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Comparative Analysis of the Publication Activity Level of the Leading Russian Universities Conducted in Reliance on Web of Science and Scopus databases

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Abstract

The article presents comparative analysis of publication activity level of 31 federal and national research universities of Russia based on Web of Science and Scopus databases for the period from 2006 to 2011.
This analysis provided the opportunity to identify three groups of universities according to publication activity increase intervals at the period concerned; to find out annual correlation ratios between the publication activity data of the Russian leading universities received from Web of Science and Scopus databases; to carry out clustering of the Russian leading universities on the basis of the distribution of their publication activity for the year 2011 according to two databases under research; to construct the cross-correlation matrix for the Russian leading universities with the most congruent dynamics of Scopus-publications for the period from 2006 to 2012.

Keywords: comparative analysis, publication activity, Web of Science, Scopus, clustering, Russian university, cross-correlation matrix.

1. Introduction

There has been an upsurge in attention of the Russian government to bibliometric statistics in recent years as the higher school reform aimed at the increase of its global competitiveness required the establishment of elite federal and national research universities and global competitiveness of the latter depends directly on the publishing activity level of their researchers which is monitored in Web of Science and Scopus databases. On 7 May, 2012 the President of Russia Vladimir Putin signed the Decree "On measures for implementation of the state policy in the field of education and science" which, in particular, touches upon the increase of

competitiveness of the Russian higher education institutions and how to make five Russian universities be in the first TOP-100 of the leading world universities according to the World University Rankings by 2020. In pursuance of this Decree the Federal Contest "Global University" has been carried out since 2014 in order to support the Russian leading universities on their way to the TOP-100 of the greatest World University Rankings. As bibliometric indices are the most important indicators of such Rankings, it is necessary to monitor the publication activity level and citation ratio of researchers of the Russian leading universities on an ongoing basis.

Markusova's et al, (2013), Rodionov,'s et al, (2014a, 2014b, 2014c), S.S. Donetskaya's (2014) et al, A. Smolentseva, 2015) works are devoted to the issue of the positioning of the Russian leading universities in the World Rankings, and the first work deals with the influence of bibliometric indicators on the Russian University Rankings.

A number of works is devoted to the development of mechanisms for stimulation of universities' publication activity level and assessment of their impact on such activity with the Russian universities taken as an example (Moskovkin, Konstantinov, Peresypkin, 2013; Moskovkin, Peresypkin, Verzunova, 2013; Moskovkin, Peresypkin, Pupynina,2013; Moskovkin, Peresypkin, Verzunova, Serkina, 2014).

2. Methods

In this research we will study the dynamics of the publication activity level of the Russian leading universities for the period from 2006 to 2011 (in one case to 2012) according to Web of Science and Scopus databases. For this purpose there have been chosen 31 federal and national research universities which had a significant number of annual publications in the databases under research. Initial data according to Web of Science database for the period from 2006 to 2011 was published in V.A. Markusova's et al (2013) work, and the data for 2011 was shown by V.A. Markusova as well. We collected the initial data according to Scopus database at the end of 2013 – in the beginning of 2014.

When conducting the comparative analysis of the publication activity level of the Russian leading universities according to the databases under research, we used methods of correlation and cluster analysis as well as classification method. When constructing cross-correlation matrix for universities with the most congruent dynamics of Scopus-publications, we added data for the year 2012.

3. Results and Discussion

Publication dynamics of the federal and national research universities included in Web of Science and Scopus databases for the period from 2006 to 2011 can be seen in Table 1. This Table also includes the calculation of increase (decrease) of these publications for the period concerned. In this Table all universities are ranged in descending order of quantity of publications included in Web of Science database in 2011. If we distribute these universities according to the certain intervals of such increase, we will have Table 2. There are 5 universities which show that quantity of

publications according to at least 1 database increased more than 4 times: The Higher School of Economics, Siberian Federal University, Moscow State University of Civil Engineering, Perm State Technical University. All universities, except the first one, are given at the bottom of Table 1.

