

A National Research Profile-Based Immediacy Index and Citation Ratio Indicator for Research Evaluation

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Introduction

In this study we analyzed the behaviour of Field-based Crown Indicators¹ (here named FCI) for two smaller EU countries, Denmark and Finland, as well as for the European Union and globally calculated over three periods, 2001-2005, 2004 (cited 2004-05) and the most recent year, 2005. The purpose was to observe the robustness and stability of the indicator as a National Immediacy Index during the latter two periods compared to the five-year window.

The motivation is to provide national research funding agencies with information on the relative *citation impact* and national *citation visibility* of the most recent output in central research areas. To this end FCI (Moed et al., 1995) is applied based on data from the National Science Indicators database (NSI, Thomson Scientific). It is calculated based on the publication profile for each country, as defined by 19 broader scientific fields. The citation visibility is defined as the *ratio* of received citations by the country over the number of expected citations.

With respect to the citation visibility two calculations are done: First, for each field its global citation impact is multiplied by its national publication volume, providing the number of *expected citations* for that field. Essentially, this value represents a 'shadow-field' of the original national research field. When compared to the actual number of citations obtained by that field it is possible to observe the number of citations gained or lost. Secondly, the aggregated values over all the 'shadow-fields' signify the expected citation volume of the country in question. Finally, when calculating the mean citation visibility ratio the underlying national publication shares of the research fields (here 19) are acting as weights.

The present study assumes that the recent five-year citation and publication window, 2001-2005, provides a robust set of indicators. However, one would like to obtain assessment information on research as recent as possible – in the form of a kind of *National Immediacy Index* (NII). We compared the citation performance during the three snapshots by diachronic citation analyses. The aim was to observe if 1) it makes sense to apply broader research fields, but in very short and recent time frames (robustness); 2) there exist a significant correlation between impact and visibility results obtained from the three snapshots (stability).

Humanity fields were excluded but social science fields were included as one of the 19 central fields

forming the profile taken from NSI (2006). Publication types covered journal and review articles, notes and proceedings papers from journals and selected central research conferences. The 'Multidisciplinary' field in NSI adheres mainly to the sciences but does not contain field-specific articles from *Nature*, *PNAS*, *Science*, etc., which are placed in their proper fields. The Public Health sub-field was included in Clinical Medicine (extracted from Social Science, general). The NSI feature "one-year period cited-to-present" was used for the data collection. National self-citations are included.

In order to be robust we considered that each field in a NII must demonstrate at least 75 publications as a threshold for the most recent year, corresponding roughly to 15 citations received in a central field over the most recent year, with an impact of .20.

Analysis Results

The citation and publication volume for Denmark was 300,716 citations to 45,930 publications ($c/p = 6.55$) for 2001-2005; for 2005 alone Denmark obtained 6,528 citations to 10,167 publications ($c/p = .64$). In 2005 Finland received 4,663 citations to 9,065 publications ($c/p = .51$).

Table 1 provides for each country, EU and globally 1) the research profile in percent-shares of each field for the period 2001-05; 2) the standard FCI scores per field for all three periods; 3) the mean absolute impact per period; and 4) the mean citation (visibility) ratios. In the latter case an index value of 1.0 signifies that the national citation visibility is as expected compared to the global one.

We observe the high Danish absolute impact (NII) for 2005 (.64; FCI = 1.49) and that the Danish profile 2005 *differs significantly* from the Global, EU and Finnish ones, with foci on Biology & Biochemistry, and less on Chemistry and Engineering. Pearson's r for DK/Global profiles = .93; FIN/Global profiles = .96; and EU/Global profiles = .997. But we observe also that FCI as well as the citation (visibility) ratios decrease slightly in Denmark along with the extension of the citation (and publication) windows. In contrast, all Finland's index scores increase, probably because their local citation behavior differs from that of Denmark (and the overall EU, which seems stable over the periods).

Quite notably, already in 2005 many national fields turn out substantial FCI scores (values in bold signify scores above 1.25): 15 fields in Denmark –

ten more than Finland. However, a closer look at the Table discloses that very often the high impact does not persist over the next analysis periods. In Denmark only Neurosciences, Molecular biology & Genetics and, in particular, Immunology contributes negatively. Although Materials Sc. scores past 2.0 in 2004(05) it decreases in the longer time frame, as does Economics. Similar ups and downs can be observed for Finland and EU.

In terms of *robustness* one field in Denmark displayed a FCI score in 2005 far below the threshold (Computer Sc., FCI = .08; 7 citations,); in Finland several fields were below the FCI threshold, e.g., Computer Science (FCI=.17); Economics (FCI = .04; 5 citations) and Mathematics (FCI = .08; 8 citations). One may hence conclude that simply to apply the most recent year (here 2005) as basis for NII *does not make sense* for smaller countries.

van Raan (1999) has proposed for institutions that a FCI index score of 2 is Very Good and 3 is Excellent. Owing to ‘flattening’ by the averaging we suggest that in the NII a FCI score of 1.25 is *Good*; 1.50 is *Very Good*; and 2.0 is *Excellent*. The highest score so far observed for the three periods was found in 2005 for Physics & Space science produced in Switzerland (2.09).

The *stability* over the three analysis periods for the FCI scores per country was measured by means of Pearson’s *r* in pairs. For both Denmark and Finland the best correlation was identified between the two periods 2004(-05) and 2001-05 (DK, *r* = .72; FIN, *r* =.78; Critical Value = .57). The correlation for Denmark between the other period pairs was very low (.37). In contrast the large-volume region of EU demonstrated the best correlation between the two

recent periods (.92), but all its correlations were very similar.

