

Quantitative Evaluation of Involvement of Counties in the International Open Access Movement

Vladimir M. Moskovkin*

Belgorod State University 308015, Belgorod, Russia

Oleg N. Polukhin

Belgorod State University 308015, Belgorod, Russia

Marina V. Sadovski

Belgorod State University 308015, Belgorod, Russia

Sizyoongo Munenge

Belgorod State University 308015, Belgorod, Russia

Oksana V. Shevchenko

Belgorod State University 308015, Belgorod, Russia

Abstract

The present paper investigated a developed method for the quantitative evaluation of involvement of countries in the international open access movement. It identified eight country open access indices which were initially connected with open access initiatives and instruments, their weighing, normalization and aggregation in a weighted average value. In a second more strict approximation, the number of indices was reduced up to six for the account of discarding duplicated data in ROAR and Open DOAR. Budapest initiative and Berlin declaration were considered as OA-initiatives; and data of the international registers, DOAJ, SHERPA/RoMEO, ROAR MAP and the Webometrics OA-repositories ranking, was considered as the tools. The calculation was done on the basis of a developed method for 133 countries.

Keywords: Open access; Involvement of countries in open access; Budapest initiative; Berlin declaration; ROAR; Open DOAR; DOAJ; SHERPA / RoMEO; ROAR MAP; Webometrics.



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1. Introduction

A fair number of scientific works are devoted to the problem of movement of the open access to scientific knowledge launched at the turn of the century. In the advanced search of “Google Scholar”, there are 394 responses to the request of the term “Open access to scientific knowledge” in the exact word combination line (8 June, 2017). Furthermore, there are very few works dedicated to the quantitative analysis of involvement of countries in this movement (Faraji *et al.*, 2018; Villalobos, 2003). Among the above-mentioned responses, we managed to single out five papers that considered the distribution of the open access repositories and journals on a country-by-country basis. The work [1] gives the distribution of OAR (Open Access Repositories) in the Open DOAR register across the leading countries of the world (Tab. 1).

Table-1. Distribution of the OAR in the Open DOAR Across the Countries of the World (7-8 October, 2008)

Country	OAR	
	Number	%
USA	317	25,36
United Kingdom	136	10,88
Germany	129	10,32
Japan	69	5,52
Australia	68	5,44
Netherlands	45	3,60
Canada	44	3,52
Italy	42	3,36
68 other countries	400	32,00
Total	1250	100

More up-to-date data on the OAR distribution in the Open DOAR and ROAR registers are shown in the [Table 2](#) (Das, 2014).

Table-2. Distribution of the OAR in the Open DOAR Across the Countries of the World (11th March, 2013)

Country	OAR	
	Open DOAR	ROAR
USA	395	547
Great Britain	209	249
Germany	165	193
Japan	138	166
Spain	98	153
Poland	75	106
France	71	82
Italy	70	88
Canada	58	85
India	54	94

According to the comparison of these tables, we see what fold the OAR has increased in the Open DOAR for four and a half years. The greatest increase of the OAR has been observed for the USA. Also this article describes the growth dynamics of the number of the OA-journals (OAJ) in the DOAJ register for the period from 2002 to 2013. Let's give the data obtained at the ends of this time interval ([Tab.3](#)).

Table-3. Top Five Countries According to the Number of the OAJ in the DOAJ Register (17 January, 2013)

Country	OA-Journals in DOAJ	
	2002	2013
USA	16	1270
Brazil	0	804
Great Britain	5	575
India	0	471
Spain	0	444

According to tables, the number of the OAJ grows much faster than of the OAR. The work ([Cuentas et al., 2017](#); [Roy et al., 2013](#)) provides the OAR distribution across 11 leading countries distinguishing those of them which function within the frameworks of the Open Archives Initiative Protocol for Metadata Harvesting (PMH, OAI), and the work ([Moskovkin et al., 2014](#)) gives the distribution of a wider set of the open access resources and instruments for the Sub-Saharan African countries. The work ([Usova, 2009](#)) describes the data of distribution of OAR and OAJ numbers across CIS countries ([Tab. 4](#)).

