Novel Indicators of Research Impact and Policy Implications

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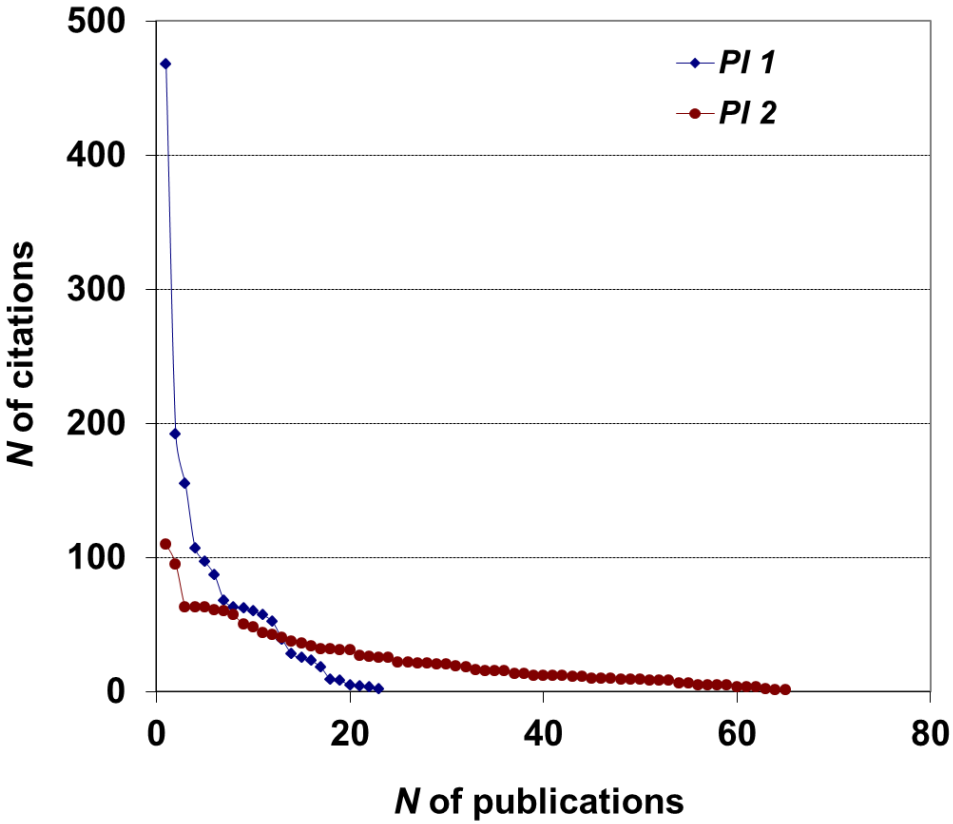
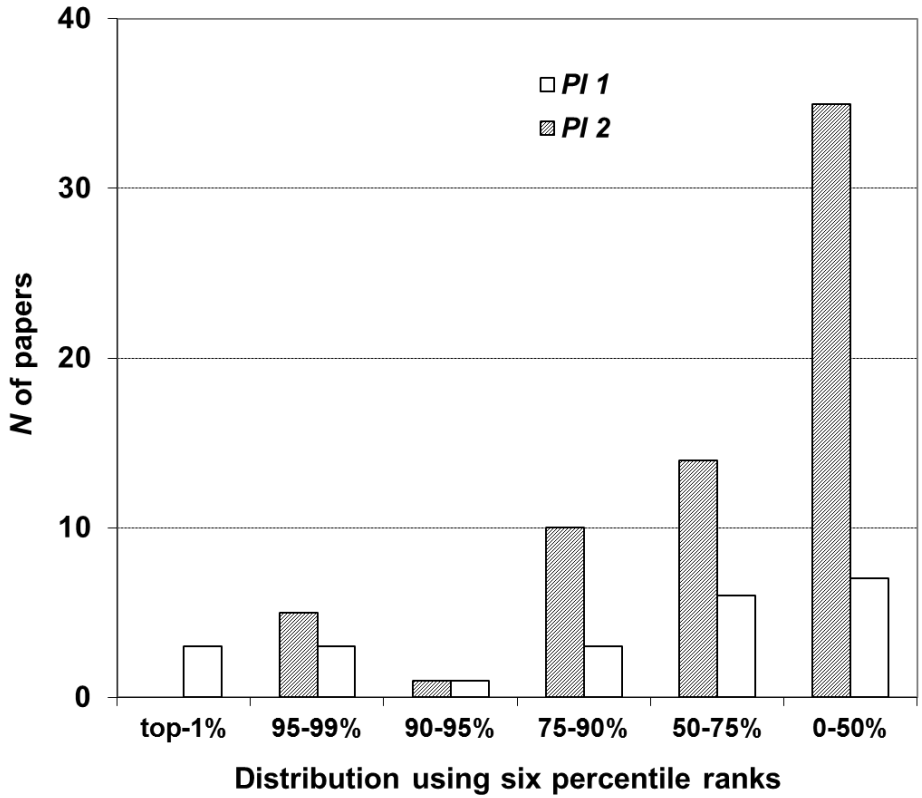