Next, Table 2 shows that there are 12 universities with increase rate of 2 to 4 times: Saint Petersburg Mineral Resources University, Novosibirsk State University, Tomsk Polytechnic University, Far Eastern Federal University, Moscow Institute of Physics and Technology, South Ural State University, Tomsk State University, Saint Petersburg State University of Information Technologies, Mechanics and Optics. Irkutsk State University, N. Bauman Moscow State Technical University, Moscow Institute for Steel and Alloys and B.N. Yeltsin Ural Federal University. This group includes universities from all parts of Table 1 (leaders, average performers and outsiders). All the other universities with publication activity growth rate lower than 2 fall into the third group. These are the remaining 14 universities which we will not specify here. It should be also noted that this group includes the universities from all parts of Table 1.

On the basis of Table 1 we can calculate annual increase (decrease) of publications for the last four years and show them in Table 3. This Table shows that there are universities with the increase of the number of publications by more than 100% for the last year according to one of the databases. They include Tomsk Polytechnic University, Far Eastern Federal University, Samara State Aerospace University, Perm State Technical University and Moscow State University of Civil Engineering. Apparently these universities have been applying the effective schemes of stimulation of the publication activity level in recent years. It also refers to the other universities which have significant publication increase as compared to the previous years. E.g. The Higher School of Economics and V.N. Yeltsin Ural Federal University in which the stimulating schemes for English language publications included in the Web of Science and Scopus databases have been applied since 2010 (V.M. Moskovkin et al 2014).

We would like to draw attention to the mismatch between the growth of the quantity of publications in the both databases for a number of universities (there is growth in one database and decrease in the other). It is probably connected with the specific nature of the subject areas of research of these universities and, hence, with a small part of overlap between publications in these databases. These are the following universities: N.I. Pirogov Russian State Medical University, Saint Petersburg State University of Information Technologies, Mechanics and Optics, Perm State University, Belgorod State University. In general, correlation ratios between publication activity level data according to Web of Science and Scopus databases obtained from all universities for different years turned out to be very high (Table 4).

A little worse correlation in 2011 is connected, in our opinion, with the fact that not all data for the year 2011 had been added to profiles of universities at the time of data capturing. The diagrams below (Fig. 1 and 2) show the distribution of publication activity level of universities for the year 2011 according to Web of Science (Fig. 1) and Scopus (Fig. 2) databases. They provide the opportunity to select clusters of

universities according to sharp inflexions in distribution curves (one of the simplest methods of data clustering).

In the first case (Fig. 1) there is the apparent leader (Novosibirsk State University) with very high publication activity level. It is followed by a cluster which contains nine leading universities (No.No.2-10). Then there is a small cluster of five universities with the average publication activity level (No.No.11-15). The distribution under consideration is closed by a cluster which contains sixteen underperforming universities with low publishing activity level (No.No.16-31).

In the second case (Fig. 2) we have more complicated distribution in which we can select 6 clusters: cluster 1 – No.No.1.2; cluster 2 – No.No.3- 7; cluster 3 – No.No.8-11; cluster 4 – No.No.12-15; cluster 5 – No.No.16- 26; cluster 6 – No.No.27- 31. If we define clusters on the basis of publication activity level of universities, the first two clusters will have very high publication activity and high publication activity, the publication activity level in the next two clusters will be higher and below the average, the last two clusters will have low level and very low publication activity level.

Table 1. Publication dynamics of the Russian federal and national research universities included in Web of Science and Scopus databases

№№	University	2006		2007		2008		2009		2010		2011		Growth, number of times	
		WoS	Sc	WoS	Sc	WoS	Sc	WoS	Sc	WoS	Sc	WoS	Sc	WoS	Sc
1	Novosibirsk State University	198	254	263	313	333	420	457	544	486	627	622	812	3.1	3.2
2	B.N.Yeltsin Ural Federal University	223	307	233	342	274	358	256	340	292	430	342	606	1.5	2.0
3	Moscow Institute of Physics and Technology	120	200	125	213	159	209	227	277	298	353	334	421	2.8	2.1
4	Moscow Physics Engineering Institute	168	268	195	293	215	267	232	275	284	340	304	489	1.8	1.8
5	Southern Federal University	251	322	211	289	258	304	312	361	254	321	296	328	1.2	1.0
6	N.I. Pirogov Russian State Medical University	161	85	160	74	186	69	170	62	196	86	296	72	1.8	0.8
7	Kazan Federal University	233	326	230	285	262	309	259	317	247	334	285	446	1.2	1.4
8	Tomsk State University	122	268	118	217	193	279	191	262	183	286	273	340	2.2	1.3
9	Saint	174	392	163	390	221	338	199	331	204	331	235	405	1.4	1.0