Table-4. Distribution of OAR and OAJ, 2009

Country	OAR	OAJ
Ukraine	13	15
Russia	29	14
Armenia	0	2
Azerbaijan	2	1
Belarus	1	0
Georgia	1	3
Kazakhstan	1	0
Kyrgyzstan	2	0
Moldova	1	1

2. Materials and Methods

We characterized the involvement of countries in the international open access movement by the statistical data from registers of the largest open access initiatives and instruments. We considered Budapest initiative "Open access" (2002) and Berlin Declaration of the open access to scientific and humanities knowledge (2003) as such initiatives; and the international registers ROAR, Open DOAR, SHERPA/RoMEO, ROAR MAP, DOAJ and Webometrics ranking for the OA-repositories as instruments. In general, we used 8 quantitative indices (a number of organizations which signed Budapest initiative and Berlin declaration shall be taken for the first two). Values of these eight indicators are also recorded in a form of a matrix (Table) for fifteen ex-USSR countries and based on it the average values for each index per one country and the total quantitative potential of the open access initiatives and instruments on a country-by-country basis shall be calculated by summation of lines of this matrix. As far as all these indices are not equal and some of them are replicated, we offer the following procedure for more precise calculation of the quantitative potential of involvement of countries in the open access. Let's choose one most essential index out of three indicators which relate to the OA-repositories. It should be understood that organizations usually register their OA-repositories simultaneously in two registers, ROAR and Open DOAR, provided that the first register is more popular. Besides, the actual number of records in these registers usually exceeds the real number of functioning OA-repositories. Replication of records takes place, for examples, due to the change of an

OA-repository name or its re-registration. Similarly, the real number of functioning OA-repositories, in which data is indexed by search engines, is reliably disclosed in the Webometrics ranking. We take this index as a basis. Let's break down six selected indicators into three groups in order of importance with assignment weighting coefficients to them (Tab. 5).

Table-5. Quantitative Indices of Involvement of Countries in the International Open Access Movement: Their Groups, Designations and Weighting Coefficients.

Group Name	Included Indices in the Group		Weighting Coefficient
	Name	Designation	
OA repositories and journals	Number of OA-repositories included in Webometrics	I ₁	1/4
	Number of OA journals included in DOAJ	I ₂	1/4
OA-policy	Number of publishing OA policies on self-archiving and copyright in SHERRA/ROMEO	I ₃	1/6
	Number of institutional OA mandates in ROAR MAP	I ₄	1/6
OA initiatives	Number of signatories-organization of the Budapest initiative	I ₅	1/12
	Number of signatories-organization of the Berlin Declaration	I ₆	1/12

When distributing weighs for these six indicators, we proceeded from the following considerations. Groups were chosen with the uniform indices (carriers of the OA-results, OA-policy, OA-initiatives), that is why there were taken equal weighting coefficients among indices of one group. The significance of the very groups (summary weighting coefficient for a group) was supposed to be increasing with the uniform interval according to the procedure specified in the table 5. Herewith the sum of group weighting coefficients was taken to be equal to one. Thus, the integrated index of involvement of countries in the international open access movement can be calculated using the weighted average value.

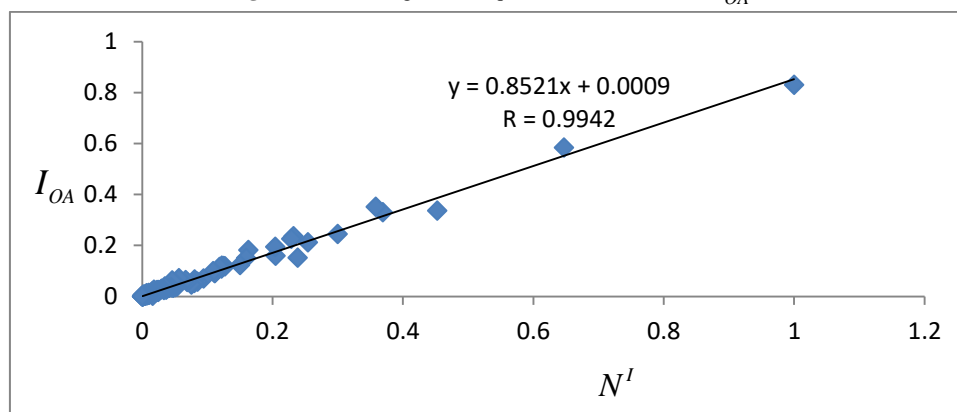
$$I_{OA} = 1/4 (I_1 / I_{1max} + I_2 / I_{2max}) + 1/6 (I_3 / I_{3max} + I_4 / I_{4max}) + 1/12 (I_5 / I_{5max} + I_6 / I_{6max}), \tag{1}$$

