Evaluation of the highly-cited researchers' database for a country:
Proposals for meaningful analyses on the example of Germany

Lutz Bornmann* & Johann Bauer**

*corresponding author:

Division for Science and Innovation Studies

Administrative Headquarters of the Max Planck Society

Hofgartenstr. 8,

80539 Munich, Germany.

Email: bornmann@gv.mpg.de

** Max Planck Institute of Biochemistry

Am Klopferspitz 18,

82152 Martinsried, Germany.

Email: jbauer@biochem.mpg.de

Abstract

In 2014 Thomson Reuters (TR, provider of the Web of Science, WoS) published a list of highly-cited researchers worldwide. This includes those scientists who have published the most papers in their discipline which belong to the 1% of the most-cited papers. Bornmann and Bauer (in press) have presented a first evaluation in which the scientists are evaluated on the basis of their affiliations. In this short communication we would like to indicate how the TR data can be used to perform a meaningful country-specific evaluation. Germany serves as the example for the analysis.

Keywords

bibliometrics; highly cited researchers; Thomson Reuters

1 Introduction

In 2014 Thomson Reuters (TR, provider of the Web of Science, WoS) published a list of highly-cited researchers worldwide (<http://highlycited.com/>). This includes those scientists who have published the most papers in their discipline which belong to the 1% of the most-cited papers. The great advantage of the TR data consists in their being standardised with regard to time (publication range from 2002 to 2012), the document type (only “articles” and “reviews”) and the discipline (the rankings of the researchers are produced within a discipline). The data therefore not only provide an overview over research excellence on the level of individual researchers, but they can also be evaluated on a higher aggregation level.

Bornmann and Bauer (in press) have presented a first evaluation in which the scientists are evaluated on the basis of their affiliations. In this short communication we would like to indicate how the TR data can be used to perform a meaningful country-specific evaluation. Germany serves as the example for the analysis.

2 Methods

In order to identify the highly-cited researchers, TR evaluates the publications with the document types “article” and “review” in journals of the natural and social sciences and the humanities published between 2002 and 2012. Of these publications, TR determines those which belong to the 1% of the most-cited publications in their subject area and publication year (Bornmann & Bauer, in press). The authors of these highly cited publications were categorized under the discipline (e.g. materials science; see <http://in-cites.com/thresholds-citation.html>) associated with the journals where their highly cited publications appeared. A ranking order was established within a discipline. The more highly cited publications a researcher had, the higher was their rank in the discipline. The list of the highly cited researchers published under the URL above includes those researchers whose ranking is equal

to or greater than the square root of the population (of all researchers in a discipline with at least one highly cited publication).

The evaluations presented below are based on the primary addresses of the researchers. As the analyses of the addresses in Bornmann and Bauer (in press) have shown, the inclusion of additional addresses for the researchers leads to results which have hardly anything to do with research quality. Thus King Abdulaziz University, Saudi Arabia, lands in second place in a worldwide institution ranking which takes into account all the addresses for highly cited researchers (i.e. in front of Harvard University and the University of Stanford). When only the primary addresses of the researchers were used, King Abdulaziz University performed much worse (Gingras, 2014).

Whereas the analyses of Bornmann and Bauer (in press) assess the institutes of larger organisations, such as those of the Max Planck Society, in combination, the current study analyses the organisations' individual institutions separately. The separation was performed because this study is also looking into regional distributions, and the institutes of an organisation are frequently distributed regionally.

3 Results

The TR database contains a total of 3215 researchers worldwide. Table 1 shows the distribution of the researchers by country. As the results show, more than half the researchers work in the USA; a further ~10% in Great Britain. Germany, with 164, has around 5% of the researchers. Similar results have been published by Myklebust (2014).

Table 1. Distribution of highly cited researchers by country. The table only includes countries with at least ten researchers.

Country	absolute frequency	per cent	Cumulative share
USA	1,701	52.91	52.91
UK	303	9.42	62.33
Germany	164	5.10	67.43
China	160	4.98	72.41

Japan	98	3.05	75.46
Canada	89	2.77	78.23
France	84	2.61	80.84
Netherlands	76	2.36	83.20
Switzerland	67	2.08	85.29
Australia	65	2.02	87.31
Italy	52	1.62	88.93
Spain	43	1.34	90.26
Saudi Arabia	33	1.03	91.29
Belgium	32	1.00	92.29
Sweden	28	0.87	93.16
Denmark	27	0.84	94.00
South Korea	21	0.65	94.65
Austria	19	0.59	95.24
Finland	14	0.44	95.68
Singapore	14	0.44	96.11
Ireland	12	0.37	96.49
Iceland	11	0.34	96.83
Iran	11	0.34	97.17
Israel	10	0.31	97.48
Turkey	10	0.31	97.79
Remaining countries	71	2.21	100.00
Total	3215	100.00	