	Petersburg State Polytechnical University														
10	N.I. Lobachevsky Nizhniy Novgorod State University	187	251	169	251	228	269	202	244	214	274	232	308	1.2	1.2
11	Tomsk Polytechnic University	75	121	99	155	165	225	150	167	151	188	192	466	2.6	3.9
12	N.G. Chernyshevsky Saratov State Universit	180	309	158	275	188	298	171	229	162	244	189	252	1.1	0.8
13	Moscow Institute for Steel and Alloys	112	152	112	159	137	186	141	216	124	201	181	342	1.6	2.3
14	Siberian Federal University	54	0	67	36	150	140	168	190	160	213	175	243	3.2	6.75
15	Saint Petersburg State University of Information Technologies. Mechanics and Optics	66	93	102	151	116	127	95	106	119	149	142	64	2.2	0.7
16	N. Bauman Moscow State Technical University	58	101	86	140	93	151	94	175	105	220	105	244	1.8	2.4
17	Far Eastern Federal University	37	66	47	73	51	71	62	79	69	113	88	254	2.4	3.8
18	Kazan National Research Technological University	70	117	74	158	77	144	83	148	100	173	86	93	1.2	0.8
19	Moscow Power Engineering Institute	70	96	71	107	93	110	98	135	80	141	75	106	1.1	1.1
20	Perm State University	55	84	56	73	59	68	80	96	67	88	71	72	1.3	0.9
21	The Higher School of Economics	6	12	11	22	17	32	23	49	34	88	61	163	10.2	13.6
22	Belgorod State	33	42	34	46	52	80	57	64	53	91	50	116	1.5	2.8

	University														
23	South Ural State University	17	37	27	54	23	61	33	50	44	78	45	98	2.6	2.6
24	Samara State Aerospace University	9	27	7	54	16	33	21	53	13	53	44	74	4.9	2.7
25	Moscow State Aviation Institute	27	79	25	97	26	77	22	63	34	105	33	83	1.2	1.1
26	Perm State Technical University	9	15	7	19	16	21	21	25	13	46	32	69	3.6	4.6
27	Moscow University of Electronic Technology	35	21	33	30	38	31	57	33	41	40	30	31	0.9	1.5
28	Saint Petersburg Mineral Resources University	7	7	3	7	12	7	14	9	16	15	24	16	3.4	2.3
29	Mordovia State University	26	28	33	43	32	26	19	21	21	21	23	29	0.9	1.0
30	Irkutsk State University	10	10	15	18	18	11	11	14	14	22	15	28	1.5	2.8
31	Moscow State University of Civil Engineering	4	1	2	5	3	4	5	1	4	4	9	8	2.3	8.0

Table 2. Distribution of federal and national research universities according to publication increase interval from 2006 to 2011

WoS	Scopus	Increase
The Higher School of Economics	Siberian Federal University The Higher School of Economics Moscow State University of Civil Engineering	More than 5 times
Samara State Aerospace University	Perm State Technical University	4-5
Perm State Technical University Saint Petersburg Mineral Resources University Siberian Federal University Novosibirsk State University	Tomsk Polytechnic University Far Eastern Federal University Novosibirsk State University	3-4
Moscow Institute of Physics and Technology	Irkutsk State University Belgorod State University	2-3