PI 1	***c/p* = 1,623 / 23 = 71.0**
PI 2	***c/p* = 1,578 / 65 = 24.3**

PI 1	$\sum_i^6 x_i n_i = 65$
PI 2	$\sum_i^6 x_i n_i = 122$

Three main problems

1. Skewed distributions

   →non-parametric statistics

2. The baselines for field delineations needed for the normalization;

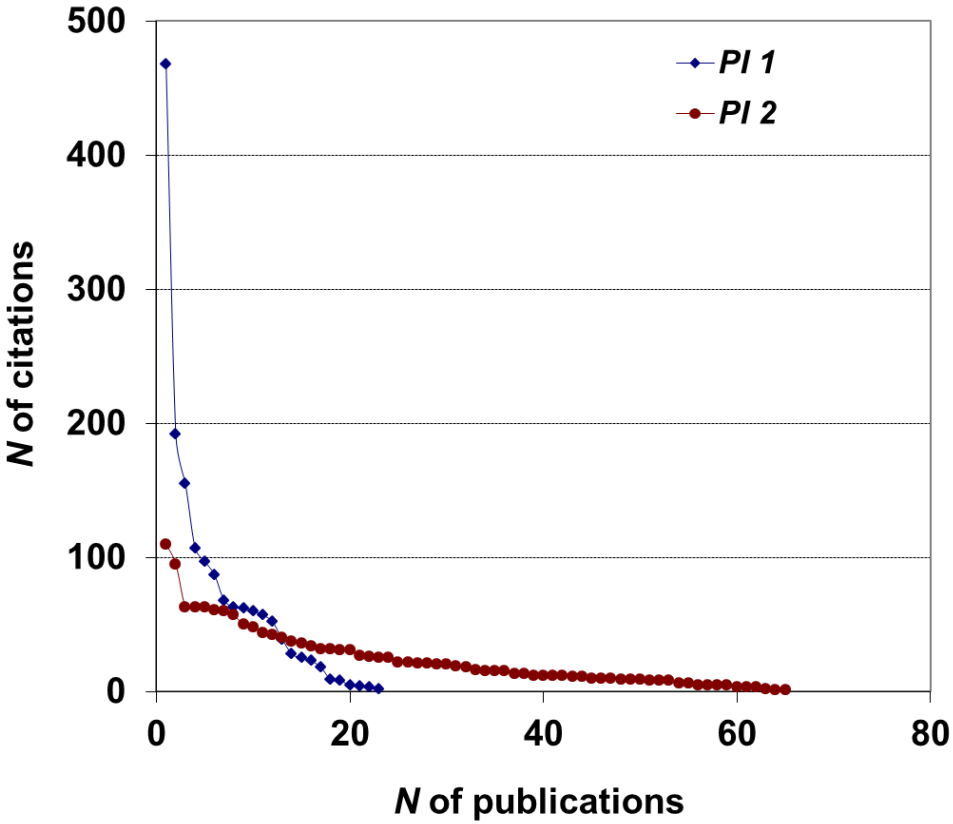
3. Can excellent research be distinguished from good research?

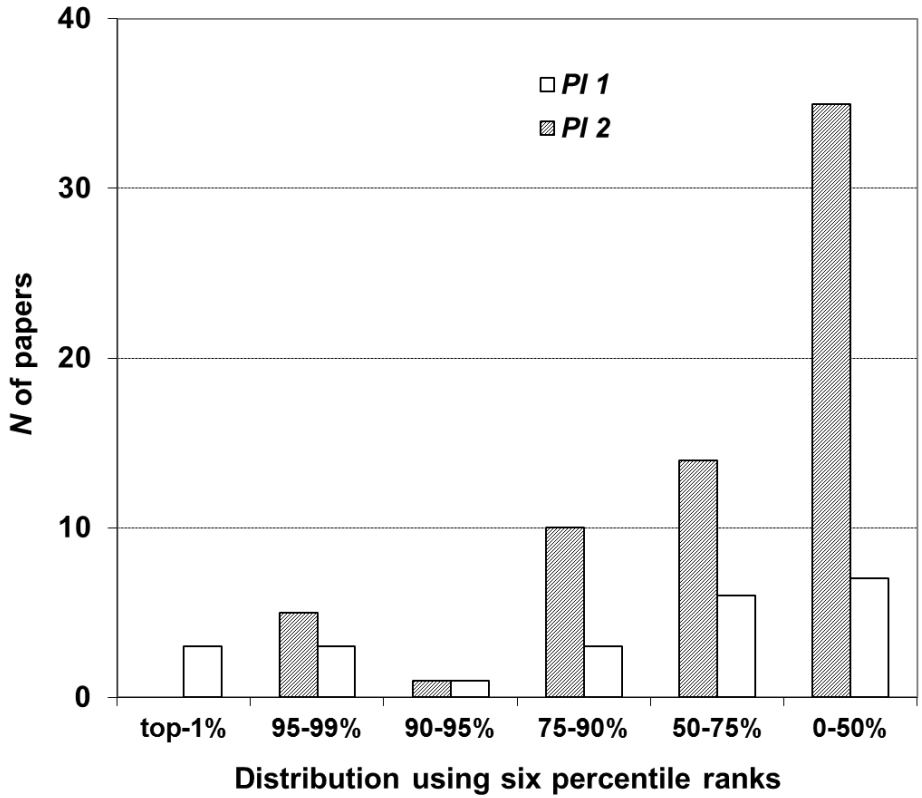
Leuven, Leiden, Budapest (1985 →):

$$MNCR = \frac{MOCR}{MECR} = \frac{\sum_{i=1}^{m} c_i}{\sum_{i=1}^{n} f_i}$$

Opthof & Leydesdorff, 2010:

$$MNCS = \left(\frac{c_{1i}}{f_i} + \frac{c_{2i}}{f_i} + \frac{c_3}{f_j} + \frac{c_4}{f_k}\right) / 4$$





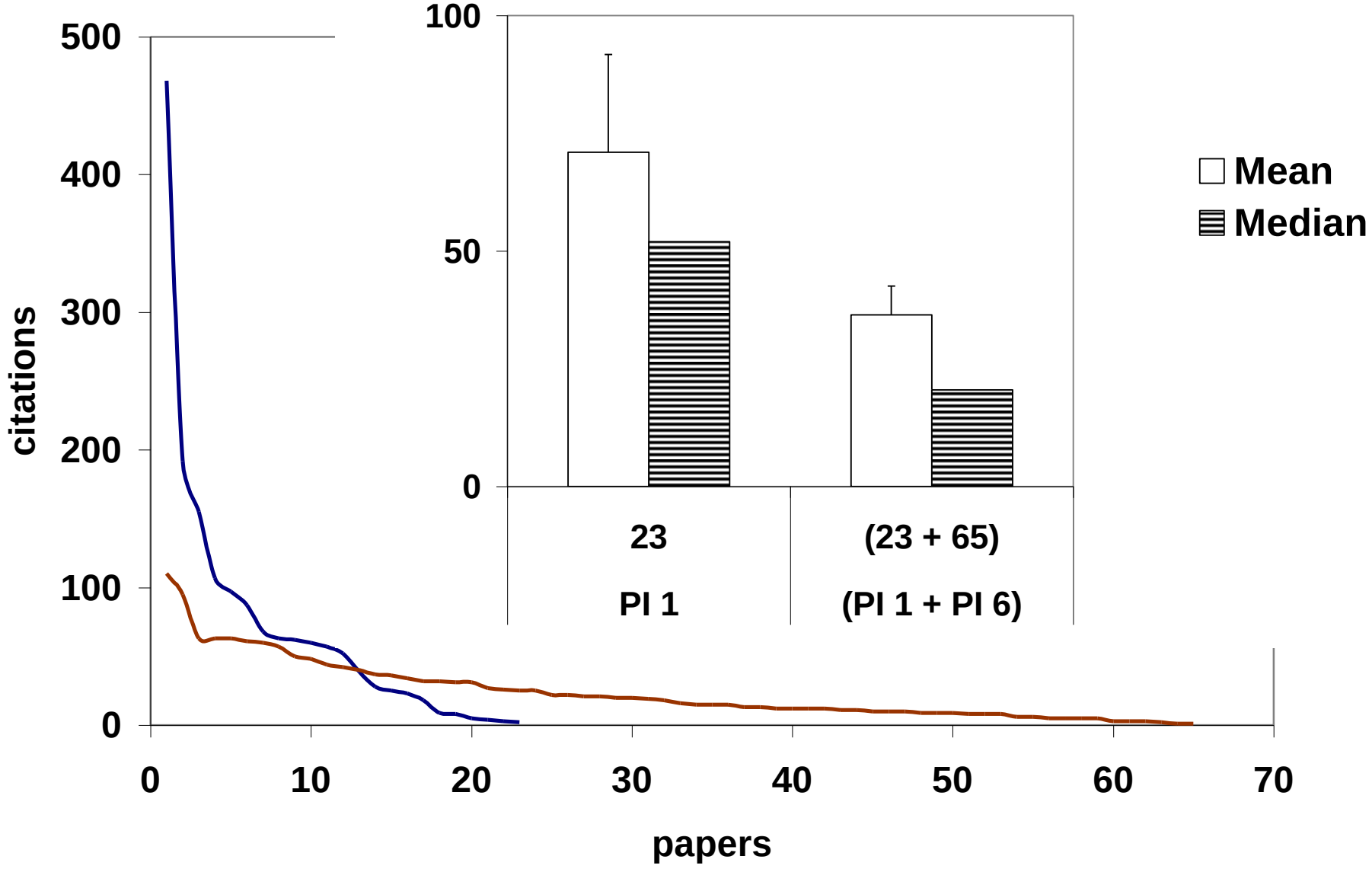
PI 1	***c/p* = 1,623 / 23 = 71.0**
PI 2	***c/p* = 1,578 / 65 = 24.3**

