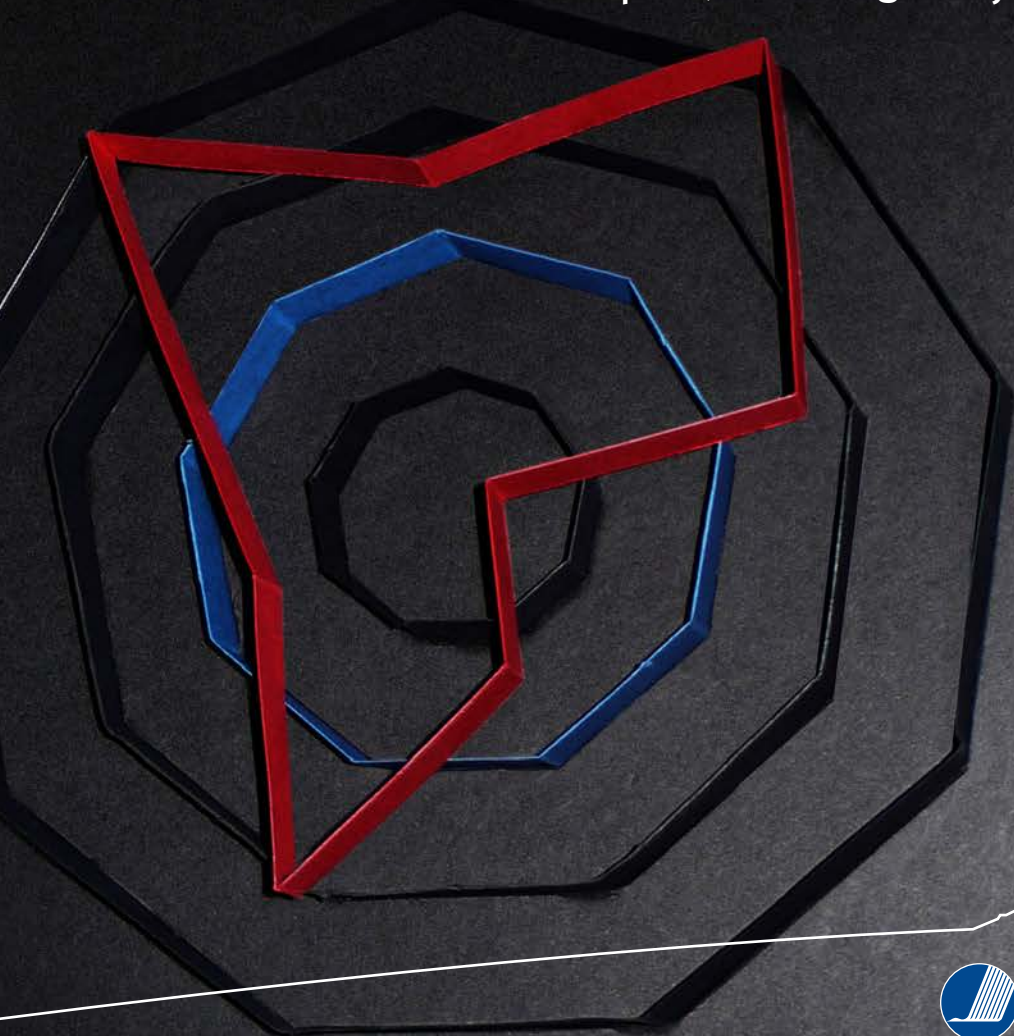


Comparing Research at Nordic Universities using Bibliometric Indicators

Second report, covering the years 2000-2012



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Comparing Research at Nordic Universities
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Second report, covering the years 2000-2012

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Preface

NordForsk aims at facilitating cooperation in all fields of research and research-driven innovation when this adds value to national activities in the Nordic region. Priority is given to analysis as a basis for funding of research collaboration judged to have considerable potential for long-term societal progress.

The present report “Comparing Research at Nordic Universities using Bibliometric Indicators, Second report, covering the years 2000–2012” is replacing the previous report from 2011 covering the years 2000-2009, basically building on the same methodology but adding more information. In this Second report, publications from the social sciences and the humanities are included (not in citation analysis), and new time intervals are applied. Both reports use data from Thomson Reuters and a Nordic network (below) for validating the data, developing the indicators and analysing the results. The discussions in the network have been paramount for the production of this second version and the presentation of data.

NordForsk wishes to thank the following participants for their valuable contribution to the second version of our report on bibliometric indicators at the university level: Henrik Aldberg (Swedish Research Council), Þorvaldur Finnbjörnsson (RANNIS - The Icelandic Centre for Research), Oddny Gunnarsdóttir (Landspítali University Hospital, Iceland), Staffan Karlsson (KTH, Sweden), Karen Skytte Larsen (Danish Agency for Science, Technology and Innovation), Yrjö Leino (CSC – IT Center for Science, Finland), Alberte Glob Nielsen (Danish Agency for Science, Technology and Innovation), Anu Nuutinen (Academy of Finland), Fredrik Niclas Piro (NIFU, Norway) [network coordinator], Jesper W. Schneider (Aarhus University, Denmark), Gunnar Sivertsen (NIFU, Norway).



Gunnel Gustafsson
Director of NordForsk

1 Introduction





1 Introduction

This report aims to demonstrate how state-of-the-art bibliometric indicators can be used at the level of universities in the Nordic countries to describe university performance in a more nuanced way than in the many international university rankings. In contrast to most such rankings, this report uses transparent methods and describes differences in university research profiles. This report does not use numbers to indicate rankings, but to represent real measurements and to give more specific information. We concentrate on providing reliable and recognisable descriptions of similarities and differences in the institutions' activities, profiles, and impacts of research.

Our network hopes to serve the needs of Nordic universities, the central research authorities in each country, as well as organisations for Nordic collaboration at both levels by providing a better understanding of bibliometric indicators. We also hope our report will inspire the development of more meaningful and transparent performance indicators for Nordic universities that can serve as the basis for annual comparisons in the future.

Our analysis is based on data covering the years 2000-2012 from the *Science Citation Index Expanded*, *Arts and Humanities Citation Index* and the *Social Science Citation Index*, which combined correspond largely to *Web of Science*. These data have been processed in a database that is updated and maintained by the Swedish Research Council under a license agreement with the producer of Web of Science, Thomson Reuters.

The publication database covers a core of about 12,000 international scientific journals, although these are known to be less representative of publication patterns in the Social Sciences and Humanities (SSH). Based on Norwegian data, we know that approximately 50 per cent of the total publication output of the universities is missing from Web of Science data. Most of this is due to publications from the SSH that are not included (Sivertsen, 2009). The publications from these fields make up almost nine per cent of all the Nordic articles in Web of Science. Based on our methods, the universities will still be comparable across different research profiles, but it is important to bear in mind that comparisons are primarily based on publications and citations in the following fields: Agriculture, Fisheries & Forestry; Biology; Biomedicine; Chemistry; Engineering & Materials Sciences; Geosciences; Health Sciences (including Psychology); and Physics & Mathematics.

Only universities with research activities above a minimum level in one or more of the fields mentioned are included in this study. In practice, this means that all general, technical and agricultural universities above a certain size in terms of publication output were included. Institutions that are specialised outside of these fields, such as *business schools*, are not included. All in all, the study covers 41 universities and 23 university hospitals. We specify the latter category to allow comparison between universities with and without university hospitals.

The methods and indicators used in this report were largely developed in two earlier reports from a bibliometric NORIA-network: "Bibliometric Performance Indicators for the Nordic Countries" (Schneider et al., 2010) and "Comparing Research at Nordic Universities using Bibliometric Indicators" (Piro et al., 2011). A main task of the latter study was to enrich the data with standardised institutional affiliations of authors of publications. In the original data from Thomson Reuters, the names of institutions are only partly standardised and therefore contain errors, while in this report all addresses have been thoroughly checked to ensure that each publication is allocated to the right institution. The report from 2011 analysed the Nordic universities and university hospitals over a 10-year period (2000-2009), splitting data into two time periods. In this report, data from 2010-2012 is also included, providing us with better possibilities to perform trend analyses. As a consequence of this, the results in our previous report (Piro et al., 2011) have changed because the time intervals are different. Throughout this report, we will not make any comparisons between these two reports, in part because we now have newer data, and in

part because an analysis using three time periods provides more real information about changes than an analysis using just two, exemplified as follows: a university may increase its citation rate from e.g. 1.10 to 1.15 when studying two large time periods (2000-2004 and 2005-2008), but when these time periods are split up and distributed across three (shorter) time periods (2000-2003, 2004-2007 and 2008-2011), we may see a decline in citation rate from the first to the second period (e.g. from 1.10 to 1.09), since it is fully possible that the publications leading to an increase in our former report mostly originated from publications in 2008 – which are now included in our third time period.

Like the report from 2011, however, the current report focuses on characterising the publication activity and research impact of the Nordic universities and on setting out research profiles for each university based on publication activity. All analyses are conducted at both the university and subject field levels, and measure the universities' performance over three time periods, 2000-2003, 2004-2007 and 2008-2012. Overall, two types of measures are used in this report: measures of research activity (activity and profile) and measures of research impact (except for the SSH field). We emphasise that citation-based performance indicators do not provide a clear measure of research quality. While they may reflect important aspects of quality, citations are primarily a formalised account of how the information is used and can thus be taken as an indicator of publications' reception at this level (Glänzel & Schoepflin, 1995).

1.1 Methods and indicators

The methods and indicators used in this report are described in detail in Appendix 1. In this appendix we also outline some of the methodological considerations behind our choice of data sources, methods and indicators. In summary, our report builds on the following *data material*:

- Data from the Thomson Reuters indices Science Citation Index Expanded, Social Sciences Citation Index and Arts & Humanities Citation Index¹.
- Data from the time period 2000-2012.
- Covering publications defined by Thomson Reuters as research articles, letters or reviews.
- Covering 64 institutions (41 universities and 23 university hospitals).

In conducting the address matching, identifying addresses 10 years back in time, we often faced the challenge of institutional mergers. Our approach has been to treat all institutions as they were in 2012.²

¹ Certain data included herein are derived from the Science Citation Index Expanded, Social Science Citation Index and Arts & Humanities Citation Index, prepared by Thomson Reuters®, Philadelphia, Pennsylvania, USA, © Copyright Thomson Reuters® 2013. All rights reserved.

² Aalto University (merger of Helsinki University of Technology, Helsinki School of Economics and University of Art and Design Helsinki), the University of Eastern Finland (merger of the University of Kuopio and the University of Joensuu) in Finland and Linnaeus University in Sweden (merger of Kalmar University and Växjö University in 2010) are treated as joint organisations in this study, and therefore all publications produced by their former organisations are attributed to them.

Methodologically our report is based on:

- Data cleaning techniques (i.e. address matching) developed at the Swedish Research Council.³
- Measures of research activity based on fractionalised⁴ publication counts, and impact measures based on fractionalised citation indicators. Self-citations are excluded.
- Data from three time periods: 2000-2003, 2004-2007 and 2008-2012 (2008-2011 for citation statistics).
- Analyses of eight main subject groups, based on the 257 journal subject classes used by Thomson Reuters during these periods: Agriculture, Fisheries & Forestry⁵ (includes 14 subject classes), Biology (13 subjects), Biomedicine (18 subjects), Chemistry (10 subjects), Engineering & Materials Sciences (46 subjects), Geosciences (8 subjects), Health Sciences⁶ (64 subjects), and Physics & Mathematics (19 subjects). All 65 subject classes from Social Sciences and Humanities have been collapsed into the category “SSH” for analysis of production, whereas multidisciplinary subjects have been reassigned to relevant categories. See Appendix 2 for further details on these groupings.
- Analyses of production statistics for universities, using a threshold of 200 fractionalised publications in the period 2008-2012 for inclusion (see discussion below).
- Analyses of citation statistics for universities, using a threshold of 50 fractionalised publications within each subject area in the time period 2008-2012 for inclusion.⁷
- Normalisation procedures relative to the “world average”, i.e. the average citation rate in Web of Science⁸ for a given field or aggregation of fields.

In deciding which universities should be included in the report, the network agreed that universities should only be included when they had more than 200 fractionalised publication points from the eight main subject fields in the period 2008-2012. An exception was made for Icelandic institutions, where the minimum size was set at 25 (only for the volume-based indicators; for the citation-based indicators the threshold is 50 publications). The reason for this limitation is that low numbers may create unreliable results, especially in the measurement of citation impact. As a result of this limitation, several universities were excluded (e.g. the University of Vaasa and the University of Lapland from Finland, the University of Agder and the University of Nordland from Norway, and IT University of Copenhagen from Denmark). The university hospitals that are included are described in Table A.2 in Appendix 1.

The universities and university hospitals in this report are compared in terms of the following *indicators*:

- Fractionalised number of publications;
- Field normalised citation rates with a three-year citation window;⁹
- Normalised proportion of highly cited papers (among the top 10 per cent of world production);¹⁰
- Relative specialisation index, indicating whether a university has higher or lower than average activity in the world in a specific scientific field.¹¹

Our report is divided into three main chapters: Chapter 2 addresses the publication activity of the Nordic universities; Chapter 3 describes the research publication profiles for the Nordic universities; and, Chapter 4 addresses the citation impact of the Nordic universities.

³ A full documentation of the Swedish Research Council database, data cleaning procedures and indicator calculations can be found in Kronman et al. (2010).

⁴ Publications and citations are fractionalised based on each organisation's share of the author addresses in the publication.

⁵ This category also includes Environmental Sciences, Plant Sciences, etc. See Appendix 2.

⁶ Health Sciences includes the subject area Psychology.

⁷ Fifty fractionalised publications equal 50 journal articles authored by one person. Alternatively: 100 journal articles with authors from two different universities.

⁸ The database at the Swedish Research Council used for this study corresponds closely to the contents of the Web of Science database except for proceedings that are lacking in the Research Council's database.