South Ural State University Tomsk Polytechnic University Far Eastern Federal University Moscow State University of Civil Engineering Tomsk State University Saint Petersburg State University of Information Technologies. Mechanics and Optics	Samara State Aerospace University South Ural State University N. Bauman Moscow State Technical University Saint Petersburg Mineral Resources University Moscow Institute for Steel and Alloys Moscow Institute of Physics and Technology B.N.Yeltsin Ural Federal University	
N.I. Pirogov Russian State Medical University N. Bauman Moscow State Technical University Moscow Physics Engineering Institute Moscow Institute for Steel and Alloys B.N.Yeltsin Ural Federal University Belgorod State University Irkutsk State University Saint Petersburg State Polytechnical University Perm State University N.I. Lobachevsky Nizhniy Novgorod State University Kazan National Research Technological University Kazan Federal University Moscow State Aviation Institute Southern Federal University Moscow Power Engineering Institute N.G. Chernyshevsky Saratov State University	Moscow Physics Engineering Institute Moscow University ofElectronic Technology Kazan Federal University Tomsk State University N.I. Lobachevsky Nizhniy Novgorod State University Moscow Power Engineering Institute Moscow State Aviation Institute Mordovia State University Saint Petersburg State Polytechnical University Southern Federal University	1-2
Mordovia State University Moscow University ofElectronic Technology	Perm State University N.I. Pirogov Russian State Medical University N.G. Chernyshevsky Saratov State University Kazan National Research Technological University Saint Petersburg State University of Information Technologies. Mechanics and Optics	Less than 1

Table 3. Dynamics of the annual change of the quantity of publications of the Russian federal and national research universities included in Web of Science and Scopus databases for the years 2008-2011. %

University	2008-2009		2009-2010		2010-2011	
	WoS	Sc	WoS	Sc	WoS	Sc
Novosibirsk State University	37.2	29.5	6.4	15.3	28.0	29.5
B.N.Yeltsin Ural Federal University	-6.6	-5.0	14.1	26.5	17.1	40.9
Moscow Institute of Physics and Technology	42.8	32.5	31.3	27.4	12.1	19.3
Moscow Physics Engineering Institute	7.9	3.0	22.4	23.6	7.0	43.8
Southern Federal University	20.9	18.8	-18.6	-11.1	16.5	2.2
N.I. Pirogov Russian State Medical University	-8.6	-10.1	15.3	38.7	51.0	-16.3
Kazan Federal University	-1.2	2.6	-4.6	5.4	15.4	33.5
Tomsk State University	-1.0	-6.1	-4.2	9.2	49.2	18.9
Saint Petersburg State Polytechnical University	-10.0	-2.1	2.5	0.0	15.2	22.4
N.I. Lobachevsky Nizhniy Novgorod State University	-11.4	-9.3	5.9	12.3	8.4	12.4
Tomsk Polytechnic University	-9.1	-25.8	0.7	12.6	27.2	147.9
N.G. Chernyshevsky Saratov State University	-9.0	-23.2	-5.3	6.6	16.7	3.3
Moscow Institute for Steel and Alloys	2.9	16.1	-12.1	-6.9	46.0	70.2
Siberian Federal University	12.0	35.7	-4.8	12.1	9.4	14.1
Saint Petersburg State University of Information Technologies. Mechanics and Optics	-18.1	-16.5	25.3	40.6	19.3	-57.1
N. Bauman Moscow State Technical University	1.1	15.9	11.7	25.7	0.0	10.9
Far Eastern Federal University	21.6	11.3	11.3	43.0	27.5	124.8
Kazan National Research Technological University	7.8	2.8	20.5	16.9	-14.0	-46.2
Moscow Power Engineering Institute	5.4	22.7	-18.4	4.4	-6.3	-24.8
Perm State University	35.6	41.2	-16.3	-8.3	6.0	-18.2
The Higher School of Economics	35.3	53.1	47.8	79.6	79.4	85.2
Belgorod State University	9.6	-20.0	-7.0	42.2	-5.7	27.5
South Ural State University	43.5	-18.0	33.3	56.0	2.3	25.6
Samara State Aerospace University	31.3	60.6	-38.1	0.0	238.5	39.6
Moscow State Aviation Institute	-15.4	-18.2	54.6	66.7	-2.9	-21.0
Perm Polytechnic University	31.3	19.1	-38.1	84.0	146.2	50.0
Moscow University of Electronic Technology	50.0	6.5	-28.1	21.2	-26.8	-22.5
Saint Petersburg Mineral Resources University	16.7	28.6	14.3	66.7	50.0	6.7
Mordovia State University	-40.6	-19.2	10.5	0.0	9.5	38.1
Irkutsk State University	-38.9	27.3	27.3	57.1	7.1	27.3
Moscow State University of Civil Engineering	66.7	-75.0	-20.0	300.0	125.0	100.0