PI 1	$\overline{obs/exp}$ **= 2.03 (± 0.55)**
PI 2	$\overline{obs/exp}$ **= 0.91 (± 0.11)**

PI 1	$\sum_i^6 x_i n_i$ **= 65**
PI 2	$\sum_i^6 x_i n_i$ **= 122**

Non-parametric statistics:

- **chi-square**
- **Kruskal-Wallis**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400
300
200
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0
citations
0
10
20
30
40
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papers
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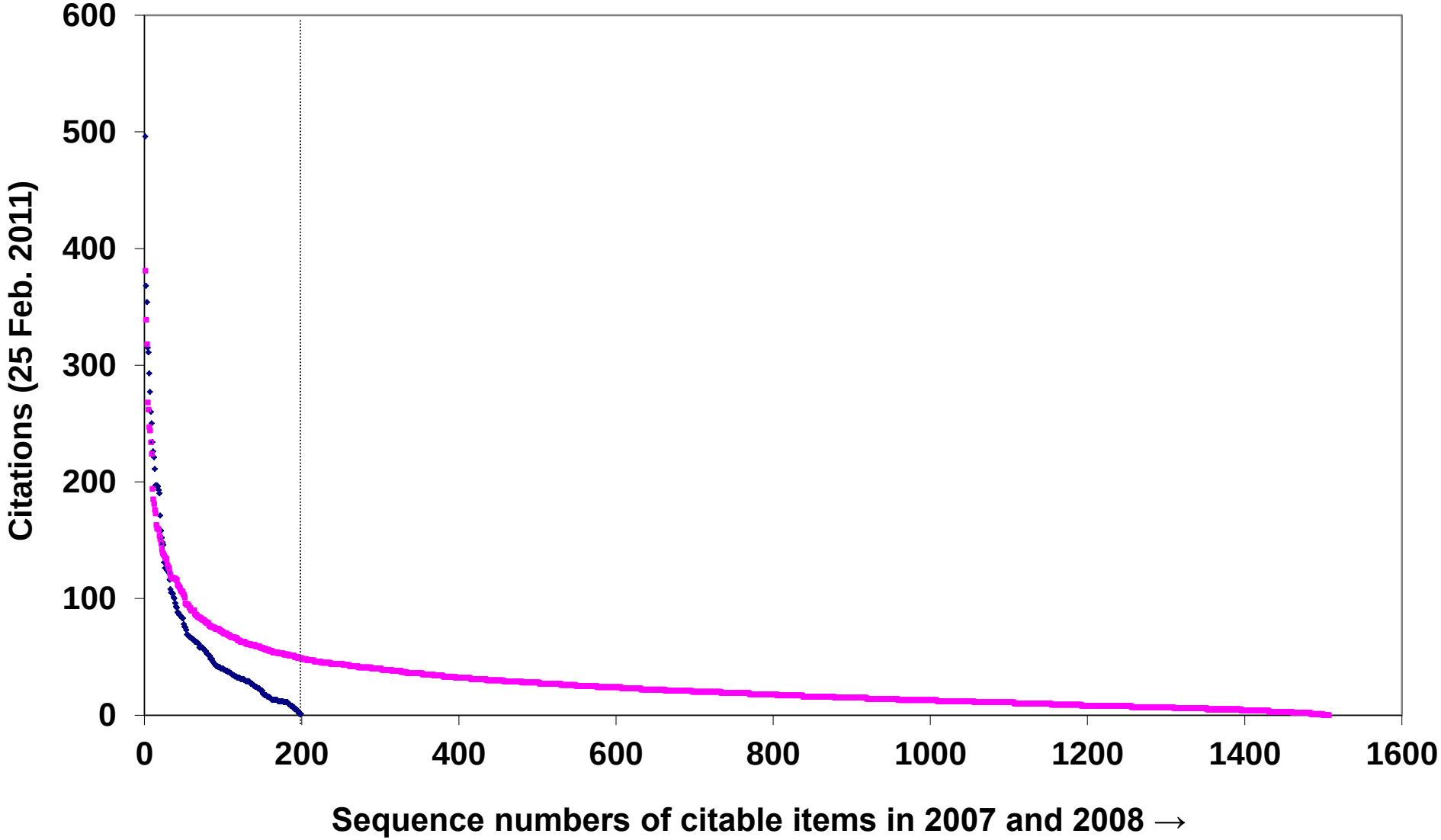
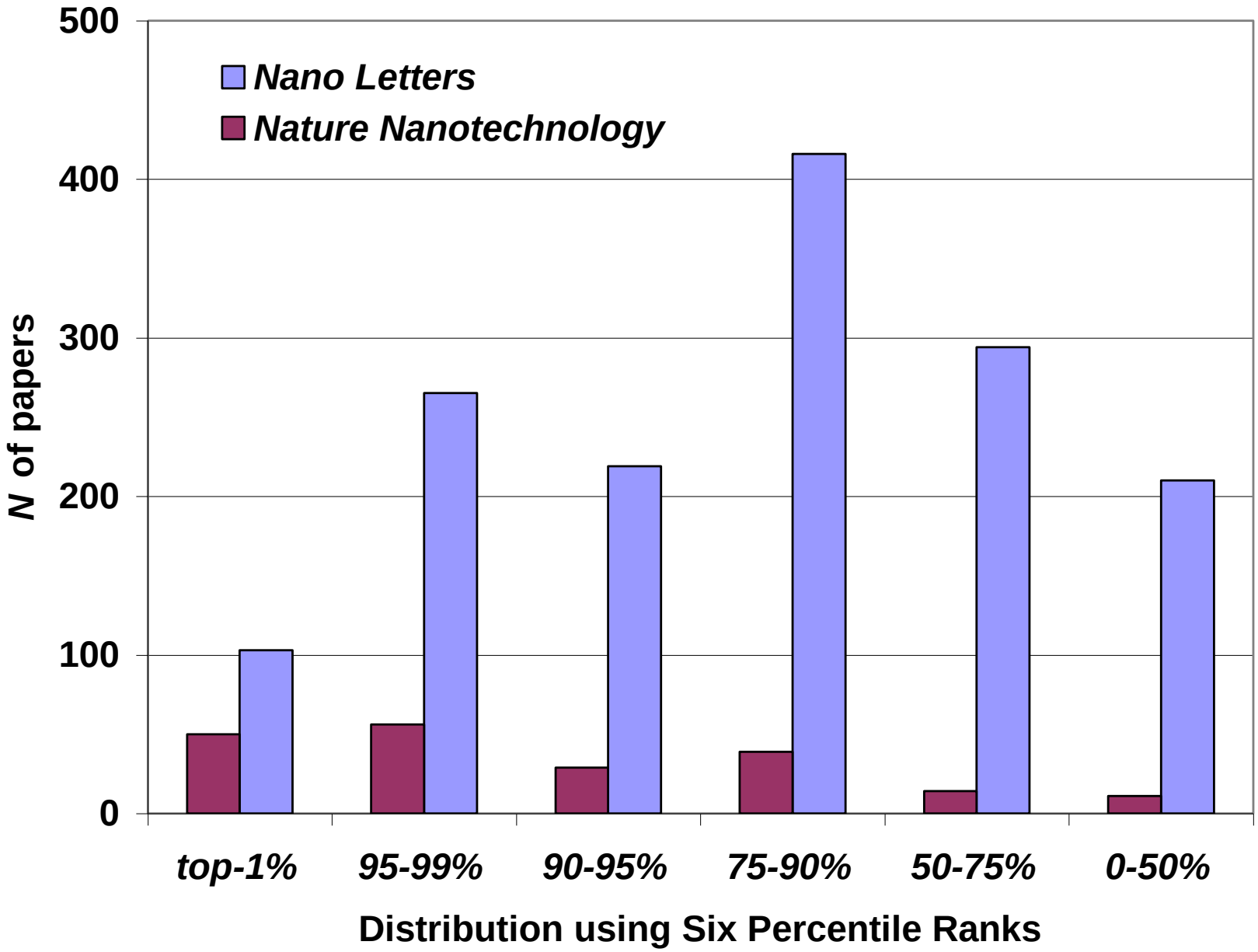
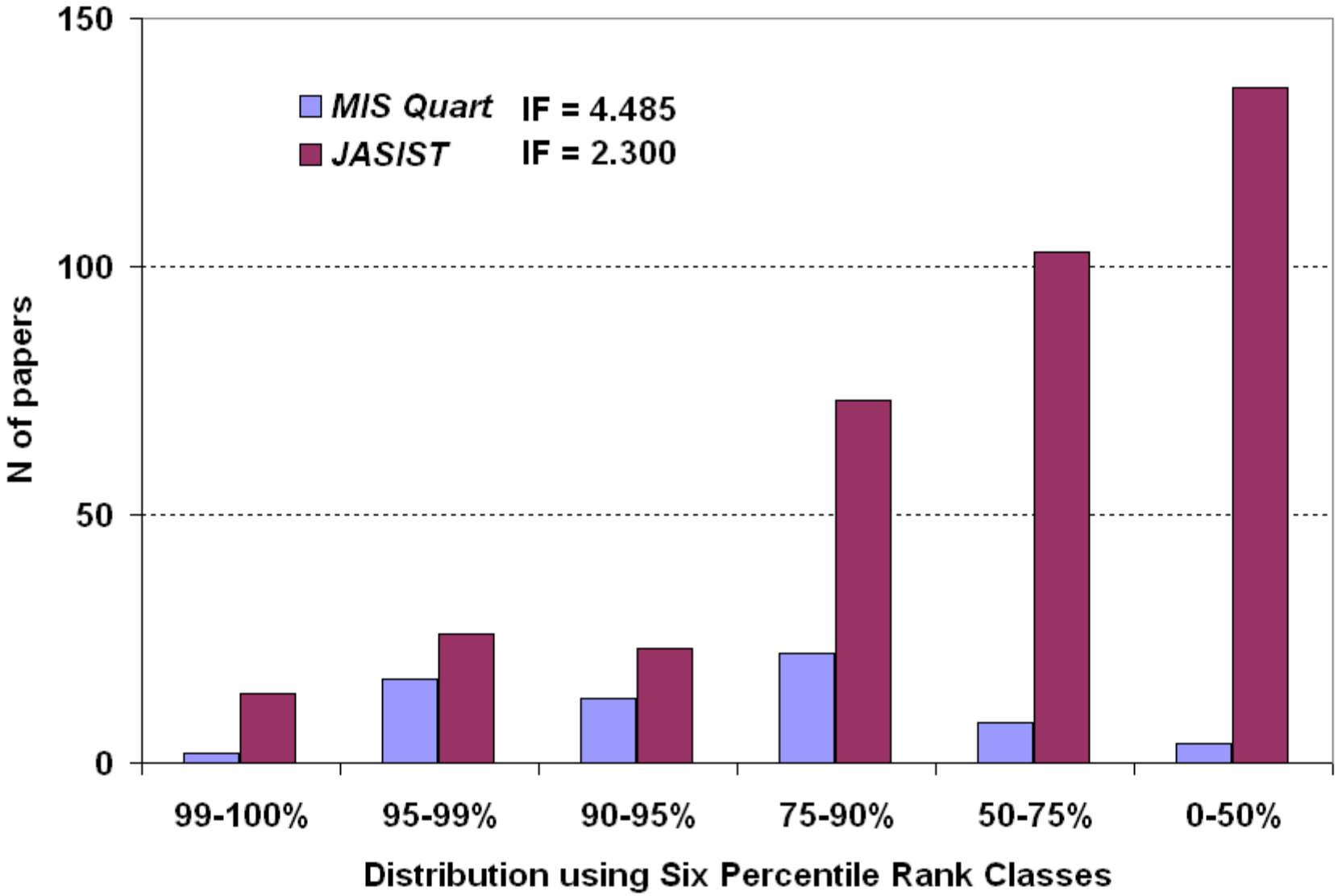
23
PI 1
(23 + 65)
(PI 1 + PI 6)
Mean
Median



