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Method for the Quantitative Evaluation of Universities' Publishing Activity by Countries Based on the Taiwanese Ranking

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Abstract—Method for the evaluation of universities' publishing activity by countries in different fields of knowledge with identification of leading clusters of countries are suggested on the basis of the Taiwanese ranking of the leading universities of the world. It is reasonable to include such calculations into the calculation system of the annual global Taiwanese ranking.

Keywords: Taiwanese ranking of universities of the world, Shanghai ranking of universities of the world, universities' publishing activity by countries , scientific fields, rank of a university, grade of a university, methods of quantitative evaluation

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The Taiwanese ranking is preferred among existing global rankings of the university activity that take the publishing activities of university scientists into account and quotation of their articles in detail[1]. The Shanghai ranking, which is similar to it, does not take the indices of publishing activity and articles that quote university scientists strongly into account.[2] In addition, this ranking is not convenient to use when estimating the quality of a national university and publishing activity because it uses the interval estimation of ranks in the middle and low part of the rating table. The places of universities with their annual ranking are given as ranks.

Starting in 2010, teams for both global rankings began to categorize leading universities in wide scientific fields, including a number of narrow subject fields. Starting this year the TOP–300 universities of the world ranking tables are being created for the Taiwanese ranking in the following six broad scientific fields: agriculture, clinical medicine, engineering, life sciences, natural sciences, and social sciences.

We summarized all the universities, along with their ranks and grades in every country in order to quantitatively evaluate universities' publishing activity by countries for all scientific fields as a whole and separately. After that, the average rank and average grade in every country were determined by division on total quantity of universities in every country. All the calculations are in the matrix of the universities' publishing activity by countries and fields of knowledge (Table 1).

The countries in this matrix are found in order of decreasing numbers of universities in a country. In the case of an equal number of universities counties, they are ranked in order of the decreasing average rank in the TOP–500 universities of the world. Thus, the quantitative and qualitative position of a country for university publishing activities as a whole or in separate wide scientific field is determined by the vector (N, R_{av}, B_{av}), where N is the number of universities in the country that are in the TOP–500 (or TOP–300), R_{av} is the average rank of the country, and B_{av} is the average grade of the country. This vector can be the basis of an integral estimate of the universities' publishing activity by countries but it is still not clear what weights should be given to the coordinates of the considered vector. For example, it is clear that the USA is the global leader in universities' publishing activity in all fields (Table 1) but how can one handle the situation where the USA has the vector (83; 123; 30.07) in the field of engineering and Switzerland has better indices for two other coordinates (2; 22; 48.18) with an order of magnitude fewer universities?

It is clear that using the same weight values will give an advantage to Switzerland in the integral index, which is why it is necessary to give a higher weight to the first coordinate of the considered vector. It seems

[1] http://ranking.heeact.edu.tw/en-us/2010/homepage/
[2] http://www.arwu.org/

Table 1. Matrix of universities' publishing activity by countries and fields of knowledge, 2010

Distribution of indices of publishing activity of leading universities of the world among countries and fields of knowledge																				
Country	All fields of knowledge			Agriculture			Clinical medicine			Engineering			Life sciences			Natural sciences			Social sciences		
	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade
USA	159	193	19.60	101	125	31.64	104	114	22.14	83	127	30.07	117	131	17.78	95	114	33.88	147	128	33.90
Germany	45	262	13.86	22	194	22.54	33	166	14.69	18	201	19.76	28	163	13.07	30	179	22.33	6	241	13.66
Great Britain	38	219	17.24	29	135	28.04	26	142	17.53	20	145	26.35	25	134	17.01	27	149	28.52	42	452	18.77
Italy	29	312	11.21	7	178	23.13	20	198	12.51	11	174	21.21	11	188	11.75	15	188	23.23	3	262	12.86
Japan	28	300	13.99	11	174	26.05	13	226	11.97	11	122	31.06	13	158	15.09	12	120	35.84	1	243	13.50
Canada	22	240	17.36	18	135	28.92	13	99	21.37	12	158	23.91	14	151	15.29	11	162	26.31	19	151	19.56
France	22	301	12.66	10	194	22.77	12	217	12.39	11	219	19.23	11	174	12.39	13	148	27.37	1	137	18.00
China	16	310	12.22	6	162	25.15	2	267	10.00	32	136	27.02	5	235	10.00	14	162	26.01	2	240	13.60
Spain	13	343	10.16	7	212	21.91	3	222	12.28	10	217	18.42	6	239	9.94	10	208	22.07	3	227	14.36
the Netherlands	12	166	18.24	9	146	32.28	8	58	23.68	8	156	24.46	9	105	15.96	10	163	24.54	11	116	20.74
Sweden	11	254	14.90	7	82	33.47	7	154	17.42	6	137	24.40	6	137	16.01	5	141	25.69	8	165	17.50
Australia	10	198	16.97	13	123	22.59	8	142	16.96	7	122	25.72	8	130	14.7	7	153	25.02	14	152	18.63
South Korea	10	312	12.45	2	147	24.88	4	217	11.99	11	123	28.62	2	195	12.25	8	163	25.36	2	273	12.64
Switzerland	8	159	18.47	7	152	28.23	5	113	17.78	2	22	48.18	7	97	16.43	6	111	13.57	4	182	16.63
Belgium	7	210	15.45	7	167	27.37	7	166	14.73	5	175	22.68	7	184	12.28	5	221	21.95	5	161	17.16
Brazil	7	366	11.13	5	192	23.99	2	177	14.12	3	189	20.98	2	175	13.20	1	88	29.84	1	160	16.68
Finland	6	299	13.21	3	180	28.87	5	177	14.50	2	231	18.22	4	205	12.73	2	198	23.06	3	207	15.30
Austria	6	331	11.29	1	148	24.25	4	219	12.19	1	157	21.99	2	191	11.34	3	213	21.30	1	293	12.04
Israel	5	201	15.80	3	173	24.18	4	205	12.63	5	190	20.58	4	149	13.63	4	132	26.21	5	224	14.44
Hong Kong	5	310	11.79	1	210	21.03	2	159	14.55	5	77	31.71	1	211	10.69	2	195	21.76	5	158	17.14
Taiwan	5	347	11.51	3	179	23.61	3	238	11.22	11	146	27.22	1	202	11.01	3	159	25.13	2	249	13.39
Denmark	4	155	18.57	4	103	36.53	3	113	18.96	3	160	25.51	4	132	15.12	3	138	25.32	3	117	20.21