Table 2. Distribution of highly cited researchers from Germany by discipline

Discipline	Germany		Worldwide		Difference per cent
	absolute	per cent	absolute	per cent	
Plant & Animal Science	18	10.98	176	5.47	5.51
Materials Science	14	8.54	147	4.57	3.97
Chemistry	16	9.76	198	6.16	3.6
Agricultural Sciences	9	5.49	112	3.48	2.01
Physics	10	6.1	144	4.48	1.62
Space Science	8	4.88	106	3.3	1.58
Computer Science	7	4.27	117	3.64	0.63
Environment/Ecology	8	4.88	137	4.26	0.62
Geosciences	9	5.49	159	4.95	0.54
Clinical Medicine	20	12.2	402	12.5	-0.3
Immunology	3	1.83	87	2.71	-0.88
Pharmacology & Toxicology	5	3.05	133	4.14	-1.09
Economics & Business	3	1.83	95	2.95	-1.12
Mathematics	3	1.83	99	3.08	-1.25
Biology & Biochemistry	7	4.27	195	6.07	-1.8
Psychiatry/Psychology	2	1.22	100	3.11	-1.89
Molecular Biology & Genetics	7	4.27	201	6.25	-1.98
Engineering	6	3.66	187	5.82	-2.16
Neuroscience &	3	1.83	129	4.01	-2.18

Behaviour					
Microbiology	2	1.22	114	3.55	-2.33
Social Sciences, general	4	2.44	177	5.51	-3.07
Total	164	100.00	3215	100.00	

Table 2 shows the results of the analysis with respect to the disciplines associated with the researchers (or their publications) from Germany. The table shows that the researchers are particularly often associated with the disciplines “Clinical Medicine” (~ 12%), “Plant & Animal Science” (~ 11%) and “Chemistry” (~ 10%). In order to give an impression which disciplines are particularly often represented by researchers in Germany, the table also includes two columns with the numbers of the worldwide distribution. As shown by the difference between the per cent values for all researchers and those from Germany, researchers from Germany are especially over-represented in “Plant & Animal Science” (5.51%), “Materials Science” (3.97%) and “Chemistry” (3.6%) and under-represented in “Microbiology” (-2.33%) and “Social Sciences, general” (-3.07%).

Table 3. Distribution of highly cited researchers from Germany by Federal State

Federal State	Number	Per cent	Cumulative per cent
Bavaria	35	21.47	21.47
Baden-Württemberg	34	20.86	42.33
North Rhine-Westphalia	23	14.11	56.44
Brandenburg	10	6.13	62.58
Hesse	10	6.13	68.71
Rhineland-Palatinate	10	6.13	74.85
Thuringia	8	4.91	79.75
Saxony	7	4.29	84.05
Berlin	6	3.68	87.73
Lower Saxony	6	3.68	91.41
Saxony-Anhalt	4	2.45	93.87
Hamburg	3	1.84	95.71
Schleswig-Holstein	3	1.84	97.55
Bremen	2	1.23	98.77
Mecklenburg-Vorpommern	1	0.61	99.39
Saarland	1	0.61	100.00
Total	163	100.00	

Table 3 shows the distribution of the highly cited researchers across the Federal States in Germany. In this assessment, one researcher could not be included since their institutional data could not be verified. As the results in the table show, around half of the researchers come from two (out of 16) federal states: Bayern (35 researchers) and Baden-Württemberg (34 researchers).

Table 4. Distribution of highly cited researchers from Germany by city. Only cities with at least four researchers are included.

City	Number	Per cent	Cumulative per cent
Greater Munich	27	16.56	16.56
Greater Berlin	16	9.82	26.38
Heidelberg	16	9.82	36.20
Mainz	9	5.52	41.72
Stuttgart	7	4.29	46.01
Bonn	5	3.07	49.08
Jena	5	3.07	52.15
Aachen	4	2.45	54.60
Frankfurt	4	2.45	57.06
Hanover	4	2.45	59.51
Cologne	4	2.45	61.96
Leipzig	4	2.45	64.42
Nuremberg/Erlangen	4	2.45	66.87
Ulm	4	2.45	69.33
Remaining cities	50	30.77	100.00
Total	163	100.00	

Table 4 shows the distribution of highly cited researchers from Germany by city. In this analysis too, one researcher could not be included since their institutional data could not be verified. For Munich and Berlin, a greater area was formed in which, for example, Martinsried is associated with Munich and Potsdam with Berlin. As the results in the table show, around half of the researchers come from six (out of 45) cities: The most researchers come from greater Munich (with 27 researchers) and greater Berlin or Heidelberg (each with 16 researchers).