	IF 2009	*N*
Nature Nanotechn. ♦♦♦♦	26.309	199
Nano Letters ■■■■	9.991	1,506


500
400
300
200
100
0
N of papers
Nano Letters
Nature Nanotechnology
top-1%
95-99%
90-95%
75-90%
50-75%
0-50%
Distribution using Six Percentile Ranks


150
100
50
0
N of papers
MIS Quart IF = 4.485
JASIST IF = 2.300
99-100%
95-99%
90-95%
75-90%
50-75%
0-50%
Distribution using Six Percentile Rank Classes

$$I3 = \sum_i x_i * f(x_i)$$

Integrated Impact Indicator

- 100 percentile ranks
- six percentile ranks (NSF)
- quartiles (UK)
- top-10% → two ranks

Table 4: Rankings between **20 journals of "Nanoscience & nanotechnology"** with highest values on *I3* (expressed as percentages of the sum) compared with *IF*s, total citations, and % *I3*(*6PR*).

Journal	N of papers (a)	% I3 (b)	IF 2009 (c)	Total citations (d)	% I3 (6PR) (e)
J Phys Chem C	5,585	20.71 [1] ++	4.224 [9]	62,072	18.79 [1] ++
Mater Sci Eng A-Struct Mater	3,222	8.82 [2] --	1.901 [12]	15,920	8.64 [2] --
Nano Lett	**1,507**	**7.99 [3] ++**	**9.991 [2]**	**42,159**	**8.38 [3] ++**
Nanotechnol	2,656	7.96 [4] --	3.137 [10]	18,748	7.22 [5] --
Advan Mater	1,512	7.61 [5] ++	8.379 [3]	34,581	7.59 [4] ++
Adv Funct Mater	883	4.24 [6] ++	6.990 [5]	16,629	4.04 [7] ++
J Nanosci Nanotechnol	1,699	3.74 [7] --	1.435 [15]	5,946	4.07 [6] --
Biosens Bioelectron	821	3.57 [8] ++	5.429 [8]	11,583	3.34 [8] ++
Scripta Mater	1,153	3.43 [9] --	2.949 [11]	8,656	3.13 [11] --
Microporous Mesoporous Mat	1,041	3.40 [10] ++	2.652 [12]	7,140	3.14 [10]
Microelectron Eng	1,064	3.14 [11] --	1.488 [13]	4,090	3.17 [9] -
Small	595	2.58 [12] ++	6.171 [7]	9,811	2.40 [14] ++
Lab Chip	520	2.34 [13] ++	6.342 [6]	8,930	2.21 [15] ++
J Vac Sci Technol B	962	2.29 [14] --	1.460 [14]	3,471	2.43 [13] --
Physica E	1,004	2.26 [15] --	1.177 [16]	3,126	2.64 [12] --
J Micromechanic Microengineer	778	1.86 [16] --	0.541 [19]	186	1.86 [16] --
Acs Nano	349	1.73 [17] ++	7.493 [4]	6,845	1.72 [17] ++
Microelectron Rel	627	1.20 [18] --	1.117 [17]	1,767	1.44 [19] --
Nat Nanotechnol	**199**	**1.20 [19] ++**	**26.309 [1]**	**13,224**	**1.47 [18] ++**
Microsyst Technol	475	1.00 [20] --	1.025 [18]	1,265	1.17 [20] --

Note. ++ $p < 0.01$ above the expectation; + $p < 0.05$ above the expectation.
Ranks are added between brackets.

Table 3. Rank-order correlations (Spearman's ρ; upper triangle) and Pearson correlations r (lower triangle) for **58 journals of Nanoscience & Nanotechnology (2009).**

Indicator	*IF-2009*	*I3*	*6PR*	*Number of publications*	*Total citations*
IF-2009		.442 **	.312 **	.159	.681 **
I3	.178		.966 **	.874 **	.900 **
6PR	.186	.998 **		.952 **	.861 **
N of publications	.064	.963 **	.962 **		.802 **
Total citations	.370 **	.935 **	.940 **	.835 **	

** Correlation is significant at the 0.01 level (2-tailed);
* Correlation is significant at the 0.05 level (2-tailed).

		Publications	Citations	Cit/Pub	% I3	% PR6
1	USA	16,039	234,370	14.61	27.73 ++	27.93 ++
2	Peoples R China	8,653	83,079	9.60	12.88 --	12.74 --
3	Japan	4,798	39,469	8.23	7.08 --	7.00 --
4	Germany	3,802	43,231	11.37	6.54 ++	6.46 ++
5	South Korea	4,250	32,772	7.71	6.10 --	6.14 --
6	France	2,803	21,099	7.53	4.04 --	3.92 --
7	England	1,963	24,875	12.67	3.24 ++	3.24 ++
8	Taiwan	2,529	19,068	7.54	3.24 --	3.30 --
9	Italy	2,021	15,738	7.79	3.00 --	2.92 --
10	India	2,215	13,593	6.14	2.67 --	2.72 --
11	Spain	1,527	14,692	9.62	2.45 ++	2.33 -
12	Canada	1,360	13,418	9.87	2.09	2.04
13	Singapore	1,219	13,785	11.31	1.94 ++	1.91
14	Netherlands	872	10,951	12.56	1.53 ++	1.51 ++
15	Australia	919	9,560	10.40	1.51 ++	1.45
16	Switzerland	682	9,565	14.02	1.29 ++	1.27 ++
17	Belgium	668	5,683	8.51	1.05 ++	1.04
18	Sweden	566	6,661	11.77	0.96 ++	0.96 ++
19	Israel	525	5,662	10.78	0.86 ++	0.78
20	Russia	1,023	3,410	3.33	0.81 --	1.11 --