Conclusion

We find it meaningful *only* to apply the National Immediacy Index calculated for the *penultimate year* cited diachronically up to the present for countries with an annual research output of approx. 8-9,000 ISI-indexed publications and the 19 broader central fields. Our results do not indicate the necessary robustness of NII nor stability for the most recent year’s research probably due to local citation behavior – both at individual field and national levels. We also propose simultaneously to apply annually our suggested NII compared to a performance analysis of the most recent five years. There are several benefits: one may immediately observe changes in the national publication profiles, research foci, FCI, citation visibility ratio and aspects like citedness, compared to the current research policy decisions, since the research done leading to the NII is young (only 3-4 years old). The two-year citation window in our NII balances between the request for recency in assessment and the ranges of citation peaks for the different research fields involved, an issue to be further investigated.

References

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Table 1. National and global research profiles (in percent), Field Crown Indicators (FCI), citation (visibility) ratios and absolute impact scores. Gray cells indicate top-4 research foci per country; bold and italics scores indicate FCI scores above index 1.25 and below 1.0. (NSI, 2006).

Scientific Fields	DK - pro-		Denmark FCI			FIN - pro-			Finland FCI			EU - pro-			EU FCI			World pro-			Global Impact		
	file 2001-05	2005 :004(-05)	2001-05	file 2001-05	2005	2004(-5)	2001-05	file 2001-05	2005	2004(-5)	2001-05	file 2001-05	2005	2004(-5)	2001-05	file 2001-05	2005	004(-5)	2001-05	2005	004(-5)	2001-05	
Agriculture & Plant Sc.	11,33	1,57	1,31	1,42	8,88	1,35	1,30	1,23	7,57	1,16	1,14	1,13	7,82	0,26	1,40	2,89							
Biology & Biochemistry	11,02	1,31	1,17	1,12	7,72	1,07	1,00	1,08	7,04	1,03	1,01	0,99	6,89	0,64	3,71	7,56							
Chemistry	8,62	1,34	1,44	1,50	9,03	1,02	0,98	1,02	12,91	1,09	1,05	1,07	13,18	0,44	2,36	4,28							
Clinical Medicine	26,20	1,57	1,45	1,48	28,16	1,38	1,25	1,43	24,30	1,05	1,03	1,01	23,14	0,48	2,62	5,27							
Computer Science	0,79	0,65	1,52	1,42	1,30	1,33	0,98	1,08	1,10	1,15	1,08	0,99	1,23	0,13	0,66	1,51							
Ecology/Environment	3,98	1,69	1,46	1,29	4,95	1,34	1,22	1,31	2,48	1,10	1,09	1,07	2,57	0,29	1,66	3,59							
Economics & Business	1,55	1,58	1,03	0,85	1,23	0,27	0,91	0,86	1,36	0,84	0,91	0,84	1,38	0,15	0,70	1,82							
Engineering	4,75	1,45	1,86	1,49	5,99	1,57	1,27	1,26	6,66	1,10	1,07	1,07	7,58	0,14	0,84	1,78							
Geosciences	3,39	1,32	1,45	1,45	2,59	1,55	1,52	1,35	2,92	1,16	1,11	1,10	2,77	0,35	1,62	3,44							
Immunology	2,16	0,87	0,80	0,83	1,56	1,07	0,99	0,96	1,59	0,96	0,95	0,95	1,50	0,90	5,34	10,62							
Materials Science	1,25	1,45	2,08	1,30	2,67	1,01	0,93	1,02	3,12	1,07	1,05	1,06	3,65	0,21	1,26	2,54							
Mathematics	1,18	1,87	1,36	1,39	1,28	0,61	0,83	1,08	2,24	1,14	1,11	1,09	1,91	0,12	0,61	1,32							
Microbiology	3,25	1,29	1,04	1,22	2,24	0,76	0,76	0,93	2,34	1,02	0,96	1,02	2,06	0,60	3,54	6,90							
Mol. Biol. & Genetics	2,65	0,91	1,13	1,17	2,82	0,74	1,00	1,05	2,74	1,00	0,98	1,01	2,64	1,12	6,32	12,63							
Multidisciplinary	1,16	1,62	1,47	1,10	1,11	0,59	0,67	0,99	1,25	1,09	1,00	1,06	1,40	0,66	2,81	4,48							
Neuro Sc. & Behavior	3,40	0,94	0,94	0,93	4,77	0,91	0,82	0,90	3,81	0,99	0,96	0,96	3,56	0,58	3,60	7,88							
Pharmacology	2,12	1,47	1,03	1,11	2,13	0,92	1,08	1,08	1,87	1,12	1,08	1,07	1,99	0,41	2,51	5,01							
Physics & Space Sc.	9,96	1,65	1,76	1,62	10,25	1,25	1,66	1,30	13,31	1,25	1,23	1,17	12,90	0,47	2,36	4,12							
Social Sc. general	1,25	1,49	1,31	1,32	1,31	0,64	0,68	1,08	1,40	1,17	1,06	1,04	1,83	0,16	0,64	1,50							
Mean Field Crown Indicator	100	1,49	1,40	1,41	100	1,19	1,18	1,25	100	1,10	1,08	1,06	100	0,43	2,36	4,65							
Citation ratio: absolute / expected		1,40	1,37	1,31		1,16	1,15	1,20		1,08	1,05	1,04											
Absolute Citation Impact		0,64	3,32	6,55		0,51	2,78	5,82		0,48	2,54	4,93											

ⁱ The field-specific Crown Indicator is named *CPP/FCSm* by Van Raan (1999), i.e., ‘citations per publications’ (CPP) over the ‘mean field citation score’ (FCSm) at a global scale. Self-citations are commonly removed and the same time windows and document types apply to both CPP and FCSm.