Where, $I_{i \max}$ – maximum value of i index over the whole sampling of countries. There is carried out the correlation analysis between I_{OA} and indicators normalized to the maximum value according to the sampling of countries $N' = N / N_{max}$. The total number of estimated countries turned out to be 133.

3. Results and Discussion

Table 6 presents initial values of eight indices of involvement of fifteen ex-USSR countries in the international open access movements, which were collected by us on 24-26 June, 2017 from the OA - initiatives and OA-instruments Websites. This table shows calculated values of N , $N' = N / N_{max}$ and I_{OA} . Countries in the table are ranked by values of the index N (N'). There has been obtained a good correlation relationship between N' and I_{OA} (Fig. 1).

Figure-1. Linear Regression Equation Between N' и I_{OA}



76.5% of the total number of the OA-initiatives and OA-instruments is accounted for 20% of countries (27 countries) (Tab. 6), i.e. we obtained the distribution closed to Pareto distribution.

If we divide all countries into 5 groups according to the five-level uniform classification scale by N' index, then we can see their very non-uniform distribution. Only USA falls into a group of countries with very high level of involvement in the OA-movement ($0.8 < N' \leq 1.0$), the United Kingdom falls into a group of countries with a high level ($0.6 < N' \leq 0.8$), Brazil falls into a group of countries with the average level ($0.4 < N' \leq 0.6$), Spain, Germany, Indonesia, Japan, Poland, Italy, India, Egypt, France fall into a group of countries with a low level ($0.2 < N' \leq 0.4$).

The rest of countries (121 countries) fall into a group with a very low level of involvement in the OA-movement that amounts to 91% of their total number.

Table-6. Quantitative Indicators of Involvement of Countries of the World in the International Open Access Movement, 24-26 June, 2017

Country	SHERPA/ROMEO	DOAJ	ROAR	DOAR	ROARMAP	Webometrics, OA-Repositories	Berlin Declaration	Budapest Open Access Initiative	N	N'	I_{OA}
I_{max}, N_{max}	558	987	808	498	137	391	98	98	3063		
1. United States	558	544	808	498	137	391	37	90	3063	1	0.8291
2. United Kingdom	280	886	258	252	120	141	1	44	1982	0.6471	0.5825
3. Brazil	67	987	158	92	20	52	1	9	1386	0.4525	0.3361
4. Spain	93	539	178	125	38	67	52	38	1130	0.3689	0.3299
5. Germany	96	262	239	195	58	116	98	33	1097	0.3581	0.3512
6. Indonesia	28	613	111	62	16	69	1	18	918	0.2997	0.2434
7. Japan	19	18	228	211	6	276	0	21	779	0.2543	0.2119
8. Poland	29	449	120	92	3	32	0	5	730	0.2383	0.1508
9. Italy	47	282	93	110	23	53	83	20	711	0.2321	0.2349
10. India	118	233	118	76	16	39	3	98	701	0.2289	0.2245
11. Egypt	3	602	11	5	0	1	2	3	627	0.2047	0.1583
12. France	45	191	96	119	23	115	23	13	625	0.2040	0.1939
13. Turkey	28	203	62	75	45	31	0	55	499	0.1629	0.1811
14. Canada	75	122	96	81	27	48	13	26	488	0.1593	0.1500
15. Colombia	31	255	65	44	5	43	1	16	460	0.1502	0.1219
16. Portugal	129	77	59	55	22	35	7	5	389	0.1270	0.1174
17. Russian Federation	31	187	61	28	6	23	1	46	383	0.1250	0.1186
18. Switzerland	28	257	19	18	10	11	27	4	374	0.1221	0.1190
19. Ukraine	19	81	94	75	15	54	3	32	373	0.1218	0.1087
20. Australia	44	83	86	57	33	51	0	9	363	0.1185	0.1146
21. Iran	17	290	9	10	0	4	0	11	341	0.1113	0.0904
22. Romania	26	286	13	3	1	2	1	9	341	0.1113	0.0912
23. Netherlands	23	178	44	35	12	15	20	6	333	0.1087	0.0983
24. Argentina	17	145	49	41	5	22	0	9	288	0.0940	0.0696
25. China	10	71	92	39	4	31	2	11	260	0.0849	0.0567
26. Sweden	19	50	75	42	12	40	6	3	247	0.0806	0.0662
27. Norway	51	57	59	53	10	9	5	0	244	0.0797	0.0518
28. Taiwan	1	28	83	60	1	57	1	0	231	0.0754	0.0459
29. Mexico	7	98	41	30	3	13	1	19	212	0.0692	0.0559
30. South Africa	17	63	49	24	9	21	18	3	204	0.0666	0.0633
31. Belgium	18	33	35	25	19	14	17	12	173	0.0565	0.0705
32. Hungary	32	26	40	36	4	19	2	4	163	0.0532	0.0383
33. Peru	6	33	43	42	7	20	0	4	155	0.0506	0.0349