		Publications	Citations	c/p	% I3	% PR6
1	Chinese Acad Sci, Beijing, Peoples R China	824	11,258	13.66	1.43^{++}	1.42^{++}
2	MIT, Cambridge, USA	420	8,372	19.93	0.89^{++}	0.90^{++}
3	Univ Calif Berkeley, Berkeley, USA	425	8,639	20.33	0.88^{++}	0.92^{++}
4	Natl Univ Singapore, Singapore, Singapore	470	6,483	13.79	0.83^{++}	0.82^{++}
5	Northwestern Univ, Evanston, USA	304	7,594	24.98	0.63^{++}	0.68^{++}
6	Univ Michigan, Ann Arbor, USA	301	5,633	18.71	0.63^{++}	0.63^{++}
7	Univ Illinois, Urbana, USA	307	6,905	22.49	0.61^{++}	0.62^{++}
8	Georgia Inst Technol, Atlanta, USA	307	5,658	18.43	0.61^{++}	0.62^{++}
9	Nanyang Technol Univ, Singapore, Singapore	383	4,110	10.73	0.60^{+}	0.59
10	Penn State Univ, University Park, USA	293	4,519	15.42	0.52^{++}	0.53^{++}
11	Univ Cambridge, Cambridge, UK	276	4,677	16.95	0.52^{++}	0.52^{++}
12	Seoul Natl Univ, Seoul, South Korea	314	4,135	13.17	0.51^{++}	0.51^{+}
13	Peking Univ, Beijing, Peoples R China	285	3,698	12.98	0.50^{++}	0.50^{++}
14	Rice Univ, Houston, USA	239	6,170	25.82	0.49^{++}	0.55^{++}
15	Purdue Univ, Lafayette, USA	282	3,931	13.94	0.48^{++}	0.48^{++}
16	Tohoku Univ, Miyagi, Japan	349	2,274	6.52	0.47^{--}	0.47^{--}
17	Univ Washington, Seattle, USA	210	5,126	24.41	0.47^{++}	0.50^{++}
18	Natl Inst Mat Sci, Ibaraki, Japan	271	2,831	10.45	0.46^{++}	0.44
19	Natl Cheng Kung Univ, Tainan, Taiwan	340	2,256	6.64	0.43^{--}	0.43^{--}
20	Stanford Univ, Stanford, USA	200	5,894	29.47	0.42^{++}	0.47^{++}