⁹ The normalisation is performed at the item level – the citation for each paper from a given university is divided by the average citation for the field of that paper (Lundberg, 2007).

¹⁰ A value of 1.0 equals the world average in the Thomson database. Average values less than 1 mean a lower proportion than the world average, e.g. 0.8 means a 20 per cent lower proportion of highly cited publications than the world average. Values over 1 mean a higher proportion than the world average, e.g. 1.2 means a 20 per cent higher proportion highly cited publications than the world average.

¹¹ See Chapter 3.3 for further explanation.

2 Publication activity





2 Publication activity

The aim of this chapter is to give an overview of the relative size of scientific publication output at the Nordic universities in the 13-year period 2000-2012 and the changes within that period.

All subject areas covered by this study are combined to produce aggregated four-year interval publication numbers, covering 2000-2003, 2004-2007 and 2008-2012 (using only the first four years of the last interval, 2008-2011, for citation analyses). The results at the national level for the five countries are briefly presented before focusing more closely on each university and university hospital in each country.

2.1 Total scientific publication output – universities and university hospitals

The total scientific publication output in the Nordic countries was studied at the national level in our earlier report (Schneider et al., 2010). In the present study, the national totals are limited to publications from universities and university hospitals. The totals are calculated for three periods using the sum of fractionalised number of publications within nine subject fields: Agriculture, Fisheries & Forestry; Biology; Biomedicine; Chemistry; Engineering & Materials Sciences; Geosciences; Health Sciences (including Psychology); Physics & Mathematics together with Social Sciences and Humanities.

As shown in Table 2.1, the relative growth rate from 2000 to 2012 is especially strong among the universities in the two smallest countries, Norway and Iceland. This finding is consistent with findings for national totals in our earlier report (Schneider et al., 2011). Compared to the baseline period, 2000-2003, both Norway and Iceland have increased their shares of total world production. In contrast, Denmark’s share is quite stable, although marginally decreasing, while Finland’s shares *have* decreased, and Sweden has seen a substantial decrease in its share of world production.

Table 2.1: Publication activity growth in selected Nordic universities and university hospitals (in the nine subject fields of the study)*

All Nordic countries	Volume 2000-2003	Volume 2004-2007	Volume 2008-2012	Percentage of world production 2000-2003	Percentage of world production 2004-2007	Percentage of world production 2008-2012	Annual growth rate
Denmark	19069	21369	34023	0.57 %	0.53 %	0.54 %	4 %
%	21.6	22.0	24.2				
Finland	18179	19449	26739	0.54 %	0.48 %	0.42 %	2 %
%	20.6	20.1	19.0				
Iceland	624	828	1648	0.02 %	0.02 %	0.03 %	9 %
%	0.7	0.9	1.2				
Norway	10567	13313	22200	0.31 %	0.33 %	0.35 %	5 %
%	12.0	13.7	15.8				
Sweden	39911	41972	56270	1.18 %	1.05 %	0.89 %	2 %
%	45.2	43.3	39.9				
Total	88349	96932	140881	2.62 %	2.42 %	2.22 %	3 %

*Data from Science Citation Index – Thomson Reuters

All Nordic countries, however, have increased their production volume from 2004-2007 to 2008-2012 (Denmark up 59 per cent; Finland up 37 per cent; Iceland up 99 per cent; Norway up 67 per cent; and Sweden up 34 per cent) (please note that the period 2008-2012 includes one more year than the period 2004-2007). But in the same period, the relative growth in the world has been 55 per cent, so the increased production has not been followed by an increased share of the world production in all Nordic countries.

Sweden has the greatest publication activity among the Nordic countries, with its universities and university hospitals contributing to 39.9 per cent of the overall publication output from Nordic universities and university hospitals in the period 2008-2012. The equivalent shares for Denmark (24.2 per cent), Finland (19.0 per cent) and Norway (15.8 per cent) are fairly similar, while those for Iceland (1.2 per cent) are much smaller. In total, the universities and university hospitals included in this report contributed to 2.2 per cent of the world production of publications in the period 2008-2012.

The universities and university hospitals in Sweden and Finland have seen relatively low growth rates in publications, while the growth is relatively high in Iceland and Norway. The differences in sizes and growth rates correspond relatively well with our earlier findings about national level performance as set out in the NORIA-net report *“Bibliometric Research Performance Indicators in the Nordic Countries”*. As discussed in this report, the increases in numbers of publications from institutions in all countries may be explained by the growth of the Thomson Reuters’ database¹² and in the science system itself (Schneider et al., 2010).

Table 2.2 gives a more detailed picture of these issues by presenting relative publication activity at the national level (for the universities and university hospitals included in our report) across subject fields for the period 2008-2012, alongside the annual growth rates since the year 2000. This table also shows the category SSH (see Appendix 2) and indicates that we have only excluded 8.7 per cent of the overall publication data from Web of Science in the citation analyses in this study where these subject areas are left out.

Table 2.2: Relative publication activity in different subject fields for selected universities and university hospitals (percentages of fractionalized number of publications), 2008-2012, and annual growth rate of the production of fractionalized publications for each field. Blue color = share 20 per cent above the Nordic average; red color = share 20 per cent below the Nordic average*

Subject field	Denmark	Finland	Iceland	Norway	Sweden	All Nordic countries	World ¹	Annual growth rate
Agriculture, Fisheries & Forestry	8.3 %	6.3 %	5.7 %	5.4 %	5.6 %	6.3 %	6.8 %	2.1 %
Biology	4.7 %	5.4 %	4.2 %	5.3 %	4.9 %	5.0 %	3.9 %	1.6 %
Biomedicine	16.6 %	14.0 %	10.6 %	12.8 %	16.1 %	15.2 %	13.8 %	0.9 %
Chemistry	5.8 %	6.8 %	3.1 %	4.2 %	6.2 %	5.9 %	9.8 %	1.2 %
Engineering & Materials Sciences	9.6 %	13.8 %	9.6 %	10.6 %	11.3 %	11.2 %	14.7 %	4.6 %
Geosciences	2.3 %	1.9 %	8.9 %	5.5 %	2.3 %	2.8 %	2.7 %	4.6 %
Health Sciences	35.2 %	30.3 %	35.6 %	38.1 %	34.8 %	34.6 %	27.7 %	2.7 %
Physics & Mathematics	9.4 %	12.2 %	10.8 %	8.0 %	10.7 %	10.3 %	13.2 %	1.8 %
SSH	7.9 %	9.2 %	11.5 %	10.1 %	8.2 %	8.7 %	7.4 %	10.9 %
(Sum)	100 %	100 %	100 %	100 %	100 %	100 %	100 %	2.8 %

¹Real numbers for World percentages are found in Appendix 3.
^{*}Data from Science Citation Index – Thomson Reuters

¹² A more thorough discussion of this is given in Schneider et al. (2010). It is argued that it is reasonable to assume that the growth in database coverage affects all the Nordic countries in the same way.

Compared to the rest of the world, the Nordic countries have relatively more publications in Biology, Biomedicine, Health Sciences and SSH, whereas the shares of publications in Agriculture, Fisheries & Forestry and Geosciences are roughly identical. The Nordic countries have relatively fewer publications in Chemistry, Engineering & Materials Sciences and Physics & Mathematics.

Sweden is responsible for just below 40 per cent of the total publication volume of the Nordic countries in the period 2008-2012. Thus, the relative publication activity of the Nordic countries in different fields, i.e. the Nordic averages by subject field, is quite similar to the Swedish numbers. As Sweden's activity is distributed this way, there are no subject fields where Sweden diverges by 20 per cent or more from the Nordic average. In contrast, results for Iceland and Norway show large fluctuations from the Nordic average. In Denmark, the publication activity in Agriculture, Fisheries & Forestry (which includes Environmental Sciences and Food Science & Technology) is much higher than the Nordic average, while Finland's publication activity in Engineering & Materials Sciences is 20 per cent higher than the Nordic average, and Finnish production in Geosciences shows the opposite tendency, being well below the Nordic average.

For *Finland*, substantial deviations from the average Nordic profile can especially be observed in Engineering & Materials Sciences (2.6 percentage points) and Physics & Mathematics (1.9 percentage points), where Finland stands out with the highest proportion of publications among the Nordic countries. Finland's relative publication activity in Geosciences (1.9 percent) is below the Nordic average, but this field is represented very unevenly in different countries, with Iceland and Norway clearly above the average, and the other three countries forming a group with a comparable and low share.

In *Iceland*, Health Sciences and Biomedicine make up 46 per cent of the Icelandic production. Geosciences is the subject field that stands out in a Nordic context, making up almost nine per cent of Iceland's production (based on a rather long history of research in this field), which is much higher than in any other Nordic country. Most other sciences show lower relative activity than in the other Nordic countries.

In Norway, Geosciences also represent a relative large share of all publications (5.5 percent). Norway is the Nordic country with the highest share in Health Sciences (38.1 percent), which is more than 2.5 percentage points more than Iceland, which has the second highest share.

Biology also has a relatively high share in Norway, while Biomedicine, Chemistry and Physics & Mathematics in particular have lower relative publication activity.

In Sweden, Health Sciences and Biomedicine together make up 51 per cent of the publication volume. As in the case of Finland, Sweden has a large proportion of publications in Physics & Mathematics, as well as in Engineering & Materials Sciences.

In Table 2.3 to Table 2.8 we show the growth rates per subject field for all Nordic countries, comparing the first and last years (2000 and 2012) and then the three aggregated time periods (2000-2003, 2004-2007 and 2008-2012), adjusting the growth for the size of the publication volumes (i.e. the baseline year(s) are set to 100).¹³

¹³ Real numbers are found in Appendix 8.

Table 2.3: Standardized growth rates for all Nordic countries, 2000-2012*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	100	129	100	108	144
Biology	100	121	100	102	153
Biomedicine	100	111	100	103	134
Chemistry	100	115	100	110	134
Engineering & Materials Sciences	100	172	100	127	175
Geosciences	100	171	100	112	176
Health Sciences	100	137	100	107	160
Physics & Mathematics	100	123	100	108	145
SSH	100	345	100	134	341
(Sum)	100	140	100	110	159

*Data from Science Citation Index – Thomson Reuters

The growth in the Nordic countries has been especially high in two fields: Engineering & Materials Sciences and in Geosciences. Biology and Health Sciences make two particularly interesting cases, because these fields saw hardly any growth between 2000-2003 and 2004-2007, but has seen a massive rise after 2007 (please note that the last period contains one more year compared to the first two periods). In the upcoming tables at the national level, the numbers are colored according to the Nordic averages in Table 2.3 (**blue color** = share 20 per cent above the Nordic average; **red color** = share 20 per cent below the Nordic average).

Table 2.4: Standardized growth rates for Denmark, 2000-2012*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	100	130	100	105	143
Biology	100	120	100	99	148
Biomedicine	100	142	100	109	156
Chemistry	100	151	100	112	164
Engineering & Materials Sciences	100	200	100	136	196
Geosciences	100	149	100	94	139
Health Sciences	100	196	100	117	202
Physics & Mathematics	100	128	100	99	147
SSH	100	327	100	124	335
(Sum)	100	168	100	112	178

*Data from Science Citation Index – Thomson Reuters

Compared to the other Nordic countries, Denmark has in particular seen an increased share of publications in Health Sciences (Table 2.4), whereas the growth in Finland has not been twenty per cent higher than the Nordic average in any subject fields (Table 2.5).

Table 2.5: Standardized growth rates for Finland, 2000-2012*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	100	131	100	109	136
Biology	100	140	100	100	154
Biomedicine	100	99	100	103	123
Chemistry	100	108	100	111	124
Engineering & Materials Sciences	100	163	100	132	125
Geosciences	100	201	100	128	156
Health Sciences	100	100	100	94	133
Physics & Mathematics	100	132	100	114	137
SSH	100	344	100	131	250
(Sum)	100	125	100	107	137

*Data from Science Citation Index – Thomson Reuters

The increased publication levels for Iceland are extreme, but are highly dependent on a very limited number of publications (Table 2.6).

Table 2.6: Standardized growth rates for Iceland, 2000-2012*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	100	267	100	129	222
Biology	100	286	100	181	294
Biomedicine	100	201	100	145	190
Chemistry	100	204	100	97	183
Engineering & Materials Sciences	100	597	100	192	602
Geosciences	100	195	100	145	225
Health Sciences	100	267	100	127	256
Physics & Mathematics	100	305	100	113	282
SSH	100	368	100	116	354
(Sum)	100	274	100	133	264

*Data from Science Citation Index – Thomson Reuters

In Norway, the growth from the first to the last period is higher in most subject fields compared to the Nordic averages (Table 2.7). Together with Iceland, Norway is the only country that has a general growth above the Nordic average.

Table 2.7: Standardised growth rates for Norway, 2000-2012*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	100	147	100	114	164
Biology	100	122	100	110	160
Biomedicine	100	139	100	112	171
Chemistry	100	124	100	129	159
Engineering & Materials Sciences	100	277	100	162	281
Geosciences	100	226	100	124	231
Health Sciences	100	177	100	122	210
Physics & Mathematics	100	194	100	140	213
SSH	100	338	100	153	357
(Sum)	100	182	100	126	210

*Data from Science Citation Index – Thomson Reuters

Lastly, the Swedish growth is quite in line with the Nordic average (Table 2.8).

Table 2.8: Standardised growth rates for Sweden, 2000-2012*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	100	118	100	107	134
Biology	100	110	100	101	150
Biomedicine	100	95	100	98	119
Chemistry	100	100	100	104	116
Engineering & Materials Sciences	100	144	100	114	148
Geosciences	100	138	100	109	156
Health Sciences	100	117	100	104	141
Physics & Mathematics	100	103	100	104	125
SSH	100	360	100	133	345
(Sum)	100	120	100	105	141

*Data from Science Citation Index – Thomson Reuters

In total, the number of fractionalised publications (including SSH) for all selected universities and university hospitals in the Nordic countries grew by 59 per cent from 2000-2003 to 2008-2012 (note that the last period is one year longer than the first), having increased more modestly (10 per cent) from 2000-2003 to 2004-2007 (Table 2.3).