Table 4. Correlation ratios between publication activity data of the federal and national research universities calculated on the bases of Web of Science and Scopus databases

Year	2006	2007	2008	2009	2010	2011
Correlation coefficients	0.92	0.91	0.95	0.96	0.96	0.89

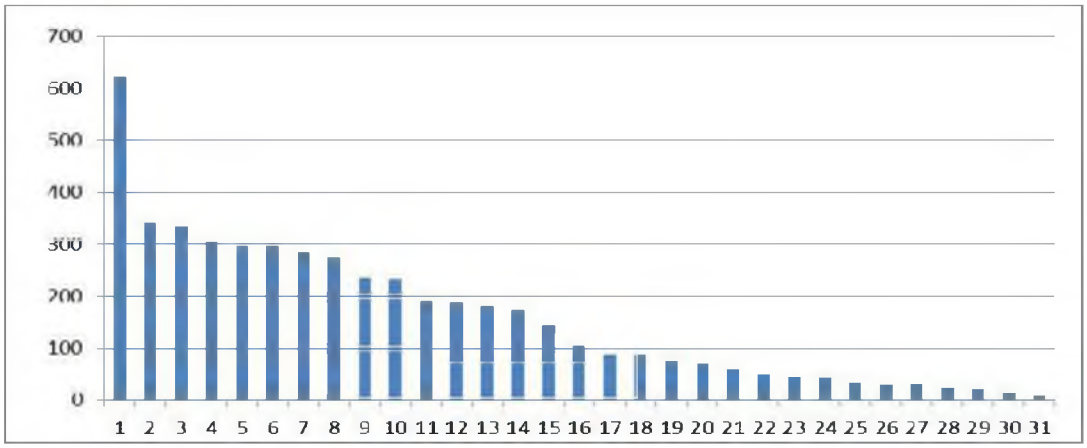

Figure1. Distribution of publication activity of universities in Web of Science database for the year 2011.

1. Novosibirsk State University 2.B.N.Yeltsin Ural Federal University 3.Moscow Physics Engineering Institute 4.Tomsk Polytechnic University 5.Kazan Federal University 6.Moscow Institute of Physics and Technology 7.Saint Petersburg State Polytechnical University 8.Moscow Institute for Steel and Alloys 9. Tomsk State University 10.Southern Federal University 11.N.I. Lobachevsky Nizhniy Novgorod State University 12.Far Eastern Federal University 13.Chernyshevsky Saratov State University 14.N. Bauman Moscow State Technical University 15.Siberian Federal University 16.The Higher School of Economics 17.Belgorod State University 18.Moscow Power Engineering Institute 19.South Utal State University 20.Kazan National Research Technological University 21.Moscow State Aviation Institute 22.Samara State Aerospace University 23.Perm State University 24.N.I. Pirogov Russian State Medical University 25.Perm Polytechnic University 26.Saint Petersburg State University of Information Technologies. Mechanics and Optics 27.Moscow University of Electronic Technology 28.Mordovia State University 29.Irkutsk State University 30.Saint Petersburg Mineral Resources University 31.Moscow State University of Civil Engineering