Table 1. (Contd.)

Distribution of indices of publishing activity of leading universities of the world among countries and fields of knowledge

Country	All fields of knowledge			Agriculture			Clinical medicine			Engineering			Life sciences			Natural sciences			Social sciences		
	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade	number	average rank	average grade
Norway	4	287	12.69	5	177	23.58	3	179	13.85	1	147	22.57	2	204	11.26	2	232	19.92	4	164	16.81
Greece	4	379	10.07	2	234	20.08	1	168	14.09	3	197	19.04	1	248	9.57				1	179	15.95
Ireland	3	324	11.33	2	205	21.51	2	276	9.62	1	178	20.44	2	205	10.90	1	258	18.73	2	283	12.30
Portugal	3	395	9.59	3	248	19.46				3	191	19.63	1	283	8.78	2	258	18.87			
Singapore	2	165	17.43	1	134	25.18	1	179	13.29	2	6	64.99	1	102	15.28	2	84	31.25	2	170	17.19
New Zeeland	2	288	11.97	3	198	21.76	2	191	12.78				2	247	9.66				2	203	15.12
Poland	2	376	9.82				1	277	9.66	1	275	15.68				2	236	19.97			
India	2	399	9.36							6	189	20.25				2	233	19.86			
Chili	2	434	8.93																		
Mexico	1	219	14.23	1	62	34.78				1	197	18.97	1	218	10.50	1	144	24.86			
Czech Republic	1	226	13.85	1	219	20.80	1	223	11.61				1	237	9.92	1	208	21.30			
Russia	1	228	13.73							1	256	16.39				1	65	33.29			
South Africa	1	296	11.71	4	221	20.73	1	243	10.81				1	257	9.39				2	194	15.32
Argentina	1	325	11.01	176	22.66								1	242	9.73						
Slovenia	1	414	9.14							1	288	15.33									
Hungary	1	498	7.91																		
Thailand	1	500	7.88																		
Iran										2	185	20.69									
Turkey										2	228	17.73									
Estonia				1	268	18.67															

Table 2. World leading clusters countries of universities' publishing activity in different scientific fields

Scientific fields	Advanced countries of the world
Agriculture	USA, Great Britain, Canada, the Netherlands, Sweden, Switzerland
Clinical medicine	USA, Great Britain, Canada, the Netherlands, Switzerland
Engineering	USA, China, Japan, South Korea, Taiwan, Hong Kong
Life sciences	USA, Great Britain, the Netherlands, Switzerland, Sweden
Natural sciences	USA, Great Britain, France, Japan, Switzerland
Social sciences	USA, Great Britain, Canada, Australia, the Netherlands

that weighted coefficients can be fixed only on the basis of expert estimation.

On the basis of a detail analysis of the distribution of values of the last two coordinates[3] of the vector of the universities' publishing activity by countries we identified the leading clusters of countries in every field of knowledge with $N \geq 5$ (Table 2).

[3] By virtue of determining strong changes in the ranked rows of these coordinates.

From Table 2 we can see that the USA appears in all fields of knowledge, Great Britain occurs in five fields of knowledge, the Netherlands and Switzerland are in four fields of knowledge and Canada is in three fields of knowledge. Five countries from east and southeast Asia are represented strongly in the leading clusters of countries in engineering.

We think that it is reasonable to include such calculations (Tables 1, 2) in the calculation system of the annual global Taiwanese ranking.