In Table 2.9 we have calculated the Relative Specialisation Index (RSI) for each country, which shows whether the universities and university hospitals of that country have a relatively higher or lower share of world publications in particular fields of science than their overall share of total world production (a more detailed presentation is given in Chapter 3.3). The RSI has its value between -1 and 1, by dividing the specific share for each country by the general share in the database. When the RSI is zero it reflects a proportion equal to that of the field in the world. As shown in Table 2.9, compared to the world, the universities and university hospitals in the Nordic countries have a relatively high research publication production in Geosciences and the bio-related subject fields (Biology, Biomedicine and Health Sciences). Compared to the world, the Nordic institutions have a smaller proportion of production in Agriculture, Fisheries & Forestry, Chemistry; Engineering & Materials Sciences and Physics & Mathematics (and also in Geosciences – except in Iceland and Norway). Please note that the national totals in Table 2.9 are limited country profiles, as they are only based on the universities and university hospitals included in this report.

Table 2.9: Relative specialization indexes for the country totals of Nordic universities and university hospitals 2008-2012 (World average = 0)*

	Agriculture, Fisheries & Forestry	Biology	Bio- medicine	Chemistry	Engineering & Materials Sciences	Geo- sciences	Health Sciences	Physics & Mathe- matics	SSH
Denmark	0.10	0.10	0.09	-0.25	-0.21	-0.08	0.12	-0.17	0.03
Finland	-0.03	0.17	0.01	-0.18	-0.03	-0.18	0.04	-0.04	0.11
Iceland	-0.09	0.04	-0.13	-0.52	-0.21	0.53	0.13	-0.10	0.21
Norway	-0.12	0.16	-0.04	-0.40	-0.16	0.34	0.16	-0.25	0.15
Sweden	-0.10	0.11	0.08	-0.23	-0.13	-0.09	0.11	-0.11	0.05
Total	-0.03	0.13	0.05	-0.25	-0.13	0.01	0.11	-0.13	0.08

*Data from Science Citation Index – Thomson Reuters

2.2 Publication activity and growth of the universities

In this section we describe the publication activity of each Nordic university and university hospital included in the study. We present the number of fractionalised publications for three time periods (2000-2003, 2004-2007 and 2008-2012), average annual growth rates (which can be negative, despite an increase in publication activity over time) and the growth rate between 2000 and 2012. As expected, the largest growth rates are found amongst the smaller and the younger universities. We also show the percentage distributions for each country based on the output of the universities, and of the university hospitals, respectively.

Table 2.10: Number of fractionalized publications in Denmark*

Denmark	Volume			Average annual growth rate	Per cent of output 2008-2012	Per cent increase 2000-2012
	2000-2003	2004-2007	2008-2012			
Aalborg University	962	1331	1889	7 %	7 %	233.6
Aarhus University	3439	3703	5989	5 %	23 %	171.9
Roskilde University	218	274	455	3 %	2 %	150.3
Technical University of Denmark	3096	3596	5219	3 %	20 %	145.5
University of Copenhagen	5654	5781	9515	4 %	37 %	155.7
University of Southern Denmark	1174	1472	2463	6 %	10 %	203.7
					100 %	
Aarhus University Hospitals	1413	1654	2667	4 %	31 %	168.7
Copenhagen University Hospitals	2721	3096	5021	5 %	59 %	175.2
University of Southern Denmark Hospitals	391	462	806	7 %	9 %	220.1
					100 %	
Total	19069	21369	34023	4 %		168.1

*Data from Science Citation Index – Thomson Reuters

Among the universities and university hospitals included in this report, and within the areas of research covered, Denmark has both the largest university (University of Copenhagen) and the largest hospital (Copenhagen University Hospitals) in the Nordic countries. It is important to note, however, that Danish research institutions in the entire period investigated here are treated according to their more recent status following widespread mergers of higher education institutions in Denmark. Two of the largest Danish universities (Copenhagen and Aarhus) have relative low publication growth rates, while the growth rates are highest at the smaller universities. Also observed in Denmark is that the university hospitals in general have increased their publication output more than the universities.

Table 2.11: Number of fractionalised publications in Finland*

Finland	Volume			Average annual growth rate	Per cent of output 2008-2012	Per cent increase 2000-2012
	2000-2003	2004-2007	2008-2012			
Aalto University	1806	2204	3085	5 %	14 %	173.5
Lappeenranta University of Technology	174	296	489	12 %	2 %	388.0
Tampere University of Technology	574	745	1108	5 %	5 %	187.7
University of Eastern Finland	1562	1671	2278	1 %	10 %	118.1
University of Helsinki	4381	4771	6707	2 %	30 %	128.5
University of Jyväskylä	999	1093	1834	4 %	8 %	160.7
University of Oulu	1669	1670	2237	1 %	10 %	112.2
University of Tampere	675	785	1218	3 %	5 %	138.8
University of Turku	2067	2077	2643	1 %	12 %	106.8
Åbo Akademi University	646	786	1089	4 %	5 %	159.5
					100 %	
Helsinki University Central Hospital	1718	1683	1875	-2 %	46 %	81.8
Kuopio University Hospital	672	494	568	-5 %	14 %	56.1
Oulu University Hospital	291	310	443	2 %	11 %	127.4
Tampere University Hospital	591	520	644	-1 %	16 %	90.2
Turku University Hospital	351	343	521	1 %	13 %	116.2
					100 %	
Total	18179	19449	26739	2 %		124.5

*Data from Science Citation Index – Thomson Reuters

Finland is represented by 10 universities, five of which have a medical faculty (Helsinki, Turku, Tampere, Oulu and Eastern Finland). There are also five university hospitals in Finland. Of the other five universities, two are technical universities (Tampere University of Technology and Lappeenranta University of Technology), while Aalto University was formed by the recent merger between Helsinki University of Technology, the Helsinki School of Economics and the University of Art and Design Helsinki.

The University of Helsinki is in a class of its own in Finland when it comes to the number of fractionalised publications for the research areas covered here. Growth rates in the number of publications vary somewhat between the Finnish universities. Overall there is a trend that in the larger universities, the publication activity has grown more slowly than in the smaller universities. The significant increase in the number of publications coming from Lappeenranta University of Technology cannot, however, be considered only as a consequence of the university's small size, but it must also reflect the university's active policy of encouraging researchers to publish their results more in internationally recognised journals. When compared to Denmark, the publication growth in the university hospitals has been more modest – with some hospitals even showing negative growth in a comparison of the first and third periods (although all hospitals increase from the second to the third period).

Table 2.12: Number of fractionalized publications in Iceland*

Iceland	Volume			Average annual growth rate	Per cent of output 2008-2012	Per cent increase 2000-2012
	2000-2003	2004-2007	2008-2012			
Agricultural University of Iceland	13	16	25	13 %	2 %	455.7
Reykjavik University	3	22	150	46 %	11 %	9578.2
University of Akureyri	14	25	70	16 %	5 %	614.5
University of Iceland	433	576	1092	8 %	82 %	259.1
					100 %	
Landspítali University hospital	160	191	311	5 %	100 %	187.9
					100 %	
Total	624	828	1648	9 %		273.6

*Data from Science Citation Index – Thomson Reuters

The highest growth among the Nordic countries is seen for Iceland. The universities of Reykjavik and Akureyri and the Agricultural University are all relatively young organisations in the process of building up their research capacity. The percentage increase between 2000 and 2012 in Table 2.12 for these universities is considerable, even though the numbers of publications involved are extremely small. However, both the University of Iceland and Landspítali University Hospital show a large increase between the periods compared to the larger universities and university hospitals in other Nordic countries.

Table 2.13: Number of fractionalized publications in Norway*

Norway	Volume			Average annual growth rate	Per cent of output 2008-2012	Per cent increase 2000-2012
	2000-2003	2004-2007	2008-2012			
Norwegian University of Life Sciences	520	719	1092	6 %	6 %	192.1
Norwegian University of Science and Technology	1721	2554	4399	7 %	25 %	230.1
University of Bergen	1836	2260	3629	4 %	20 %	167.8
University of Oslo	3102	3792	6362	5 %	36 %	175.1
University of Stavanger	127	195	529	12 %	3 %	380.7
University of Tromsø	828	940	1719	6 %	10 %	193.4
						100 %
St.Olavs Hospital	248	306	485	3 %	11 %	146.6
University Hospital North Norway	174	213	386	6 %	9 %	203.4
University of Bergen Hospitals	523	634	1003	4 %	22 %	166.1
University of Oslo Hospitals	1487	1701	2597	3 %	58 %	143.0
						100 %
Total	10567	13313	22200	5 %		181.5

*Data from Science Citation Index – Thomson Reuters

Norway is represented by four broad universities (in Oslo, Bergen and Tromsø, and the Norwegian University of Science and Technology in Trondheim), one agricultural university and one former university college that recently acquired university status (University of Stavanger). All of the four broad universities have medical faculties and close cooperation with university hospitals. For the universities in Oslo and Bergen, this cooperation involves several hospitals, while the universities in Tromsø and Trondheim each have their “own” university hospital. There has been an increase in publication activity for *all* Norwegian universities and university hospitals included here, both from the first to the second period and from the second to the third period. The growth has been especially marked at the smallest university (in Stavanger). The Norwegian University of Science and Technology, however, also stands out with a growth rate that is almost twice as high as that found for the universities of Bergen and Oslo.

Table 2.14: Number of fractionalized publications in Sweden*

Norway	Volume			Average annual growth rate	Per cent of output 2008-2012	Per cent increase 2000-2012
	2000-2003	2004-2007	2008-2012			
Chalmers University of Technology	2116	2276	2773	2 %	6 %	122.9
Karlstad University	139	249	387	10 %	1 %	324.7
Karolinska Institutet	4409	4867	6961	3 %	14 %	134.8
Linköping University	1888	2056	3112	4 %	6 %	163.1
Linnaeus University	190	395	643	10 %	1 %	307.4
Luleå University of Technology	534	583	905	4 %	2 %	154.2
Lund University	5020	5538	7156	2 %	15 %	125.8
Mid Sweden University	200	252	446	7 %	1 %	219.2
Royal Institute of Technology	2736	3236	4489	4 %	9 %	151.8
Stockholm University	2434	2742	4123	3 %	8 %	151.1
Swedish University of Agricultural Sciences	2086	2017	2842	2 %	6 %	126.4
Umeå University	1909	2098	3264	3 %	7 %	141.1
University of Gothenburg	3199	3278	4786	2 %	10 %	125.5
Uppsala University	4699	4908	6586	2 %	13 %	125.1
Örebro University	127	301	566	17 %	1 %	646.6
					100 %	
Karolinska University Hospital	2565	2245	2228	-4 %	31 %	62.1
Linköping University Hospital	451	445	424	-3 %	6 %	68.7
Norrland's University Hospital	455	345	325	-9 %	4 %	30.9
Sahlgrenska University Hospital	1500	1261	1194	-6 %	17 %	47.9
Skåne University Hospital	1924	1707	1690	-4 %	23 %	62.0
Uppsala University Hospital	1108	883	996	-6 %	14 %	45.7
Örebro University Hospital	223	291	377	3 %	5 %	146.5
					100 %	
Total	39911	41972	56270	2 %		120.4

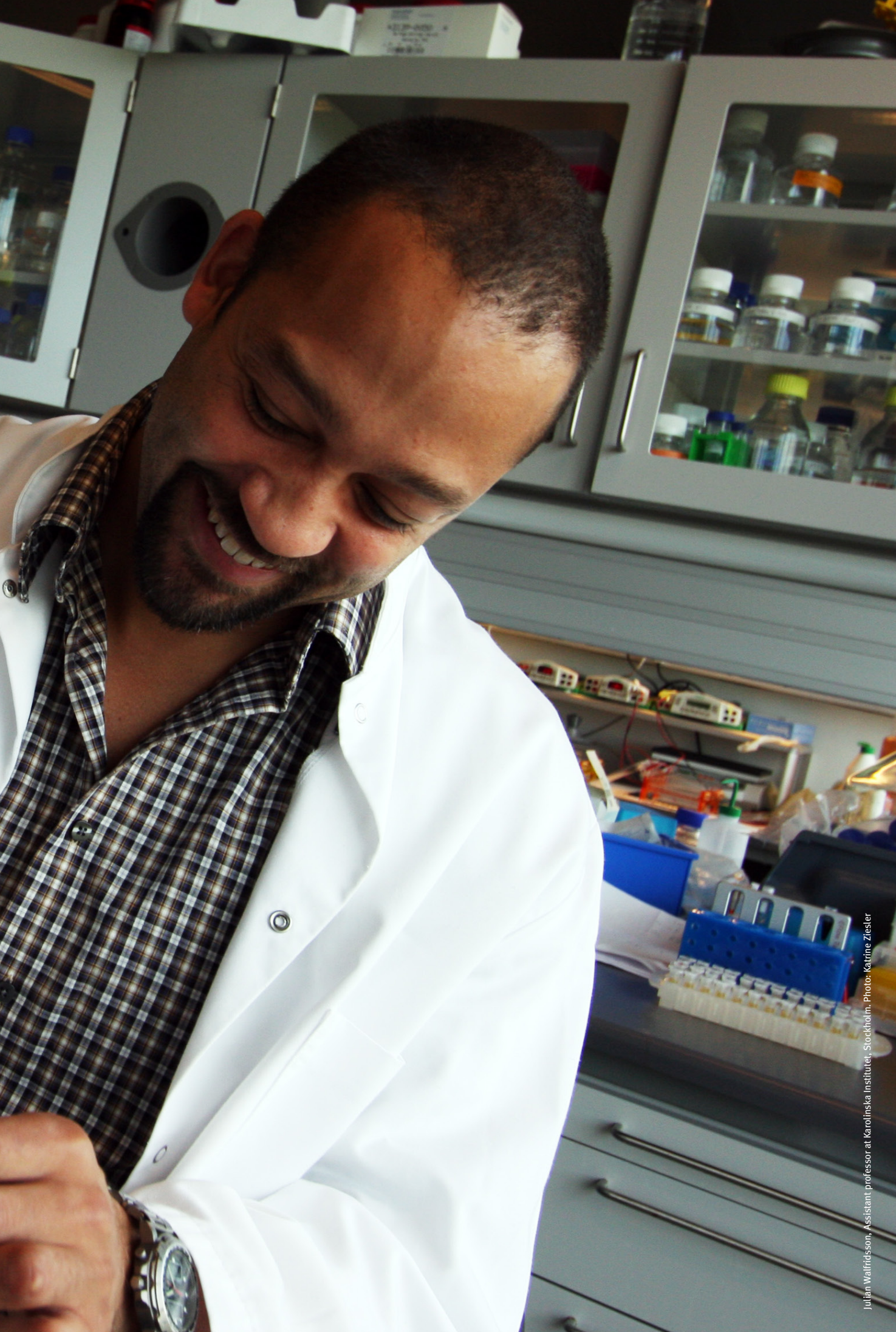
*Data from Science Citation Index – Thomson Reuters

As shown in Table 2.14, the Swedish institutions overall have the lowest growth rates in publications between the three periods studied. There are large variations between Swedish institutions, with several universities demonstrating constant (or even falling publication rates, i.e. negative growth figures) between the three time periods. In addition, the output from Swedish university hospitals seems to have decreased markedly, with all university hospitals showing negative growth rates (which is the complete opposite of the observed trends in Denmark, but more in line with Finland).