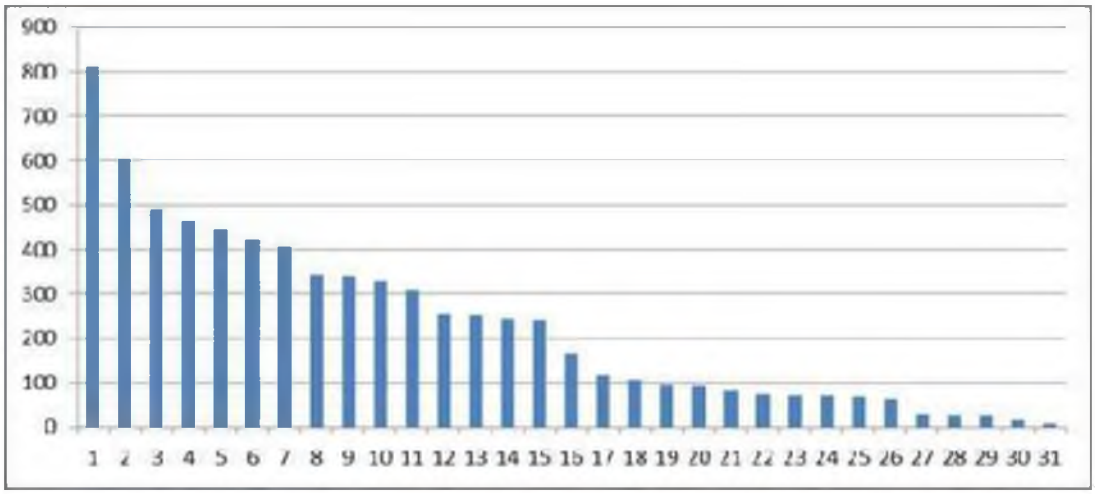

Figure 2. Distribution of publication activity of universities in Scopus database for the year 2011.

1.Novosibirsk State University 2.B.N.Yeltsin Ural Federal University 3.Moscow Institute of Physics and Technology 4.Moscow Physics Engineering Institute 5.Southern Federal University 6.N.I. Pirogov Russian State Medical University 7.Kazan Federal University 8.Tomsk State University 9.Saint Petersburg State Polytechnical University10.N.I. Lobachevsky Nizhniy Novgorod State University 11.Tomsk Polytechnic University 12.N.G. Chernyshevsky Saratov State University 13.Moscow Institute for Steel and Alloys 14.Siberian Federal University 15.Saint Petersburg State University of Information Technologies. Mechanics and Optics 16.N. Bauman Moscow State Technical University 17.Far Eastern Federal University 18.Kazan National Research Technological University 19.Moscow Power Engineering Institute 20.Perm State University 21.The Higher School of Economics 22.Belgorod State University 23.South Ural State University 24.Samara State Aerospace University 25.Moscow State Aviation Institute 26.Perm Polytechnic University 27.Moscow University of Electronic Technology 28.Saint Petersburg Mineral Resources University 29.Mordovia State University 30.Irkutsk State University 31.Moscow State University of Civil Engineering

In general, the cluster which contains sixteen underperforming universities defined on the basis of Web of Science database (Fig. 1) corresponds to the last two clusters (of 16 universities) defined on the bases of Scopus database (Fig. 2).

Finally, we constructed a matrix of pair correlation according to statistical sampling of Scopus publications for the period from 2006 through the end of 2012 for all universities under study. We excluded universities whose correlation ratio turned out to be lower than 0.7 for less than 6 times from this matrix. As a result we constructed a matrix of the universities tightly correlating with one another in the number of Scopus publications (Table 5).

This group includes 18 universities out of 31 federal and national research universities, and pair correlation ratio for them is more than 0.56 in each case. Thus, these Universities showed congruent dynamics of Scopus publications.

4. Conclusion

The comparative analysis of publication activity level of the Russian federal and national research universities conducted in reliance on Web of Science and Scopus databases provided the opportunity:

- to identify three groups of universities according to publication activity increase intervals at the period concerned;
- to find out annual correlation ratios between the publication activity data of the Russian leading universities received from Web of Science and Scopus databases ;
- to carry out clustering of the Russian leading universities on the basis of the distribution of their publication activity for the year 2011 according to two databases under research;
- to construct the cross-correlation matrix for the Russian leading universities with the most congruent dynamics of Scopus-publications for the period from 2006 to 2012.