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Notes
Active Dataset
Scree Plot
Component Matrix
Rotated Component Matrix
Total Variance Explained
Component Transformation Mat
Component Plot of Factors 1, 2,
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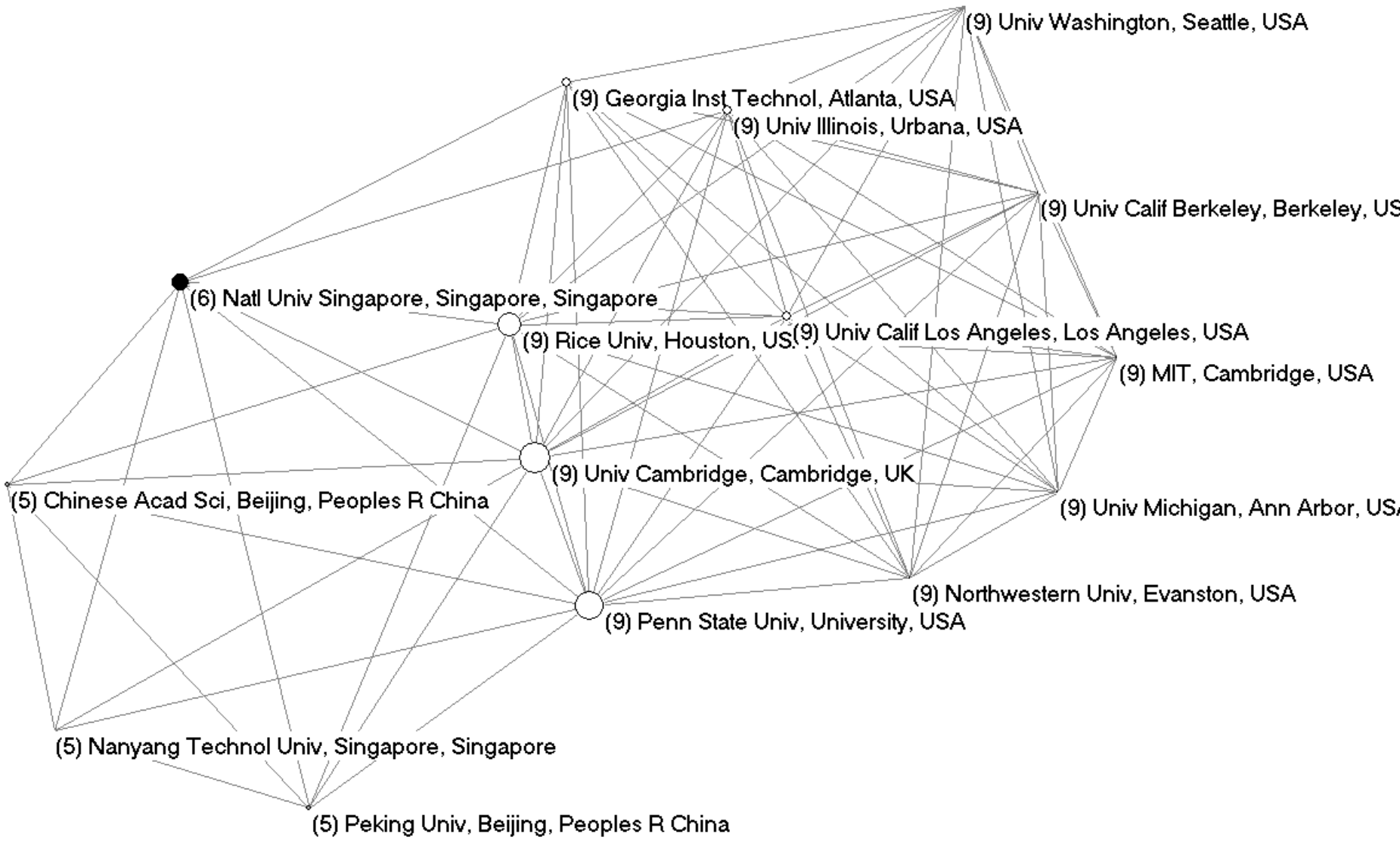
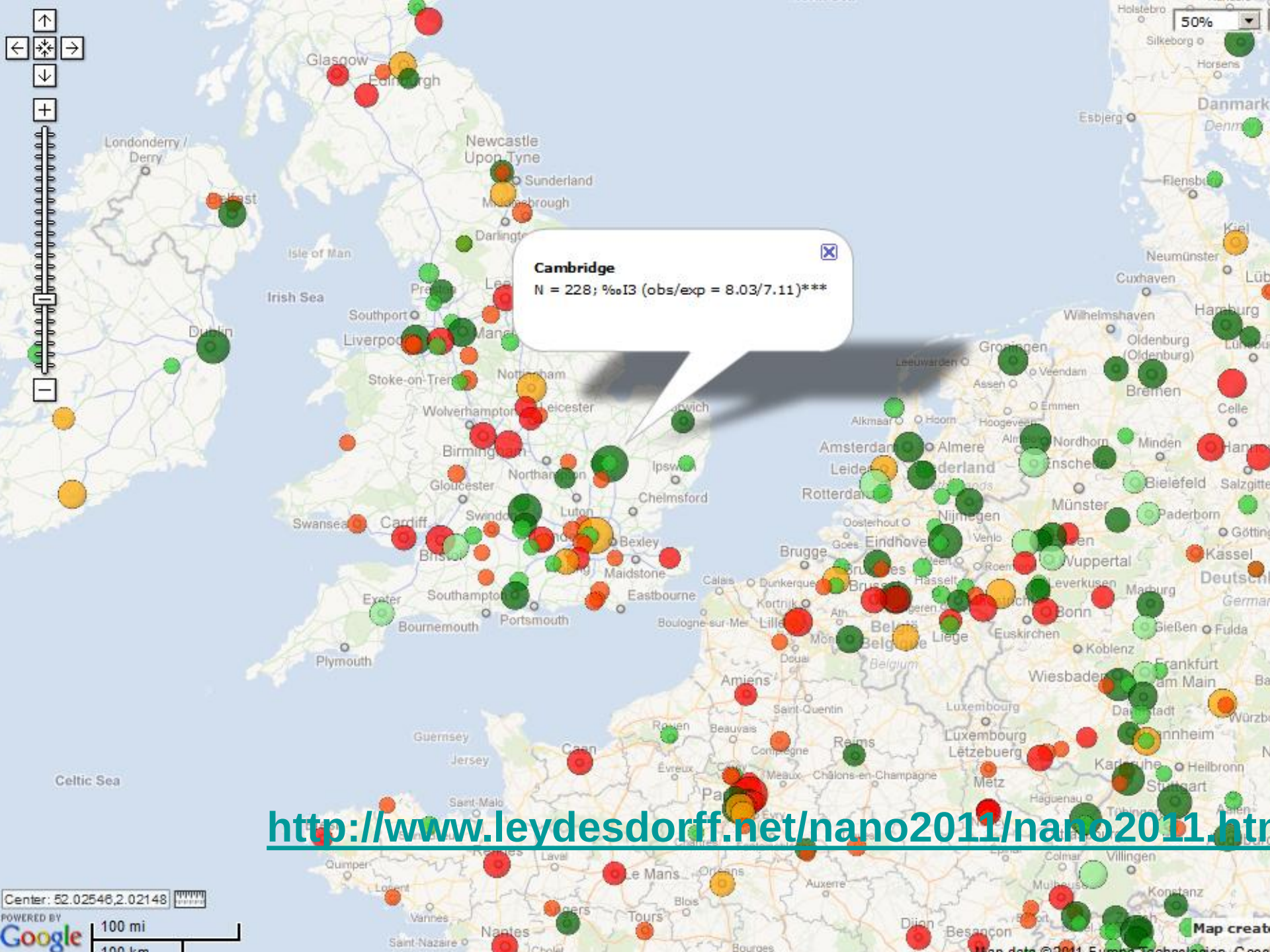
'actor Analysis
Title
Notes
Active Dataset
Scree Plot
Component Matrix
Rotated Component Matrix
Total Variance Explained
Component Transformation Mat
Component Plot of Factors 1, 2,

Rotated Component Matrix[a]

	Component			
	1	2	3	4
NANO LETT	.934		.192	
ADV MATER	.889		.153	
SMALL	.875		.293	
ADV FUNCT MATER	.853			
NANO TODAY	.841		.234	
INT J NANOTECHNOL	.838		.363	.130
J PHYS CHEM C	.836			
NANO	.816			
NAT NANOTECHNOL	.766		.147	
ACS NANO	.761			
PLASMONICS	.753			
NANOTECHNOLOGY	.741		.372	.326
J NANOMATER	.593		.205	.258
NANO RES	.526			
PHYSICA E	.430	-.144	.157	.245
J NANOPART RES	.334		.309	
MICROPOR MESOPOR MAT	.310			
ACS APPL MATER INTER	.260			
FULLER NANOTUB CAR N	.245			
NANOSCALE RES LETT	.165		.111	
ACM J EMERG TECH COM				
IET NANOBIOTECHNOL		.910		
MICROFLUID		.886		

	Journals (N = 14,794)	Institutes (N = 5,726)
1	*J Phys Chem C* $^{--}$	Chinese Acad Sci, Beijing, Peoples R China $^{++}$
2	*Nano Lett* $^{++}$	Univ Calif Berkeley, Berkeley, USA $^{++}$
3	*Advan Mater* $^{++}$	MIT, Cambridge, USA $^{+}$
4	*Nanotechnology* $^{--}$	Northwestern Univ, Evanston, USA $^{++}$
5	*Adv Funct Mater* $^{++}$	Natl Univ Singapore, Singapore, Singapore $^{++}$
6	*Physica E* $^{--}$	Univ Michigan, Ann Arbor, USA $^{++}$
7	*Small* $^{++}$	Georgia Inst Technol, Atlanta, USA $^{++}$
8	*ACS Nano* $^{++}$	Univ Illinois, Urbana, USA $^{++}$
9	*Nat Nanotechnol* $^{++}$	Rice Univ, Houston, USA $^{++}$
10	*Nano* $^{--}$	Peking Univ, Beijing, Peoples R China $^{++}$
11	*Nano Res* $^{--}$	Univ Cambridge, Cambridge, UK $^{++}$
12	*Int J Nanotechnol* $^{--}$	Univ Washington, Seattle, USA $^{++}$
13	*Nano Today* $^{++}$	Penn State Univ, University, USA $^{++}$
14	*J Nanomater* $^{--}$	Nanyang Technol Univ, Singapore, Singapore $^{++}$
15	*Plasmonics* $^{--}$	Univ Calif Los Angeles, Los Angeles, USA $^{++}$