The four small and young universities (Karlstad, Linnaeus, Mid Sweden and Örebro) show the highest annual growth rates (between 6-15 per cent), while the four older, broad universities (Gothenburg, Lund, Stockholm and Uppsala) have increased their publication activity much less (2-3 per cent annual growth). In the previous report comparing the Nordic universities, this pattern was also observed, and it was suggested that the pattern could reflect funding schemes; using a one-year lag between funding (in constant prices) and output, the four small universities' funding increased by 28 per cent between 2000-2004 and 2005-2009 while their publication output increased by 84 per cent. The publication output of the four large universities increased by five per cent during the same period, while their funding increased by just 3 per cent (with a one year time lag) (Piro et al., 2011).

3 Research Profiles





Julian Walfredsson, Assistant professor at Karolinska Institutet, Stockholm. Photo: Katrine Ziesler

3 Research Profiles

The aim of this chapter is to demonstrate differences and similarities in the science research profiles of the Nordic universities by measuring their relative publication activities in the main scientific subject areas. We have restricted the presentation of research profiles to the last five-year period (2008-2012). We present the percentages of fractionalised publication counts, distributed among the nine major subject areas for each university and university hospital (Table 3.1 to Table 3.5). In Appendix 4, we set out the relative contribution of each university or university hospital to the overall national output within each subject field. However, the focus of Chapter 3 is the research profiles of the universities. Based on factor analysis we show how the universities group around different major domains, creating a figure that maps the universities’ overall profiles (Figure 3.1). We then use nonagons (i.e. a nine-sided regular polygon) to illustrate which subject fields the universities are specialised in (Figures 3.2 to 3.6).

3.1 Publications per research field for each Nordic university

Table 3.1 to Table 3.5 present the percentage share of fractionalised publication counts distributed among major subject areas for each Nordic university and university hospital. We use colours to describe the size of the publication output in each area of research relative to the size in the overall output of all the universities in a country, i.e. whether or not a university or a university hospital has a share equal to or above the national level. This national comparison of research profiles is supplemented by comparisons with baselines for the Nordic countries and for the world in later sections of the report. The publication numbers constituting the percentages in Table 3.1 to Table 3.5 are found in Appendix 5.

Table 3.1: Different subject areas’ share of the publication volume (fractionalized) in Denmark during 2008-2012, within each university and university hospital (green colour = equal to or above the national level)*

Danish universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sciences	Geosciences	Health Sciences	Physics & Mathematics	SSH	Total
Total	8 %	5 %	17 %	6 %	10 %	2 %	35 %	9 %	8 %	100 %
Aalborg University	7 %	1 %	10 %	4 %	37 %	1 %	13 %	10 %	17 %	100 %
Aarhus University	15 %	8 %	15 %	8 %	5 %	3 %	20 %	12 %	13 %	100 %
Roskilde University	6 %	6 %	11 %	8 %	7 %	2 %	7 %	13 %	40 %	100 %
Technical University of Denmark	10 %	4 %	12 %	11 %	33 %	3 %	5 %	21 %	1 %	100 %
University of Copenhagen	12 %	7 %	23 %	6 %	3 %	4 %	27 %	9 %	10 %	100 %
University of Southern Denmark	3 %	4 %	18 %	8 %	6 %	1 %	35 %	10 %	14 %	100 %
Aarhus University Hospitals	1 %	1 %	13 %	0 %	1 %	0 %	82 %	0 %	0 %	100 %
Copenhagen University Hospitals	0 %	2 %	16 %	0 %	1 %	0 %	80 %	0 %	0 %	100 %
University of Southern Denmark Hospitals	0 %	2 %	15 %	1 %	1 %	0 %	80 %	0 %	0 %	100 %

*Data from Science Citation Index – Thomson Reuters

The *Danish* universities seem to be “clustered” in two groups. The first is a group of technically and natural science-oriented universities: Aalborg University, whose main research field is Engineering & Materials Sciences, and the Technical University of Denmark, whose main research fields are Engineering & Materials Sciences and Physics & Mathematics. The other universities can be considered as a group with broader portfolios, although Roskilde University has considerably lower activity in the Health Sciences compared to the other universities in this group (while at the same time having the highest share of SSH publications).

Table 3.2: Different subject areas’ share of the publication volume (fractionalized) in Finland during 2008-2012, within each university and university hospital (green colour = equal to or above the national level)*

Finnish universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sciences	Geosciences	Health Sciences	Physics & Mathematics	SSH	Total
Total	6 %	5 %	14 %	7 %	14 %	2 %	30 %	12 %	9 %	100 %
Aalto University	3 %	0 %	4 %	10 %	39 %	1 %	4 %	29 %	10 %	100 %
Lappeenranta University of Technology	6 %	0 %	2 %	10 %	56 %	1 %	2 %	10 %	12 %	100 %
Tampere University of Technology	2 %	1 %	6 %	10 %	50 %	1 %	4 %	24 %	3 %	100 %
University of Eastern Finland	14 %	5 %	19 %	8 %	10 %	2 %	27 %	9 %	7 %	100 %
University of Helsinki	12 %	10 %	20 %	7 %	4 %	4 %	22 %	10 %	12 %	100 %
University of Jyväskylä	5 %	9 %	7 %	12 %	9 %	0 %	19 %	24 %	14 %	100 %
University of Oulu	5 %	6 %	13 %	5 %	18 %	5 %	26 %	14 %	8 %	100 %
University of Tampere	0 %	1 %	14 %	0 %	6 %	0 %	55 %	3 %	21 %	100 %
University of Turku	5 %	9 %	16 %	7 %	7 %	1 %	32 %	13 %	10 %	100 %
Åbo Akademi University	5 %	4 %	13 %	20 %	29 %	1 %	10 %	6 %	12 %	100 %
Helsinki University Central Hospital	0 %	1 %	14 %	0 %	1 %	0 %	83 %	0 %	0 %	100 %
Kuopio University Hospital	1 %	1 %	20 %	0 %	2 %	0 %	75 %	1 %	1 %	100 %
Oulu University Hospital	0 %	2 %	8 %	0 %	1 %	0 %	88 %	0 %	1 %	100 %
Tampere University Hospital	0 %	1 %	20 %	0 %	2 %	0 %	77 %	0 %	0 %	100 %
Turku University Hospital	0 %	0 %	14 %	0 %	1 %	0 %	83 %	0 %	0 %	100 %

*Data from Science Citation Index – Thomson Reuters

The *Finnish* universities seem to be divided into three groups. In the first group, the University of Tampere and University of Turku are strongly focused on life sciences (with about half of their publications coming from Health Sciences and Biomedicine), but it should be noted that Social Sciences and Humanities are important subject fields at these universities. The second group is formed by Aalto University and the technological universities in Tampere and Lappeenranta, which mainly publish in Engineering & Material Sciences and to some extent in Physics and Mathematics. The rest of the universities have a more even distribution of publication activity across the different subject fields.

Table 3.3: Different subject areas’ share of the publication volume (fractionalized) in Iceland during 2008-2012, within each university and university hospital (green colour = equal to or above the national level)*

Icelandic universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sciences	Geosciences	Health Sciences	Physics & Mathematics	SSH	Total
Total	6 %	4 %	11 %	3 %	10 %	9 %	36 %	11 %	11 %	100 %
Agricultural University of Iceland	70 %	10 %	2 %	0 %	0 %	16 %	1 %	0 %	0 %	100 %
Reykjavik University	2 %	1 %	4 %	0 %	48 %	1 %	9 %	22 %	13 %	100 %
University of Akureyri	8 %	1 %	6 %	5 %	6 %	6 %	35 %	3 %	30 %	100 %
University of Iceland	6 %	6 %	12 %	4 %	7 %	13 %	26 %	13 %	13 %	100 %
Landspítali University hospital	1 %	1 %	11 %	0 %	1 %	0 %	84 %	0 %	2 %	100 %

*Data from Science Citation Index – Thomson Reuters

In *Iceland*, the University of Akureyri and University of Iceland have broad, general profiles including activity in Health Sciences and fairly high activity in the Geosciences. Reykjavik University stands out as a more specialized technical university in our analysis.

Table 3.4: Different subject areas’ share of the publication volume (fractionalized) in Norway during 2008-2012, within each university and university hospital (green colour = equal to or above the national level)*

Norwegian universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sciences	Geosciences	Health Sciences	Physics & Mathematics	SSH	Total
Total	5 %	5 %	13 %	4 %	11 %	5 %	38 %	8 %	10 %	100 %
Norwegian University of Life Sciences	44 %	14 %	16 %	3 %	6 %	3 %	5 %	2 %	7 %	100 %
Norwegian University of Science and Technology	5 %	4 %	7 %	7 %	31 %	3 %	18 %	14 %	9 %	100 %
University of Bergen	4 %	8 %	13 %	3 %	7 %	13 %	34 %	7 %	11 %	100 %
University of Oslo	3 %	5 %	14 %	6 %	6 %	7 %	33 %	11 %	15 %	100 %
University of Stavanger	4 %	2 %	4 %	3 %	31 %	4 %	20 %	8 %	25 %	100 %
University of Tromsø	7 %	11 %	14 %	5 %	2 %	7 %	35 %	6 %	13 %	100 %
St.Olavs Hospital	0 %	1 %	12 %	0 %	2 %	0 %	83 %	1 %	1 %	100 %
University Hospital North Norway	0 %	2 %	11 %	0 %	1 %	0 %	84 %	1 %	2 %	100 %
University of Bergen Hospitals	0 %	1 %	16 %	0 %	1 %	0 %	81 %	0 %	1 %	100 %
University of Oslo Hospitals	0 %	1 %	18 %	1 %	1 %	0 %	78 %	0 %	1 %	100 %

*Data from Science Citation Index – Thomson Reuters

The *Norwegian* universities can be divided into three groups. The first group contains the three universities of Bergen, Oslo and Tromsø, all of which have broad research profiles. The more technically oriented University of Stavanger and Norwegian University of Science and Technology in Trondheim make up a second group – although they both have large shares of SSH disciplines, University of Stavanger in particular. The Norwegian University of Life Sciences stands apart from these first two groups, as it has a specialised profile corresponding closely to its origins as an agricultural college.