Table 5. Pair correlation matrix for universities with the most congruent dynamics of Scopus publications for 2006-2012.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Moscow Physics Engineering Institute	1	0.87	0.94	0.91	0.93	0.71	0.85	0.95	0.93	0.79	0.95	0.86	0.84	0.92	0.93	0.96	0.82	0.98
2	Novosibirsk State University	0.87	1	0.82	0.96	0.93	0.96	0.74	0.86	0.84	0.81	0.82	0.95	0.97	0.92	0.82	0.81	0.68	0.9
3	Kazan Federal University	0.94	0.82	1	0.86	0.92	0.66	0.88	0.92	0.87	0.79	0.95	0.81	0.75	0.8	0.87	0.91	0.61	0.96
4	Moscow Institute of Physics and Technology	0.91	0.96	0.86	1	0.89	0.87	0.74	0.9	0.83	0.75	0.87	0.89	0.96	0.9	0.86	0.87	0.65	0.93
5	Moscow Institute for Steel and Alloys	0.93	0.93	0.92	0.89	1	0.83	0.84	0.89	0.89	0.86	0.89	0.9	0.85	0.89	0.9	0.88	0.73	0.96
6	Siberian Federal University	0.71	0.96	0.66	0.87	0.83	1	0.61	0.72	0.74	0.76	0.64	0.92	0.93	0.85	0.66	0.62	0.58	0.76
7	Tomsk Polytechnic University	0.85	0.74	0.88	0.74	0.84	0.61	1	0.94	0.8	0.56	0.95	0.76	0.72	0.76	0.89	0.92	0.64	0.91
8	B.N.Yeltsin Ural Federal	0.95	0.86	0.92	0.9	0.89	0.72	0.94	1	0.89	0.66	0.98	0.86	0.87	0.89	0.94	0.98	0.73	0.97

	University																		
9	N.I. Lobachevsky Nizhniy Novgorod State University	0.93	0.84	0.87	0.83	0.89	0.74	0.8	0.89	1	0.89	0.84	0.94	0.8	0.95	0.77	0.83	0.87	0.91
10	Tomsk State University	0.79	0.81	0.79	0.75	0.86	0.76	0.56	0.66	0.89	1	0.63	0.88	0.69	0.83	0.58	0.6	0.69	0.77
11	Far Eastern Federal University	0.95	0.82	0.95	0.87	0.89	0.64	0.95	0.98	0.84	0.63	1	0.78	0.8	0.82	0.95	0.99	0.66	0.97
12	Belgorod State University	0.86	0.95	0.81	0.89	0.9	0.92	0.76	0.86	0.94	0.88	0.78	1	0.92	0.96	0.74	0.76	0.78	0.88
13	N. Bauman Moscow State Technical University	0.84	0.97	0.75	0.96	0.85	0.93	0.72	0.87	0.8	0.69	0.8	0.92	1	0.92	0.82	0.81	0.68	0.87
14	South Ural State University	0.92	0.92	0.8	0.9	0.89	0.85	0.76	0.89	0.95	0.83	0.82	0.96	0.92	1	0.81	0.83	0.89	0.9
15	Samara State Aerospace University	0.93	0.82	0.87	0.86	0.9	0.66	0.89	0.94	0.77	0.58	0.95	0.74	0.82	0.81	1	0.98	0.71	0.95
16	Irkutsk State University	0.96	0.81	0.91	0.87	0.88	0.62	0.92	0.98	0.83	0.6	0.99	0.76	0.81	0.83	0.98	1	0.73	0.97
17	Moscow State University of Civil Engineering	0.82	0.68	0.61	0.65	0.73	0.58	0.64	0.73	0.87	0.69	0.66	0.78	0.68	0.89	0.71	0.73	1	0.74
18	The Higher School of Economics	0.98	0.9	0.96	0.93	0.96	0.76	0.91	0.97	0.91	0.77	0.97	0.88	0.87	0.9	0.95	0.97	0.74	1

Note: correlation ratios with the value not less than 0.7 are in italics.

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