Table 5. Distribution of highly cited researchers from greater Munich by discipline

Discipline	Greater Munich		Germany		Difference per cent
	absolute	Per cent	absolute	Per cent	
Molecular Biology & Genetics	5	18.52	7	4.29	14.23
Space Science	4	14.81	8	4.91	9.9
Physics	4	14.81	10	6.13	8.68
Psychiatry/Psychology	2	7.41	2	1.23	6.18
Computer Science	2	7.41	7	4.29	3.12
Immunology	1	3.7	3	1.84	1.86
Mathematics	1	3.7	3	1.84	1.86
Social Sciences, general	1	3.7	4	2.45	1.25
Pharmacology & Toxicology	1	3.7	5	3.07	0.63
Engineering	1	3.7	6	3.68	0.02
Biology & Biochemistry	1	3.7	7	4.29	-0.59
Clinical Medicine	3	11.11	20	12.27	-1.16
Microbiology	0	0	2	1.23	-1.23
Economics & Business	0	0	3	1.84	-1.84
Neuroscience & Behavior	0	0	3	1.84	-1.84
Environment/Ecology	0	0	8	4.91	-4.91
Geosciences	0	0	8	4.91	-4.91
Agricultural Sciences	0	0	9	5.52	-5.52
Plant & Animal Science	1	3.7	18	11.04	-7.34
Materials Science	0	0	14	8.59	-8.59
Chemistry	0	0	16	9.82	-9.82
Total	27	100.00	163	100.00	

Table 5 shows the highly cited researchers who work in greater Munich, classified by discipline. The distribution of researchers by discipline is compared with that for researchers in the whole of Germany. As this comparison shows, researchers in greater Munich are particularly over-represented in “Molecular Biology & Genetics” (14.23%), “Space Science” (9.9%) and “Physics” (8.68%).

Table 6 shows the distribution of highly cited researchers who work in Germany by institution. It is apparent that the University of Heidelberg has the most highly cited researchers. But overall the Max Planck institutes dominate among the institutions.

Table 6. Distribution of highly cited researchers from Germany by institution. The table only includes institutions with at least three researchers.

Institution	Number	Per cent	Cumulative per cent
University of Heidelberg	8	4.88	4.88
Max Planck Institute of Molecular Plant Physiology	6	3.66	8.54
University of Munich	6	3.66	12.20
Technical University Munich	5	3.05	15.24
European Molecular Biology Laboratory	4	2.44	17.68
German Research Center for Environmental Health	4	2.44	20.12
Max Planck Institute for Chemistry	4	2.44	22.56
Max Planck Institute for Polymer Research	4	2.44	25.00
RWTH Aachen University	4	2.44	27.44
University of Bonn	4	2.44	29.88
University of Frankfurt	4	2.44	32.32
German Heart Centre Munich	3	1.83	34.15
Hannover Medical School	3	1.83	35.98
Max Planck Institute for Astrophysics	3	1.83	37.80
Max Planck Institute of Colloids and Interfaces	3	1.83	39.63
Max Planck Institut für Kohlenforschung	3	1.83	41.46
Max Planck Institute for Plant Breeding Research	3	1.83	43.29
Helmholtz Centre for Environmental Research	3	1.83	45.12
University of Erlangen-Nuremberg	3	1.83	46.95
University of Gießen	3	1.83	48.78
University of Hohenheim	3	1.83	50.61
University of Kiel	3	1.83	52.44
University of Ulm	3	1.83	54.27
Remaining institutions	75	46.73	100.00
Total	164	100.00	

4 Discussion

As the evaluations in this study show, the data from TR can, on the one hand, be used to investigate the distribution of research excellence in a country. The distribution in Germany is seen to be characterized by a high degree of concentration: In Germany, around half the researchers work in only two Federal States (Bavaria und Baden-Württemberg). Around a

third of the researchers in Germany work in facilities which are located in only three cities (of their greater areas) – Munich, Berlin and Heidelberg.

On the other hand, the TR data can be used to perform evaluations with regard to disciplines. Here, the comparison of a subgroup with a whole can show in which disciplines researchers are over or under-represented. As the assessments for Germany show, researchers from Germany, compared with researchers a whole, are over-represented in “Plant & Animal Science” as well as “Materials Science”. In greater Munich, researchers in “Molecular Biology & Genetics” as well as “Space Science” are over-represented in comparison with Germany as a whole.

Evaluations, as we have performed here for Germany, can provide interesting insights into the distribution of (subject-specific) research excellence in a country.

References

- Bornmann, L., & Bauer, J. (in press). Which of the world's institutions employ the most highly cited researchers? An analysis of the data from highlycited.com. *Journal of the Association for Information Science and Technology*.
- Gingras, Y. (2014). How to boost your university up the rankings, *University World News*. Retrieved from <http://www.universityworldnews.com/article.php?story=20140715142345754>
- Myklebust, J. P. (2014). Meet the world's 3,215 hottest researchers. Retrieved July 1, 2014, from <http://www.universityworldnews.com/article.php?story=20140626174600925>