Table 3.5: Different subject areas’ share of the publication volume (fractionalized) in Sweden during 2008-2012, within each university and university hospital (green colour = equal to or above the national level)*

Swedish universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sciences	Geosciences	Health Sciences	Physics & Mathematics	SSH	Total
Total	6 %	5 %	16 %	6 %	11 %	2 %	35 %	11 %	8 %	100 %
Chalmers University of Technology	3 %	1 %	7 %	14 %	40 %	2 %	3 %	28 %	4 %	100 %
Karlstad University	6 %	3 %	5 %	5 %	21 %	1 %	20 %	15 %	23 %	100 %
Karolinska Institutet	1 %	3 %	30 %	1 %	1 %	0 %	63 %	1 %	1 %	100 %
Linköping University	2 %	2 %	10 %	5 %	20 %	0 %	33 %	16 %	11 %	100 %
Linnaeus University	7 %	9 %	13 %	3 %	11 %	4 %	17 %	17 %	21 %	100 %
Luleå University of Technology	7 %	0 %	2 %	8 %	47 %	4 %	8 %	15 %	9 %	100 %
Lund University	5 %	6 %	17 %	7 %	11 %	3 %	30 %	11 %	10 %	100 %
Mid Sweden University	7 %	3 %	3 %	4 %	28 %	1 %	24 %	10 %	21 %	100 %
Royal Institute of Technology	3 %	1 %	6 %	14 %	37 %	2 %	3 %	29 %	5 %	100 %
Stockholm University	6 %	8 %	13 %	12 %	5 %	9 %	11 %	16 %	20 %	100 %
Swedish University of Agricultural Sciences	50 %	18 %	13 %	3 %	4 %	2 %	5 %	1 %	4 %	100 %
Umeå University	6 %	6 %	17 %	5 %	6 %	2 %	38 %	10 %	11 %	100 %
University of Gothenburg	3 %	6 %	18 %	4 %	3 %	3 %	41 %	6 %	15 %	100 %
Uppsala University	3 %	7 %	20 %	8 %	9 %	4 %	25 %	15 %	9 %	100 %
Örebro University	5 %	1 %	7 %	5 %	9 %	0 %	45 %	3 %	25 %	100 %
Karolinska University Hospital	0 %	2 %	21 %	1 %	0 %	0 %	75 %	0 %	0 %	100 %
Linköping University Hospital	0 %	1 %	11 %	1 %	1 %	0 %	85 %	0 %	1 %	100 %
Norrland’s University Hospital	0 %	1 %	11 %	1 %	2 %	0 %	86 %	0 %	0 %	100 %
Sahlgrenska University Hospital	1 %	1 %	13 %	0 %	1 %	0 %	84 %	0 %	0 %	100 %
Skåne University Hospital	1 %	1 %	14 %	0 %	1 %	0 %	82 %	1 %	0 %	100 %
Uppsala University Hospital	1 %	1 %	14 %	0 %	1 %	0 %	83 %	0 %	0 %	100 %
Örebro University Hospital	1 %	1 %	13 %	0 %	1 %	0 %	82 %	0 %	1 %	100 %

*Data from Science Citation Index – Thomson Reuters

Sweden is the only Nordic country to have a specialised medical university, Karolinska Institutet, where 96 per cent of the output is in the Biomedicine and Health Sciences fields. The Swedish University of Agricultural Sciences has half (50 per cent) of its total output in Agriculture, Fisheries & Forestry, but still retains a relatively broad profile. The three technical universities also have relatively broad subject profiles, with no more than half of their output in technical fields. Karlstad University and Mid Sweden University also have a large proportion of technical sciences in their portfolios (21-28 per cent). The remaining universities have broader subject profiles, including life and health sciences.

3.2 University profiles according to their publication output

In order to investigate similarities in scientific research profiles between universities in the Nordic countries more systematically than would be possible based on a qualitative assessment of the results in Table 3.1 to Table 3.5, we performed a factor analysis to identify how universities cluster together (based on correlating subject profiles). Factor analysis is a dimensionality reduction technique. Its purpose is to identify a relatively small number of latent themes, dimensions or factors underlying a larger set of variables. This is done by distinguishing sets of variables that have more in common with each other than with the other variables in the analysis. What the subsets of variables have in common is the underlying dimension or factors. In the present analysis, the nine research fields (the category SSH is also included) are the initial (subject) dimensions which are targeted for reduction. After reduction, the universities will be clustered in relation to the reduced number of subject dimensions. The analysis is based on the universities' research profiles for the third period (2008-2012), as shown in Table 3.1 to Table 3.5. The results of the factor analysis are shown in Figure 3.1; each country's universities are highlighted with different colours, and the size of the circles indicates the size of each university's total research publication productivity. The university hospitals are not included in the factor analysis as they are too specialised.

Figure 3.1 can be interpreted in the following way: the universities are positioned in the figure according to how similar their research profiles are. The closer they are positioned to each other, the more similar their research profiles. Conversely, the longer the distance between two universities (or groups of universities), the less comparable they are. This is an important perspective to offer the ranking-oriented area of university performance indicators, as most international rankings do not take into consideration that the universities have very different profiles.

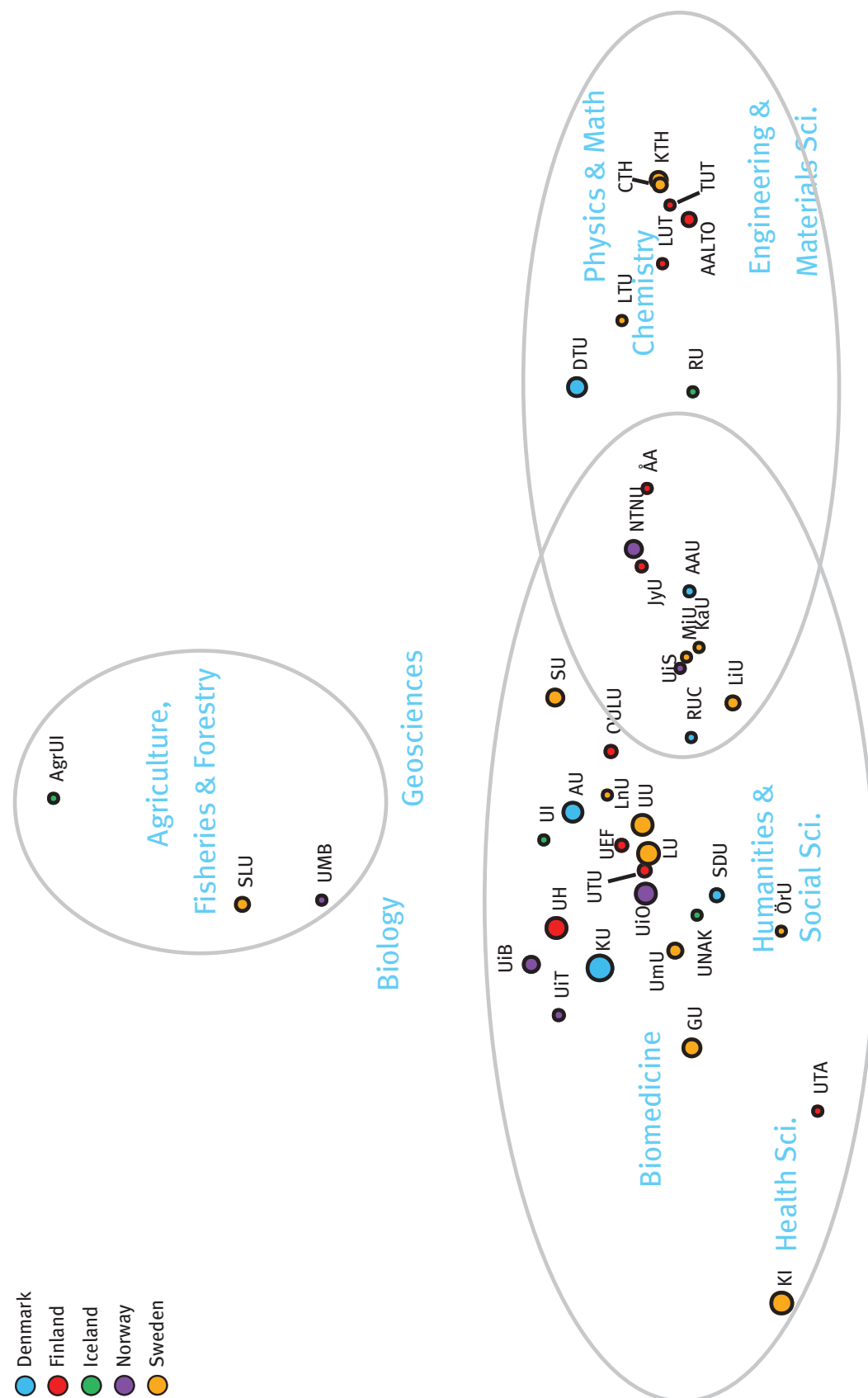
The factor analysis "reduces" the initial nine research fields to what appears to be three latent main dimensions. These main dimensions are illustrated in Figure 3.1 as the three clustered areas, although the lines are difficult to draw between them. The three main dimensions that emerge from the analysis are the "applied technical sciences" (to the east in the map), general universities (to the west in the map), and "agricultural" sciences (to the north in the map).

The results show that the specialised technical and agricultural science universities are clustered in two distinct factors, whereas universities that include medical and health faculties are clustered together in two dimensions that are hard to separate due to an uneven volume of Health Sciences and Biomedicine, and SSH (i.e. Social Sciences and Humanities). The institutions in the cluster down to the left in Figure 3.1 are typically the older, more traditional universities that include a variety of faculties, but as the publication production of medical fields typically comprises about 40 per cent of the total annual research output of these universities, these have a powerful influence on the overall calculation. Stockholm University stands out as an exception among these general universities, as it has no medical faculty.

The universities are identified using the following acronyms in the figure:

Aalborg University	DEN ● AAU
Aarhus University	DEN ● AU
Roskilde University	DEN ● RUC
Technical University of Denmark	DEN ● DTU
University of Copenhagen	DEN ● KU
University of Southern Denmark	DEN ● SDU
Aalto University	FIN ● AALTO
Åbo Akademi University	FIN ● ÅA
Lappeenranta University of Technology	FIN ● LUT
Tampere University of Technology	FIN ● TUT
University of Eastern Finland	FIN ● UEF
University of Helsinki	FIN ● UH
University of Jyväskylä	FIN ● JyU
University of Oulu	FIN ● OULU
University of Tampere	FIN ● UTA
University of Turku	FIN ● UTU
Agricultural University of Iceland	ICE ● AgrUI
Reykjavik University	ICE ● RU
University of Akureyri	ICE ● UNAK
University of Iceland	ICE ● UI
Norwegian University of Life Sciences	NOR ● UMB
Norwegian University of Science and Technology	NOR ● NTNU
University of Bergen	NOR ● UiB
University of Oslo	NOR ● UiO
University of Stavanger	NOR ● UiS
University of Tromsø	NOR ● UiT
Chalmers University of Technology	SWE ● CTH
Karlstad University	SWE ● KaU
Karolinska Institutet	SWE ● KI
Linköping University	SWE ● LiU
Linnaeus University	SWE ● LnU
Luleå University of Technology	SWE ● LTU
Lund University	SWE ● LU
Mid Sweden University	SWE ● MiU
Royal Institute of Technology	SWE ● KTH
Stockholm University	SWE ● SU
Swedish University of Agricultural Sciences	SWE ● SLU
Umeå University	SWE ● UmU
University of Gothenburg	SWE ● GU
Uppsala University	SWE ● UU
Örebro University	SWE ● ÖrU

Figure 3.1: Factor Analysis grouping Nordic universities by bibliometric research profiles. The symbol size is proportional to total research publication productivity



3.3 Relative Specialization Index (RSI)

We have now described the distribution of subject fields at the Nordic universities and grouped them along three (to four) major dimensions. In this section, we will elaborate on these findings by calculating the Relative Specialisation Index (RSI) for each university (defined in *REIST-2*, 1997). The RSI gives an overview of a university's research profile (or specialisation) by comparing the shares of fields of science among the university's total publications to the overall shares of each field among the world's total publications.

The symmetric RSI is a relative indicator based upon the Activity Index (AI), which is defined as:

$$AI = \frac{\text{the share of the given field in the publications of the given university}}{\text{the share of the given field in the world total of publications}}$$

The RSI is then defined as:

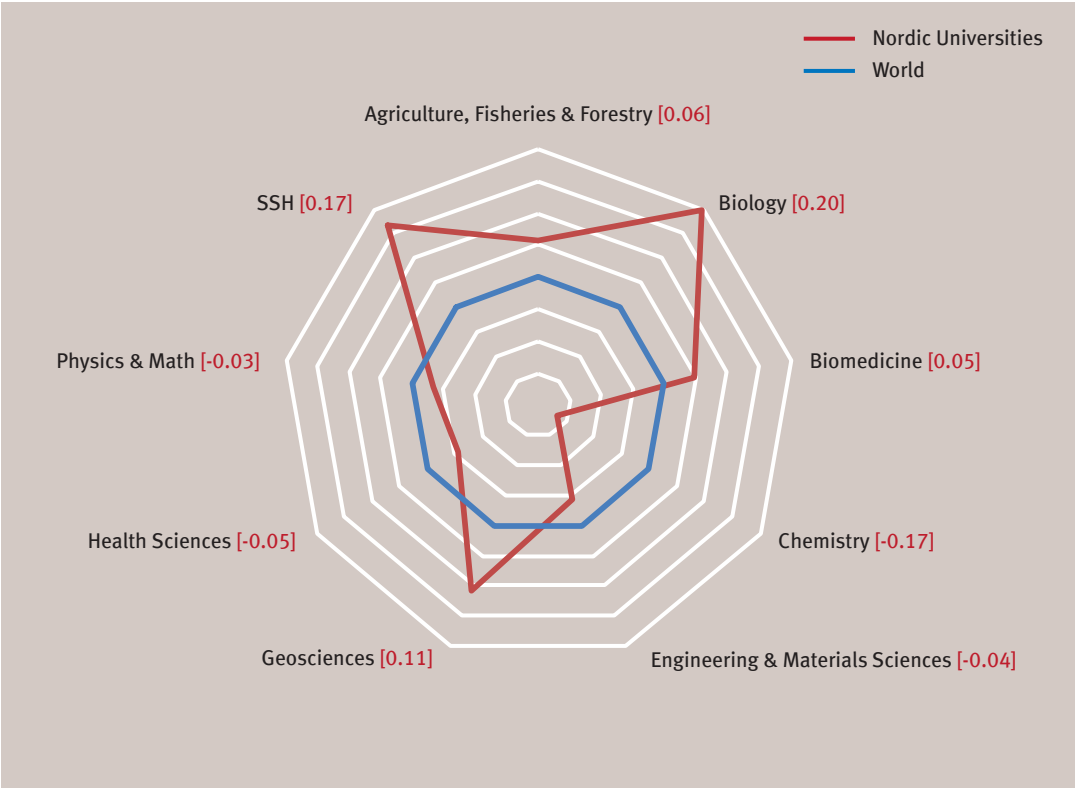
$$RSI = \frac{AI - 1}{AI + 1}$$

The RSI will take its values in the range -1 to 1. The value indicates whether a university has a higher-than-average activity in the world in a scientific field ($RSI > 0$) or a lower-than-average activity ($RSI < 0$). $RSI = 0$ reflects a completely balanced situation.