3	Austria	23	37	19	28	8	8	23	4	150	0.04 90	0.05 40
3	Chile	9	76	22	20	0	15	1	3	146	0.04 77	0.03 49
3	Greece	16	29	39	35	4	13	6	3	145	0.04 73	0.03 30
3	Czech Republic	15	75	13	17	4	10	7	2	143	0.04 67	0.04 24
3	Finland	41	20	22	16	31	11	0	0	141	0.04 60	0.06 21
3	Malaysia	8	41	37	21	1	28	0	2	138	0.04 51	0.03 36
4	Serbia	11	91	9	9	2	2	4	0	128	0.04 18	0.03 34
4	Croatia	10	69	7	21	2	3	1	5	118	0.03 85	0.02 99
4	Ecuador	5	25	30	26	0	23	0	4	113	0.03 69	0.02 59
4	Denmark	27	23	17	12	8	8	7	4	106	0.03 46	0.03 81
4	Korea, Republic of	8	45	0	33	0	15	0	1	102	0.03 33	0.02 42
4	Slovenia	7	47	10	11	8	5	2	1	91	0.02 97	0.02 95
4	Ireland	6	13	24	22	10	14	1	0	90	0.02 94	0.02 71
4	Belarus	3	5	23	24	3	18	1	2	79	0.02 58	0.01 99
4	New Zealand	11	15	21	12	7	10		2	78	0.02 55	0.02 37
4	Venezuela	1	18	21	16	4	8	2	7	77	0.02 51	0.02 25
5	Cuba	9	39	11	10	0	2	1	2	74	0.02 42	0.01 64
5	Pakistan	12	40	4	3	1	0	1	10	71	0.02 32	0.02 43
5	Bulgaria	9	33	9	8	1	6	2	3	71	0.02 32	0.02 04
5	Costa Rica	4	44	9	6	0	6	1	1	71	0.02 32	0.01 79
5	Lithuania	3	27	11	11	9	4	0	1	66	0.02 15	0.02 21
5	Kenya	1	2	19	26	5	8	3	1	65	0.02 12	0.01 54
5	Nigeria	6	8	15	15	1		1	12	58	0.01 89	0.01 61
5	Thailand	2	21	11	12	0	10	0	1	57	0.01 86	0.01 32
5	Moldova	2	16	9	7	8	1	1	11	55	0.01 80	0.02 52
5	Bangladesh	7	16	10	10	0	4	0	6	53	0.01 73	0.01 38
6	Korea, Democratic People's Republic	1	5	44	0	0	0	0	0	50	0.01 63	0.00 16
6	Algeria	3	12	8	13	4	7	0	3	50	0.01 63	0.01 58
6	Hong Kong	2	28		4	4	6	1	1	46	0.01 50	0.01 81
6	Slovakia	5	34	0	0	1	0	0	0	40	0.01 31	0.01 13
6	Estonia	1	14	4	7	3	3	1	0	33	0.01 08	0.01 03
6	Philippines	2	9	11	7	0	2		2	33	0.01 08	0.00 59
6	Zimbabwe	0	0	9	9	0	6	7	1	32	0.01 04	0.01 06
6	Sri Lanka	2	8	1	12	0	6	3		32	0.01 04	0.00 90
6	Macedonia	8	9	1	3	0	1	1	8	31	0.01 01	0.01 30
6	Bosnia and Herzegovina	6	13	3	2	0	2	1	3	30	0.00 98	0.00 98
7	Sudan	0	0	10	8	0	8	0	1	27	0.00 88	0.00 60
7	Tanzania	0	0	9	10	0	5	1		25	0.00 82	0.00 40

