presents additive calculation. Three respective formulae for calculating this indicator are given below:

$$I_{1i} = \left(\frac{n_i}{n_{max}}\right) \left(1 - \frac{R_i}{R_{max}}\right), \quad (1)$$

$$I_{2i} = \sqrt{\left(\frac{n_i}{n_{max}}\right) \left(1 - \frac{R_i}{R_{max}}\right)}, \quad (2)$$

$$I_{3i} = \frac{n_i}{n_{max}} + \left(1 - \frac{R_i}{R_{max}}\right). \quad (3)$$

III. RESULTS AND DISCUSSION

Table 2 shows figures resulting from calculations based on QS and THE data that Table 1 contains according to formulae (1) – (3). Naturally, calculations were not performed for regions that have universities with no ranks. For QS and THE $n_{max} = 17$, for QS $R_{max} = 900$, for THE $R_{max} = 1001$.

TABLE II Calculations of integral indicators of regional university competitiveness according to formulae (1) – (3) using Table 1 data

№	Region	Number of universities (n)	Aggregate Ranking $R_i(QS)$	Aggregate Ranking R_i			Aggregate Ranking $R_i(THE)$	Aggregate Ranking R_i		
				$I_{ii}(QS)$	$I_{is}(QS)$	$I_{is}(QS)$		$I_{ii}(THE)$	$I_{is}(THE)$	$I_{is}(THE)$
1	Moscow	17	422.70	0.5303	0.7282	1.5303	728.30	0.2724	0.5219	1.2724
2	St. Petersburg	5	397.40	0.1624	0.4053	0.8526	673.43	0.0962	0.3102	0.6214
3	Tomsk Oblast	3	326.00	0.1125	0.3355	0.8142	685.86	0.0556	0.2357	0.4913
4	Republic of Tatarstan	3	400.33	0.0980	0.3130	0.7317	872.00	0.0227	0.1508	0.3053
5	Novosibirsk Oblast	2	567.17	0.0435	0.2086	0.4875	783.67	0.0255	0.1598	0.3348
6	Perm Krai	2	900.00	0.0000	0.0000	0.1176	1001.00	0.0000	0.0000	0.1176
7	Samara Oblast	2	665.00	0.0307	0.1753	0.3788	975.75	0.0030	0.0545	0.1429
8	Republic Bashkortostan	2					1001.00	0.0000	0.0000	0.1176
9	Altai Krai	1	600.00	0.0196	0.1400	0.3922				
10	Belgorod Oblast	1					967.33	0.0020	0.0445	0.0925
11	Volgograd Oblast	1					967.33	0.0020	0.0445	0.0925
12	Voronezh Oblast	1	900.00	0.0000	0.0000	0.0588	1001.00	0.0000	0.0000	0.0588
13	Sverdlovsk Oblast	1	369.00	0.0347	0.1863	0.6488	1001.00	0.0000	0.0000	0.0588
14	Irkutsk Oblast	1					1001.00	0.0000	0.0000	0.0588
15	Kaliningrad Oblast	1					1001.00	0.0000	0.0000	0.0588
16	Krasnoyarsk Krai	1	900.00	0.0000	0.0000	0.0588	1001.00	0.0000	0.0000	0.0588
17	Nizhny Novgorod Oblast	1	625.00	0.0180	0.1341	0.3644	1001.00	0.0000	0.0000	0.0588
18	Rostov Oblast	1	558.33	0.0223	0.1494	0.4385	1001.00	0.0000	0.0000	0.0588
19	Saratov Oblast	1	518.33	0.0249	0.1579	0.4829	1001.00	0.0000	0.0000	0.0588
20	Chelyabinsk Oblast	1	900.00	0.0000	0.0000	0.0588	1001.00	0.0000	0.0000	0.0588
21	Republic Saha	1					1001.00	0.0000	0.0000	0.0588
22	Primorsky Krai	1	524.33	0.0246	0.1567	0.4762	1001.00	0.0000	0.0000	0.0588
23	Omsk Oblast	1					1001.00	0.0000	0.0000	0.0588

Table 2 demonstrates that according to all six integral indicators of regional university competitiveness the leaders are the first five regions (Moscow, Saint Petersburg, Tomsk Oblast, Republic of Tatarstan, Novosibirsk Oblast). The value of these indicators for Moscow is higher than the same ones for Saint Petersburg. The difference is within the interval from 1.68 to 3.23. The mean value is 2.23.

Table 3 shows cross-correlation matrix for six integral indicators of regional university competitiveness calculated on the bases of Table 2 data. High values of Pearson correlation coefficient in this matrix imply that any of the formulae (1) – (3) can be used for calculations.

TABLE III Cross-correlation matrix for integral indicators of regional university competitiveness

TABLE IV	$I(L_i)(QS)$	$I(2i)(QS)$	$I(3i)(QS)$	$I(L_i)(THE)$	$I(2i)(THE)$	$I_s(THE)$
$I(L_i)(QS)$	1					
$I(2i)(QS)$	0.92590 727	1				
$I(3i)(QS)$	0.89316 8618	0.98634320 3	1			
$I(L_i)(THE)$	0.99084 8868	0.89963396	0.85603422 4	1		
$I(2i)(THE)$	0.92585 4928	0.93376250 7	0.88060062	0.93964781	1	
$I(3i)(THE)$	0.96549 901	0.92674108 5	0.87747228 1	0.97774412 4	0.98817815 9	1

IV. CONCLUSIONS

The paper identifies Russian universities that entered at least one of the rankings such as QS and THE for past three years. There are 51 universities. These universities were grouped according to 23 Russian regions. We counted the number of universities in each region and calculated their aggregate positioning in each of the rankings under study.

Using the methodology of calculating the integral indicator of regional university competitiveness suggested in paper [16] these indicators were calculated in three variants for each ranking. It led to identifying five leading regions or university excellence centers. They are Moscow, Saint Petersburg, Tomsk Oblast, Republic of Tatarstan, and Novosibirsk Oblast.

Pairwise correlation is observed between all the values of six integral indicators. The suggested methodology can be used for spatial analysis of university competitiveness in regions of any country and in any set of countries.

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