It is important to note that the RSI reflects a certain internal balance among the fields at the given university; positive RSI values must always be balanced by negative ones, as no university can have only positive RSI values (or only negative values for that matter). As a benchmark, an $RSI = 0$ value is used for all research fields, which corresponds to the “world standard case” as graphically presented by a regular nonagon in the following figures. The numbers behind the graphical presentation of the RSIs in this section are presented in detail in Appendix 6.

In this chapter we present the RSIs using nonagon diagrams, offering a visual presentation of each university's research publication activity in nine subject fields. Figure 3.2 shows that when we consider all the Nordic universities and university hospitals together in comparison to the world, they appear to have a specialisation profile that favors Biology and Biomedicine. Geosciences, Agricultural Sciences (including fisheries and forestry), as well as the category SSH (in reality even higher) are also shown as being relatively high activity areas in the profile. Other natural sciences, Health Sciences and Engineering are less active compared to world averages.

Figure 3.2: Nordic universities' (excluding university hospitals) Relative Specialization Index (RSI) compared to the world (2008-2012)*

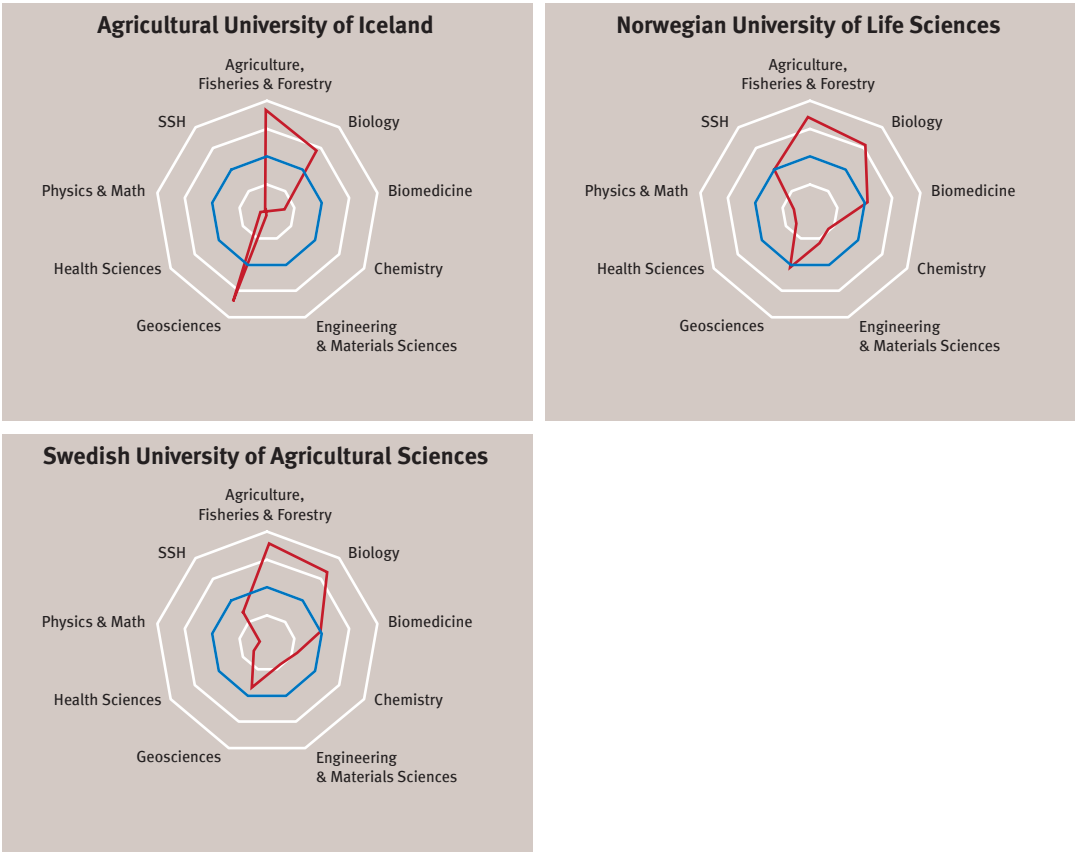


*Data from Science Citation Index – Thomson Reuters

Similar specialization diagrams (based on RSI) for each of the Nordic universities are presented in the following section, where the universities are grouped based on their position in Figure 3.1. We have grouped the universities according to the results of the factor analysis: 1) the agricultural universities, 2) the technical universities, 3) general universities. Because it is difficult to draw a clear line between technical and general universities, we have used the presence of a medical faculty to distinguish technical from general universities. This makes it easier to compare between universities that have already been shown to have similar profiles on a more general level, thus offering a more detailed picture of variations between institutions, than simply comparing across countries.

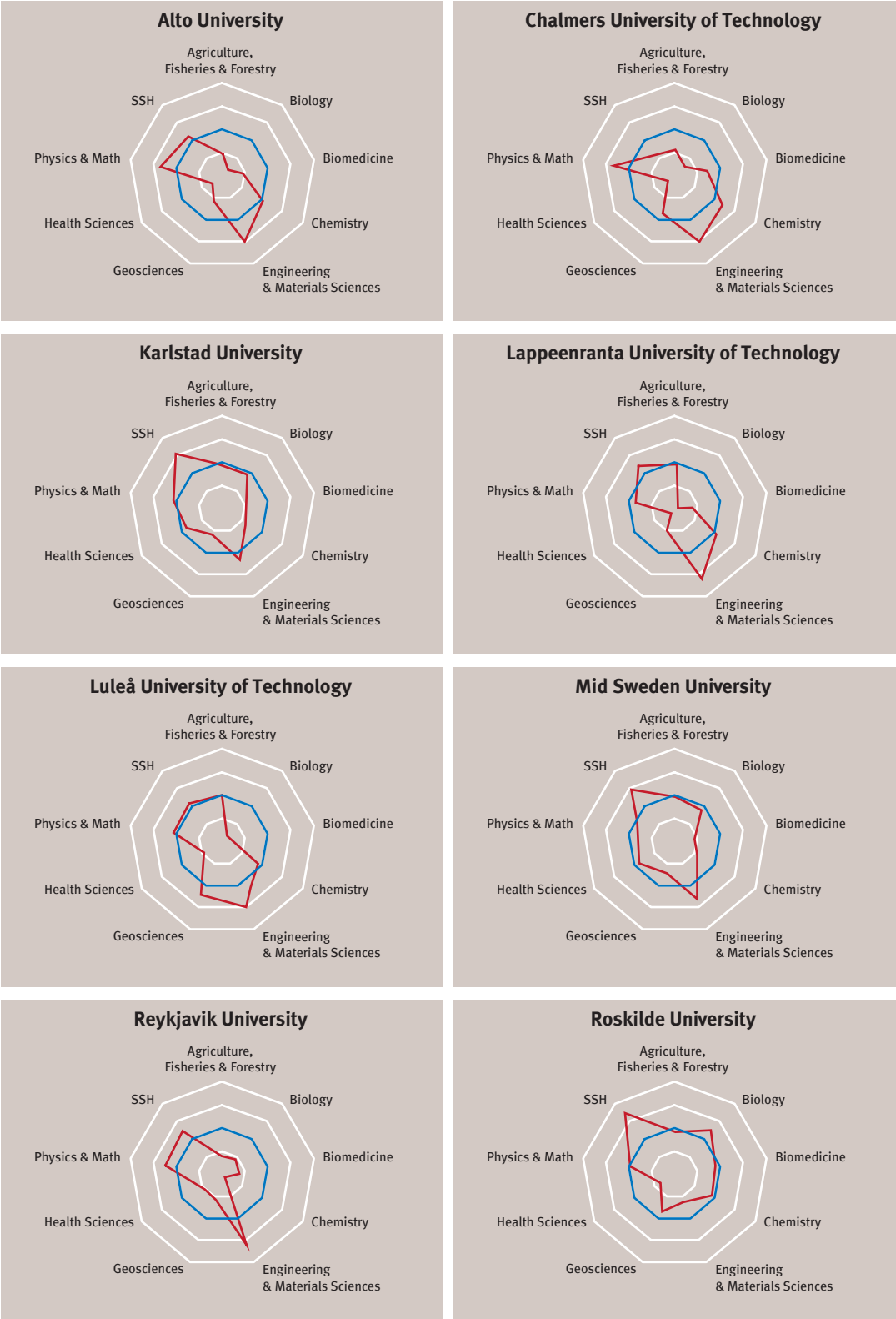
Figure 3.3 shows the specialization profiles of the universities classified as agricultural universities in the factor analysis (universities found north in Figure 3.1). Figure 3.4 shows universities without a medical faculty (mostly bottom right). Figure 3.5 shows the universities classified as 'general', i.e. universities having a medical faculty. RSI numbers for all universities (and subject fields) are found in Appendix 6.

Figure 3.3: Relative Specialization Index for agricultural universities
(blue line equals the world average, red line equals the Nordic university analyzed)*



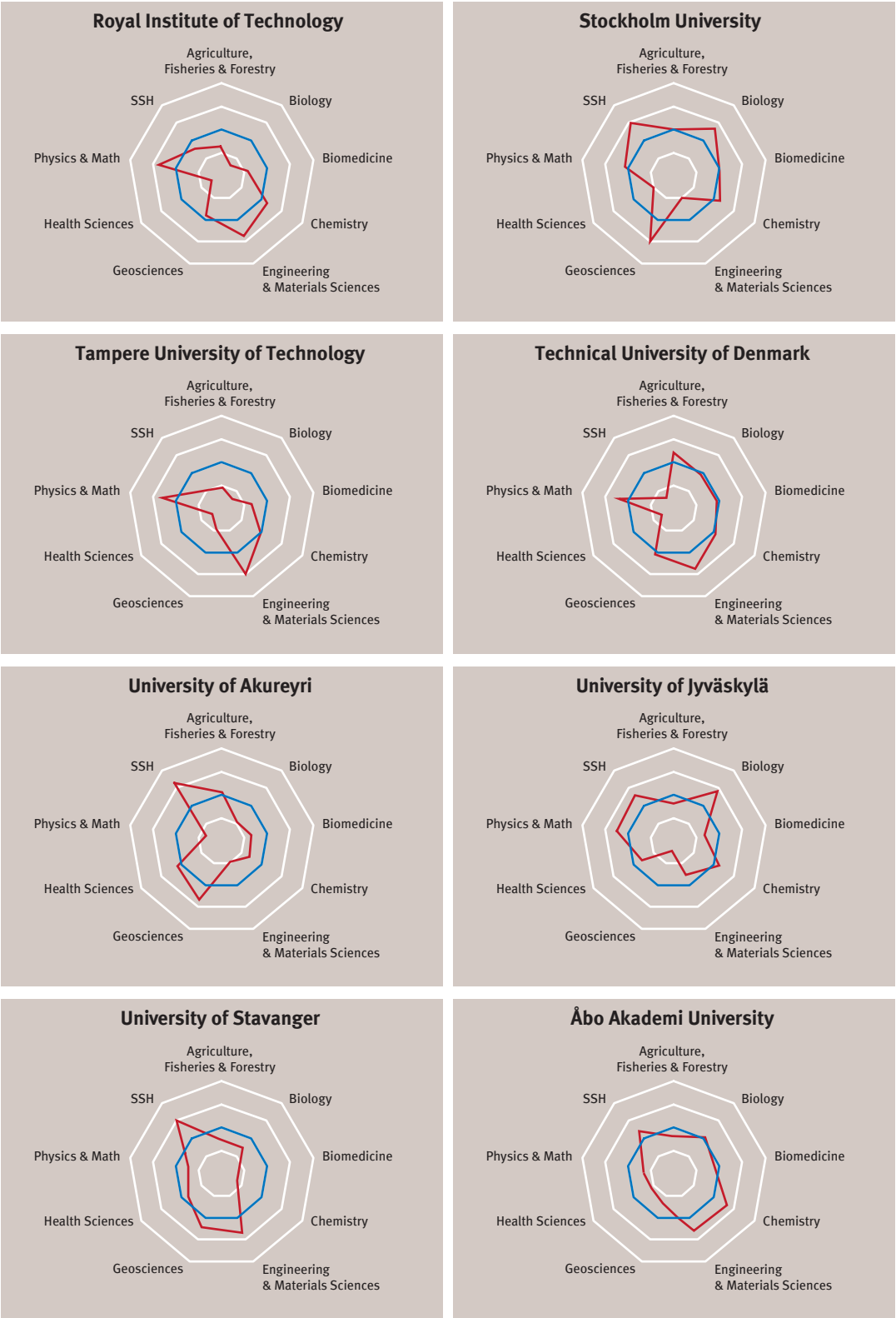
*Data from Science Citation Index – Thomson Reuters

Figure 3.4: Relative Specialization Index for universities without a medical faculty
 (blue line equals the world average, red line equals the Nordic university analyzed)*