(9) Univ Washington, Seattle, USA
(9) Georgia Inst Technol, Atlanta, USA
(9) Univ Illinois, Urbana, USA
(9) Univ Calif Berkeley, Berkeley, US
(6) Natl Univ Singapore, Singapore, Singapore
(9) Rice Univ, Houston, US
(9) Univ Calif Los Angeles, Los Angeles, USA
(9) MIT, Cambridge, USA
(9) Univ Cambridge, Cambridge, UK
(5) Chinese Acad Sci, Beijing, Peoples R China
(9) Univ Michigan, Ann Arbor, US
(9) Northwestern Univ, Evanston, USA
(9) Penn State Univ, University, USA
(5) Nanyang Technol Univ, Singapore, Singapore
(5) Peking Univ, Beijing, Peoples R China



http://www.leydesdorff.net/nano2011/nano2011.htm

Scientometrics
DOI 10.1007/s11192-012-0750-5

An evaluation of impacts in "Nanoscience & nanotechnology": steps towards standards for citation analysis

Loet Leydesdorff

http://www.leydesdorff.net/maps/institutions.html

Conclusions

1. Are units above or below expectation? (e.g., *z*-test for excellence; top-10%)
2. Are differences in ranking statistically significant or only a size effect? (Dunn's test)
3. Scoring schemes are *normative* (e.g., NSF using six percentile rank classes; quartiles; top-10%) → aggregation rules;
4. Fractional counting can correct for in-between field differences (*pm*).

The journal *Cognitive Science*

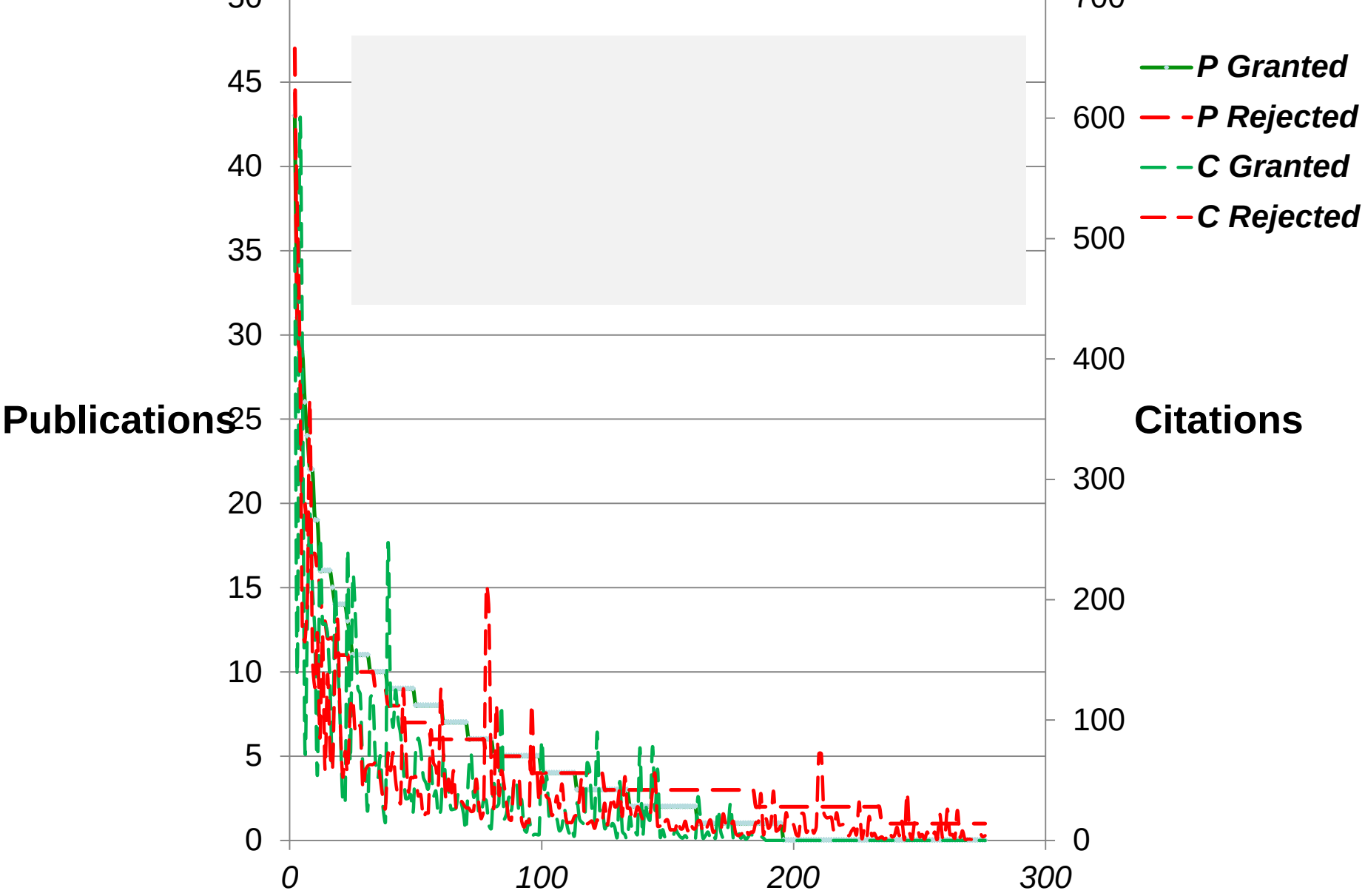
	1988	1998	2008
Factor 1	Exp. Psychology	**Linguistics**	**Neurosciences**
Factor 2	**Linguistics**	**Biology**	Perception/Vision
Factor 3	**Cognitive psychology**	Devl. Psychology	Devl. Psychology
Factor 4	**Computer science**	**Cognitive psychology**	Exp. psychology
Factor 5	Philosophy	**Computer science**	**Cognitive psychology**

- WoS: “experimental psychology”;
- NSF: “experimental psychology”

http://arxiv.org/abs/1203.4725

(with Tobias Opthof) **Citation Analysis with Medical Subject Headings (MeSH) using the Web of Knowledge: A new routine**,

JASIST (in press).



Van den Besselaar & Leydesdorff (2009);
Bornmann, Leydesdorff, & Van den Besselaar (2010)