7	Iraq	3	15	1	1	0	4	0	1	25	0.00 82	0.00 81
7	Ghana	2	4	6	4	1	2	3	2	24	0.00 78	0.00 84
7	Cyprus	1	4	7	4	0	4	2	0	22	0.00 72	0.00 56
7	Uruguay	2	15	2	3	0	0	0	0	22	0.00 72	0.00 44
7	Iceland	1	5	2	3	5	1	4	0	21	0.00 69	0.01 17
7	Nepal	3	13	3	1	0	0	1	0	21	0.00 69	0.00 50
7	Kazakhstan	1	1	5	5	1	7	0	0	20	0.00 65	0.00 62
7	Singapore	3	0	6	4	3	3	0	0	19	0.00 62	0.00 65
8	Morocco	1	10	3	2	0	1	1	1	19	0.00 62	0.00 52
8	Kyrgyzstan	0	2	4	9	2	0	0	0	17	0.00 56	0.00 29
8	Latvia	0	0	11	0	2	3	0	0	16	0.00 52	0.00 44
8	Georgia	1	3	2	2	0	1	0	7	16	0.00 52	0.00 77
8	Azerbaijan	0	0	4	2	2	2	1	3	14	0.00 46	0.00 71
8	Bolivia	1	4	3	2	1	1	0	2	14	0.00 46	0.00 49
8	Nicaragua	1	4	3	3	0	2	0	0	13	0.00 42	0.00 26
8	Ethiopia	0	4	2	2	0	1	2	0	11	0.00 36	0.00 34
8	Albania	3	3	1	2	0	1	0	1	11	0.00 36	0.00 31
8	Qatar	1	6	1	1	0	1	0	0	10	0.00 33	0.00 25
9	Israel	2	5	1	0	0	0	2	0	10	0.00 33	0.00 36
9	Armenia	1	1	2	2	0	0	0	3	9	0.00 29	0.00 31
9	Senegal	1	0	2	2	0	0	0	3	8	0.00 26	0.00 28
9	United Arab Emirates	2	6	0	0	0	0	0	0	8	0.00 26	0.00 21
9	Tunisia	0	4	2	1	0	1	0	0	8	0.00 26	0.00 17
9	Jordan	1	3	0	0	0	3	0	1	8	0.00 26	0.00 38
9	Botswana	0	0	3	2	0	1	0	1	7	0.00 23	0.00 15
9	Namibia	0	0	2	2	0	1	0	2	7	0.00 23	0.00 23
9	Cameroon	0	1	1	2	0	0	3	0	7	0.00 23	0.00 28
9	Uganda	0	1	0	2	0	1	2	0	6	0.00 20	0.00 26
10	Saudi Arabia	0	13	0	0	0	6	0	0	6	0.00 20	0.00 71
10	Puerto Rico	2	1	1	1	0	1	0	0	6	0.00 20	0.00 15
10	Vietnam	0	1	0	0	0	3	0	1	5	0.00 16	0.00 30
10	Montenegro	2	4	0	0	0	0	0	0	5	0.00 16	0.00 16
10	Guatemala	1	3	0	1	0	0	0	0	5	0.00 16	0.00 11
10	Lebanon	0	2	1	0	0	1	0	0	4	0.00 13	0.00 11
10	Lesotho	0	0	2	1	0	0	0	1	4	0.00 13	0.00 09
10	Libya	0	3	0	0	0	0	0	0	3	0.00 10	0.00 08
10	Rwanda	0	0	1	2	0	0	0	0	3	0.00 10	0.00 00
10	Palestinian Territories	0	1	1	0	0	2	0	0	3	0.00 10	0.00 15
10	Yemen	0	2	0	0	0	0	0	0	3	0.00 10	0.00 05