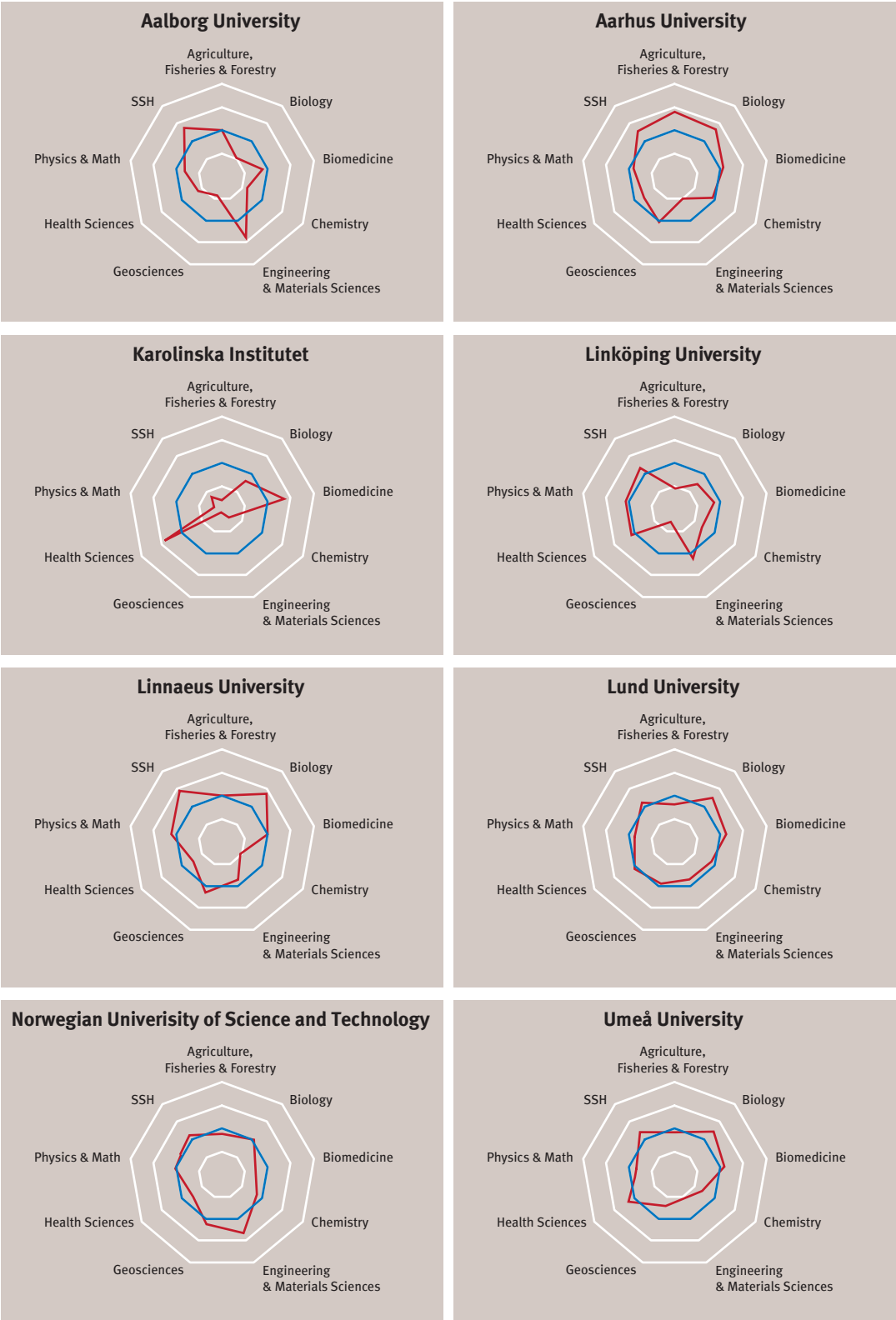
*Data from Science Citation Index – Thomson Reuters

Figure 3.4: Relative Specialization Index for universities without a medical faculty (blue line equals the world average, red line equals the Nordic university analyzed)*



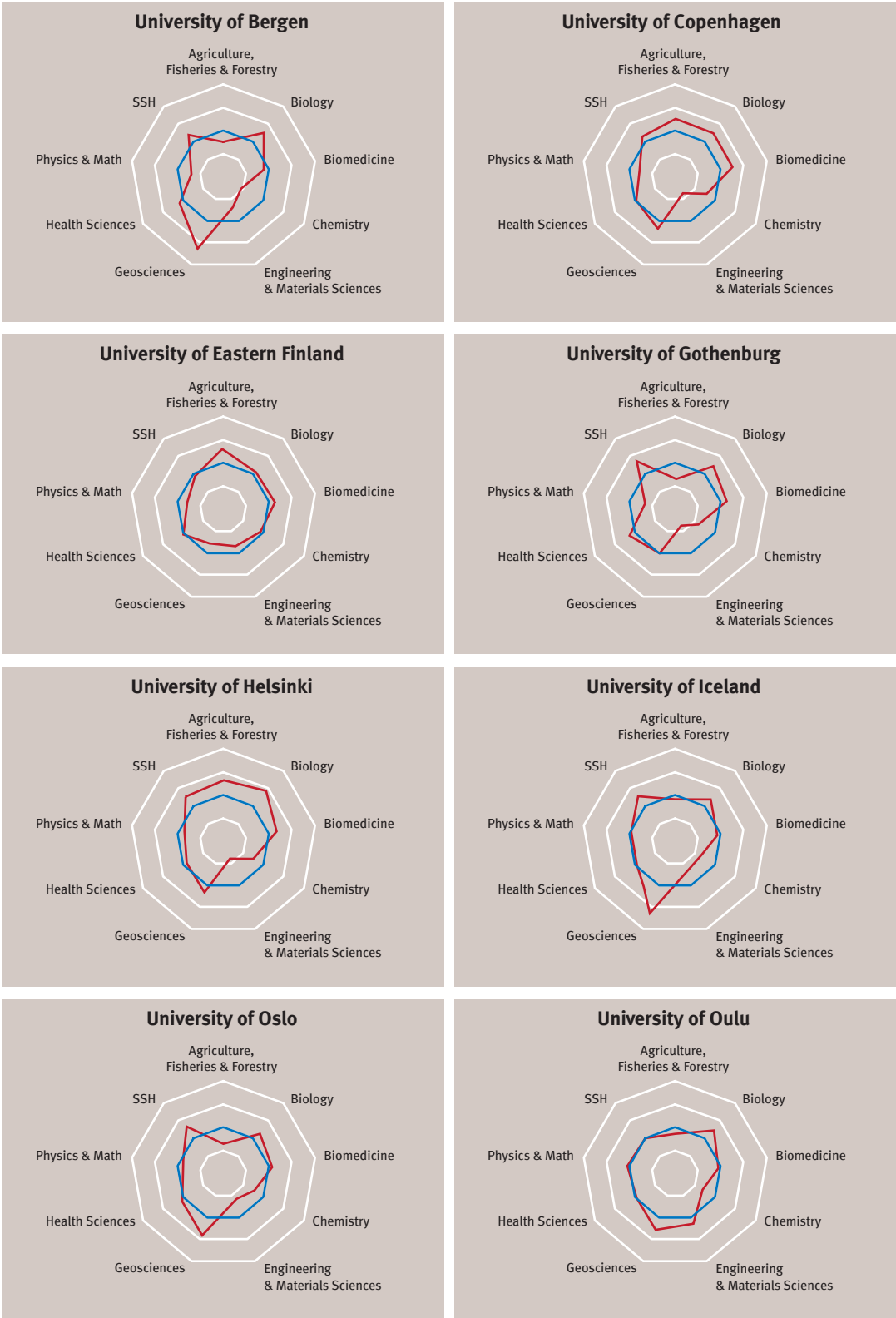
*Data from Science Citation Index – Thomson Reuters

Figure 3.5: Relative Specialization Index for general universities with a medical faculty
 (blue line equals the world average, red line equals the Nordic university analyzed)*



*Data from Science Citation Index – Thomson Reuters

Figure 3.5: Relative Specialization Index for general universities with a medical faculty (blue line equals the world average, red line equals the Nordic university analyzed)*



*Data from Science Citation Index – Thomson Reuters

Figure 3.5: Relative Specialization Index for general universities with a medical faculty
(blue line equals the world average, red line equals the Nordic university analyzed)*



*Data from Science Citation Index – Thomson Reuters

In this chapter we have shown the research publication profiles of the Nordic universities, clearly illustrating the diversity that exists both within each country and within clusters of similar universities, across countries. Even within clusters of more alike universities, based on overall publication activity, the universities have different research profiles. This variation is usually hidden in aggregated university rankings. The aim of this chapter has thus been to highlight the diversity of the Nordic universities, and the need to specify profiles and subject fields when comparing them. The methods we have presented can also be used by the universities themselves, to get a clearer overview of their activities and profiles, in comparison with other universities.

4 Citation impact of the Nordic universities





4 Citation impact of the Nordic universities

The aim of this chapter is to compare the citation impact of the Nordic universities over three four-year periods. The chapter contains two parts: first, we analyse citation impact at an aggregated university level (Chapter 4.1). We then analyse citation impact, broken down by subject field, for each university (Chapter 4.2).

All citation analyses presented in this report are carried out according to the following procedures and calculations:

- Field normalised (fractionalised) citation rates;
- Excluding self-citations;
- Three-year citation window;
- Analyses of eight main subject groups, based on the 257 journal subject classes used by Thomson Reuters during these periods: Agriculture, Fisheries & Forestry¹⁴ (includes 14 subject classes), Biology (13 subjects), Biomedicine (18 subjects), Chemistry (10 subjects), Engineering & Materials Sciences (46 subjects), Geosciences (8 subjects), Health Sciences¹⁵ (64 subjects), and Physics & Mathematics (19 subjects).

We report relative citation rates as index values, where an index value of 1.00 is the “world average” for the aggregated field. An index value of 1.10 represents citation rates 10 per cent above the world average and an index value of 0.90 represents citation rates 10 per cent below world average. Citation rates are item-normalised according to publication type, publication year, and field-specific citation rates. This means that citation rates per publication are compared to the average citation rates for the same type of publications, in the same years, for the specific research field, before they are aggregated to provide totals. This enables the comparison of so-called *relative* citation indicators across research fields, publication types and publication years. Such relative indicators are needed here because the typical number of citations is highly dependent on research field, publication type and the time allowed before citations are counted.

Please note that for the citation statistics presented in this study, the later period is based on publications from 2008-2011, providing a period one year shorter than the period used in our analysis of publication activity (see Chapter 2). The publications from 2012 are left out from the calculation because the citation window would have been too short to provide reliable results.

Another phenomenon that affects the reliability of citation indicators is the skewness of citation distributions; while a few publications get cited heavily, most publications are seldom or never cited (although recent studies suggest that the share of publications that do get cited is increasing¹⁶). The calculation of an average (normalised) citation rate for any number of publications is therefore highly dependent on the presence and citation rates of a relatively small portion of highly cited publications. In light of this, a rule of thumb is that a minimum of 50 publications per unit should be used to produce reliable citation indicators in professional bibliometrics. We have followed this rule in this report. None-

¹⁴ This category also includes Environmental Sciences, Plant Sciences, etc. See Appendix 2.

¹⁵ Health Sciences includes the subject area Psychology.

¹⁶ See e.g. Vetenskapsrådet (2010).

theless, we need to point out that the citation indicator for any given university, in any given field of research, may still be highly dependent on the presence or absence of just a few highly cited publications. We give special attention to highly cited publications in a more focused analysis in Section 4.2.2 below. The indicator “Share of top 10 publications” is calculated based on the share each Nordic university has of the 10 per cent most highly cited papers, in each subject, field divided by the world share of the 10 per cent most highly cited papers in the same subject field. The world average therefore corresponds with a value of 1.00.

4.1 Overall citation impact (all subjects)

First we investigate the overall field normalised (fractionalised) citation rates for the universities and university hospitals, and citation rates for their share of highly cited papers, for all periods, and how they have changed over time (Table 4.1 to Table 4.5, and at the national level in Table 4.6). This analysis aggregates all research fields into one overall citation score, which is then weighted according to research profiles based on field normalised citation scores. The aggregated indicator is reasonably comparable across different research profiles and types of universities. We also investigate whether citation rates vary between publications that are nationally and internationally co-authored (Table 4.7).

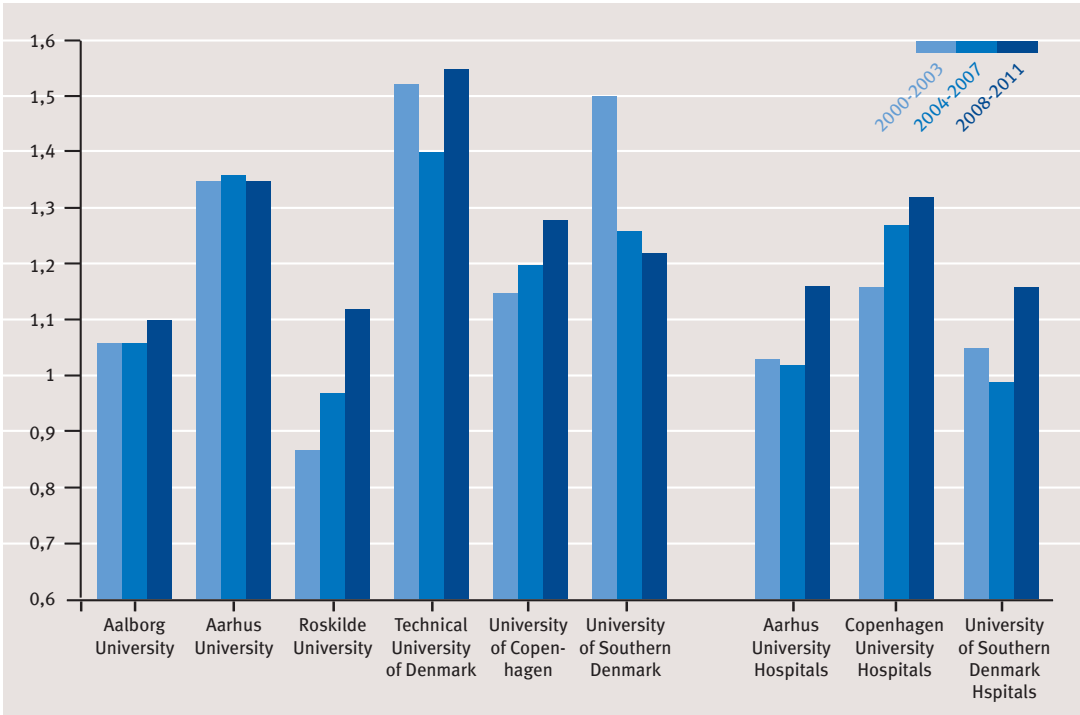
Table 4.1: Field normalized citation rates and share of top 10 publications (fractionalized), Denmark*

Denmark	Citation rate			Share of top 10 publications			Number of field normalized citations
	2000-2003	2004-2007	2008-2011	2000-2003	2004-2007	2008-2011	2008-2011
Aalborg University	1.06	1.06	1.10	0.88	0.97	0.97	1316
Aarhus University	1.35	1.36	1.35	1.33	1.41	1.48	5347
Roskilde University	0.87	0.97	1.12	0.56	0.84	1.12	246
Technical University of Denmark	1.52	1.40	1.55	1.66	1.59	1.64	6205
University of Copenhagen	1.15	1.20	1.28	1.18	1.26	1.33	8430
University of Southern Denmark	1.50	1.26	1.22	1.73	1.30	1.21	1994
							(23537)
Aarhus University Hospitals	1.03	1.02	1.16	1.15	1.03	1.22	2378
Copenhagen University Hospitals	1.16	1.27	1.32	1.19	1.47	1.51	5052
University of Southern Denmark Hospitals	1.05	0.99	1.16	1.21	1.06	1.28	658
							(8087)
Averages and total for Denmark	1.25	1.25	1.31	1.30	1.33	1.39	31624

*Data from Science Citation Index – Thomson Reuters

All Danish universities have relative citation impacts that are clearly above the world average in 2008-2011 (Table 4.1). The Technical University of Denmark and Aarhus University have the highest impact when we consider the overall impact over all three time periods measured. These universities also stand out in terms of shares of highly cited papers. The numbers in Table 4.1 are illustrated in Figure 4.1 to get an easier overview of trends over time.