1	Burkina Faso	0	0	0	0	0	1	0	1	2	0.00 07	0.00 15
1	Cape Verde	0	0	0	2	0	0	0	0	2	0.00 07	0.00 00
1	Madagascar	0	1	0	0	0	0	0	1	2	0.00 07	0.00 11
1	Mauritius	1	1	0	0	0	0	0	0	2	0.00 07	0.00 06
1	Afghanistan	0	0	0	1	0	0	0	1	2	0.00 07	0.00 09
1	Oman	0	2	0	0	0	0	0	0	2	0.00 07	0.00 05
1	Syria	1	0	1	0	0	0	0	0	2	0.00 07	0.00 03
1	Angola	1	0	0	0	0	0	0	0	1	0.00 03	0.00 03
1	Côte D'Ivoire	0	0	0	0	0	0	0	1	1	0.00 03	0.00 09
1	Guinea	0	0	0	0	0	0	1	0	1	0.00 03	0.00 09
1	Liberia	0	0	0	0	0	0	0	1	1	0.00 03	0.00 09
1	Mali	0	0	0	0	0	0	0	1	1	0.00 03	0.00 09
1	Reunion	1	0	0	0	0	0	0	0	1	0.00 03	0.00 03
1	Somalia	0	0	0	0	0	0	0	1	1	0.00 03	0.00 09
1	Gambia	0	0	0	0	0	0	1	0	1	0.00 03	0.00 09
1	Bahrain	1	0	0	0	0	0	0	0	1	0.00 03	0.00 03
1	Macau	0	0	0	0	0	1	0	0	1	0.00 03	0.00 06
1	Seychelles	1	0	0	0	0	0	0	0	1	0.00 03	0.00 03
1	Uzbekistan	0	0	0	0	0	0	0	1	1	0.00 03	0.00 09
1	Isle of Man	1	0	0	0	0	0	0	0	1	0.00 03	0.00 03
1	Kosovo	1	0	0	0	0	0	0	0	1	0.00 03	0.00 03
1	Luxembourg	0	0	0	0	0	1	0	0	1	0.00 03	0.00 06
1	Malawi	0	0	1	0	0	0	0	0	0	0	0.00 00
	Summa	2342	938 4	4201	3287	856	2250	529	820	2365 4	7.72 24	6.70 35
	Summa/133	17.609	70.5 56	31.5 86	24.7 1	6.43 6	16.917	3.977	6.165	177.8 49	0.05 8	0.05 0

4. Conclusion

The present paper presented a developed method for the quantitative evaluation of involvement of countries in the international open access movement in which principles consisted in the identification of indices of involvement of countries in the open access, their weighing, normalization and aggregation on the weighted average value basis. Two global initiatives – Budapest initiative and Berlin declaration, were considered as the OA-initiative, and particularly, databases according to their subscribers. The international registers according to the OA-repositories (ROAR, Open DOAR), OA-journals (DOAJ), OA-policies (SHERPA/RoMEO, ROAR MAP) and ranking of the OA-repositories in Webometrics were initially considered as the OA-instruments. During more strict selection of indices, we excluded the data of ROAR and Open DOAR registers from consideration due to their errors and duplication. Finally, six quantitative indices were divided into three groups (OA-carriers, OA-policies, OA-initiatives) with different weighting coefficients. Weighing and normalization of these indices provided the opportunity to obtain the weighted average integrated index of involvement of countries in the open access which varied from 0 to 1. There was a high correlation relationship between values of this index and the total number of the OA-initiatives and OA-instruments. It was found that 76.5% of the total number of these initiatives and instruments was accounted for by the first 20% of countries. The application of the uniform five-level classification scale according to N' index indicated that 91% of countries (121 countries) fell into the group with very low level of involvement of countries in the OA-movement.

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