Figure 4.1: Field normalized citation rates for Danish institutions*



*Data from Science Citation Index – Thomson Reuters

If these results are contrary to those found in other studies of citation impact, we must bear in mind that we have conducted a separate analysis for the university hospitals in this study (which are not directly visible in most rankings). We must also consider that changes from one period to the next might be due to the presence of a few highly cited articles.

The Finnish universities have weighted relative citation impacts that fall both below and above the world average (Table 4.2). Finland’s two largest universities in terms of publication output (Helsinki and Aalto) and the largest university hospital (Helsinki University Central Hospital) are all well above the world average for citation rates. There are small changes over time, with one noticeable exception, Turku University Hospital, which has seen an impressive increase in citation rates in the last time period. In general, using three time periods, compared to two periods in our former report, has led to a change in the decreasing trend in citation indicators observed for Finland, as it now seems to have turned.

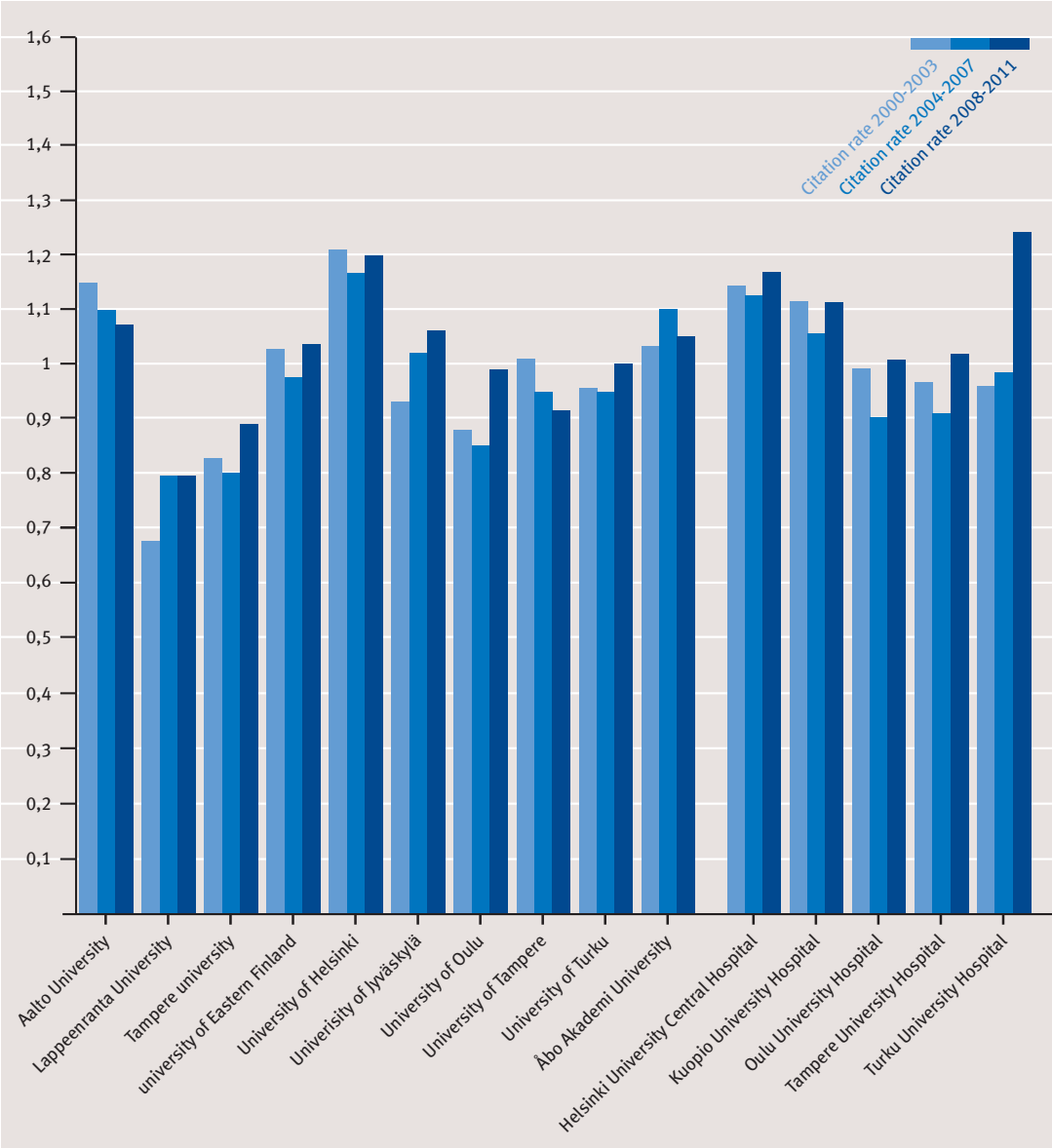
Table 4.2: Field normalized citation rates and share of top 10 publications (fractionalized), Finland*

Finland	Citation rate			Share of top 10 publications			Number of field normalized citations
	2000-2003	2004-2007	2008-2011	2000-2003	2004-2007	2008-2011	2008-2011
Aalto University	1.15	1.09	1.07	1.10	1.08	1.04	2329
Lappeenranta University of Technology	0.68	0.80	0.80	0.40	0.56	0.64	260
Tampere University of Technology	0.83	0.80	0.89	0.72	0.70	0.82	752
University of Eastern Finland	1.03	0.98	1.04	0.94	0.90	0.98	1789
University of Helsinki	1.21	1.17	1.20	1.23	1.14	1.10	5618
University of Jyväskylä	0.94	1.02	1.06	0.69	0.92	1.02	1321
University of Oulu	0.88	0.85	0.99	0.78	0.75	0.97	1642
University of Tampere	1.01	0.95	0.92	0.98	0.84	0.85	712
University of Turku	0.96	0.95	1.00	0.87	0.86	0.91	1856
Åbo Akademi University	1.03	1.10	1.05	0.81	1.03	0.87	797
							(17076)
Helsinki University Central Hospital	1.14	1.13	1.17	1.15	1.17	1.18	1746
Kuopio University Hospital	1.12	1.06	1.12	1.15	1.00	1.05	512
Oulu University Hospital	0.99	0.90	1.01	0.91	0.91	1.02	355
Tampere University Hospital	0.97	0.91	1.02	0.92	0.76	1.03	519
Turku University Hospital	0.96	0.99	1.24	0.94	0.97	1.27	499
							(3631)
Averages and total for Finland	1.06	1.03	1.08	1.00	0.98	1.01	20707

*Data from Science Citation Index – Thomson Reuters

The numbers in Table 4.2 are illustrated in Figure 4.2 to get an easier overview of trends over time.

Figure 4.2: Field normalized citation rates for Finnish institutions*



*Data from Science Citation Index – Thomson Reuters

Table 4.3: Field normalized citation rates and share of top 10 publications (fractionalized), Iceland*

	Citation rate			Share of top 10 publications			Number of field normalized citations
	2000-2003	2004-2007	2008-2011	2000-2003	2004-2007	2008-2011	2008-2011
Iceland							
Agricultural University of Iceland	-	-	-	-	-	-	17
Reykjavik University	-	-	-	-	-	-	97
University of Akureyri	-	-	-	-	-	-	31
University of Iceland	0.81	1.04	1.07	0.55	0.82	0.94	772
							(918)
Landspítali University hospital	1.31	1.33	1.07	1.29	1.38	1.06	258
Averages and total for Iceland ¹	0.94	1.11	1.05	0.72	0.99	0.94	1176

¹ Includes the publications/citations from Reykjavik University and University of Akureyri.

*Data from Science Citation Index – Thomson Reuters

Landspítali University Hospital had the highest relative citation impact of all the university hospitals included in this study between 2000-2007, but in the last period the citation rate has dropped substantially – arguably due to reduced citation rates in the highly cited papers (Table 4.3). The University of Iceland shows an increased impact during the three periods. The smaller universities are not shown in the table, as their output is too small to produce a reliable citation indicator.

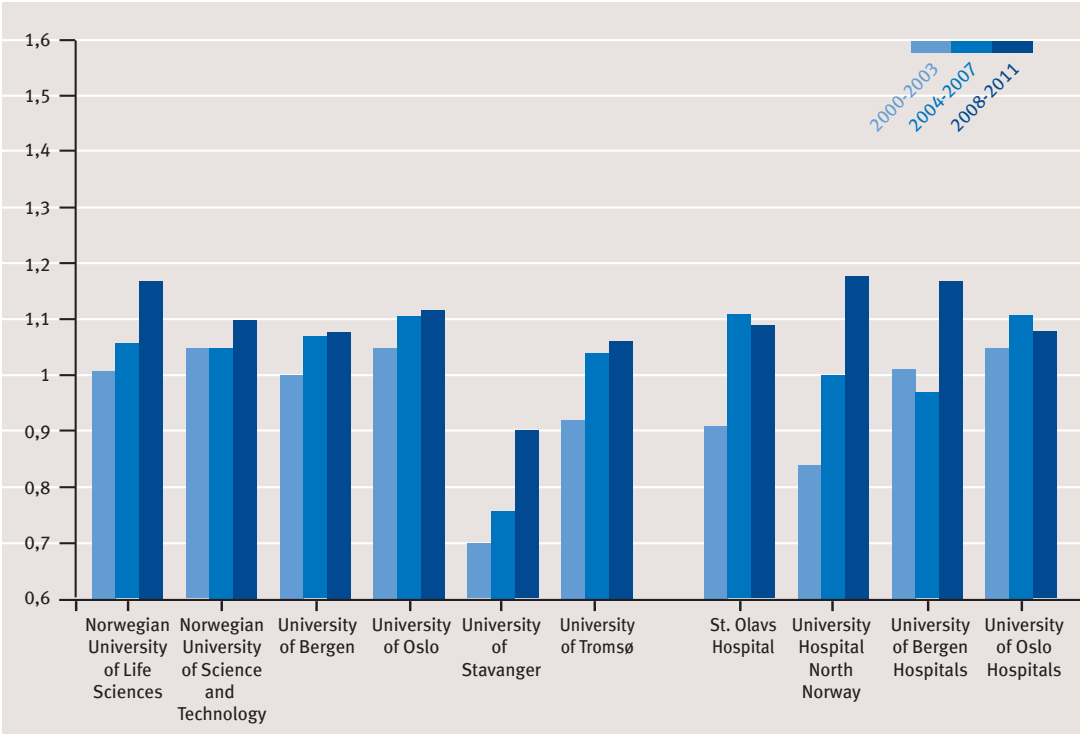
Table 4.4: Field normalized citation rates and share of top 10 publications (fractionalized), Norway*

Norway	Citation rate			Share of top 10 publications			Number of field normalized citations
	2000-2003	2004-2007	2008-2011	2000-2003	2004-2007	2008-2011	2008-2011
Norwegian University of Life Sciences	1.01	1.06	1.17	1.00	1.13	1.19	922
Norwegian University of Science and Technology	1.05	1.05	1.10	0.95	0.96	1.07	3387
University of Bergen	1.00	1.07	1.08	0.94	1.07	1.05	2757
University of Oslo	1.05	1.11	1.12	1.00	1.05	1.11	4790
University of Stavanger	0.70	0.76	0.90	0.39	0.61	0.72	295
University of Tromsø	0.92	1.04	1.06	0.77	0.99	0.98	1261
							(13413)
St.Olavs Hospital	0.91	1.11	1.09	0.86	1.06	1.19	411
University Hospital North Norway	0.84	1.00	1.18	0.68	0.85	1.33	349
University of Bergen Hospitals	1.01	0.97	1.17	0.87	1.01	1.18	935
University of Oslo Hospitals	1.05	1.11	1.08	1.03	1.08	1.04	2163
							(3858)
Averages and total for Norway	1.02	1.07	1.10	0.95	1.03	1.08	17271

*Data from Science Citation Index – Thomson Reuters

With the exception of the University of Stavanger, which has a small output in this context, all Norwegian institutions have citation impacts of around the same level, i.e. above the world average, but not very high (Table 4.4). The increased impact from the second to the third period, though, is much stronger than from the first to the second period. A striking finding in Norway is the much higher share of highly cited papers observed in the university hospitals. The numbers in Table 4.4 are illustrated in Figure 4.3 to get an easier overview of trends over time.

Figure 4.3: Field normalized citation rates for Norwegian institutions*



*Data from Science Citation Index – Thomson Reuters

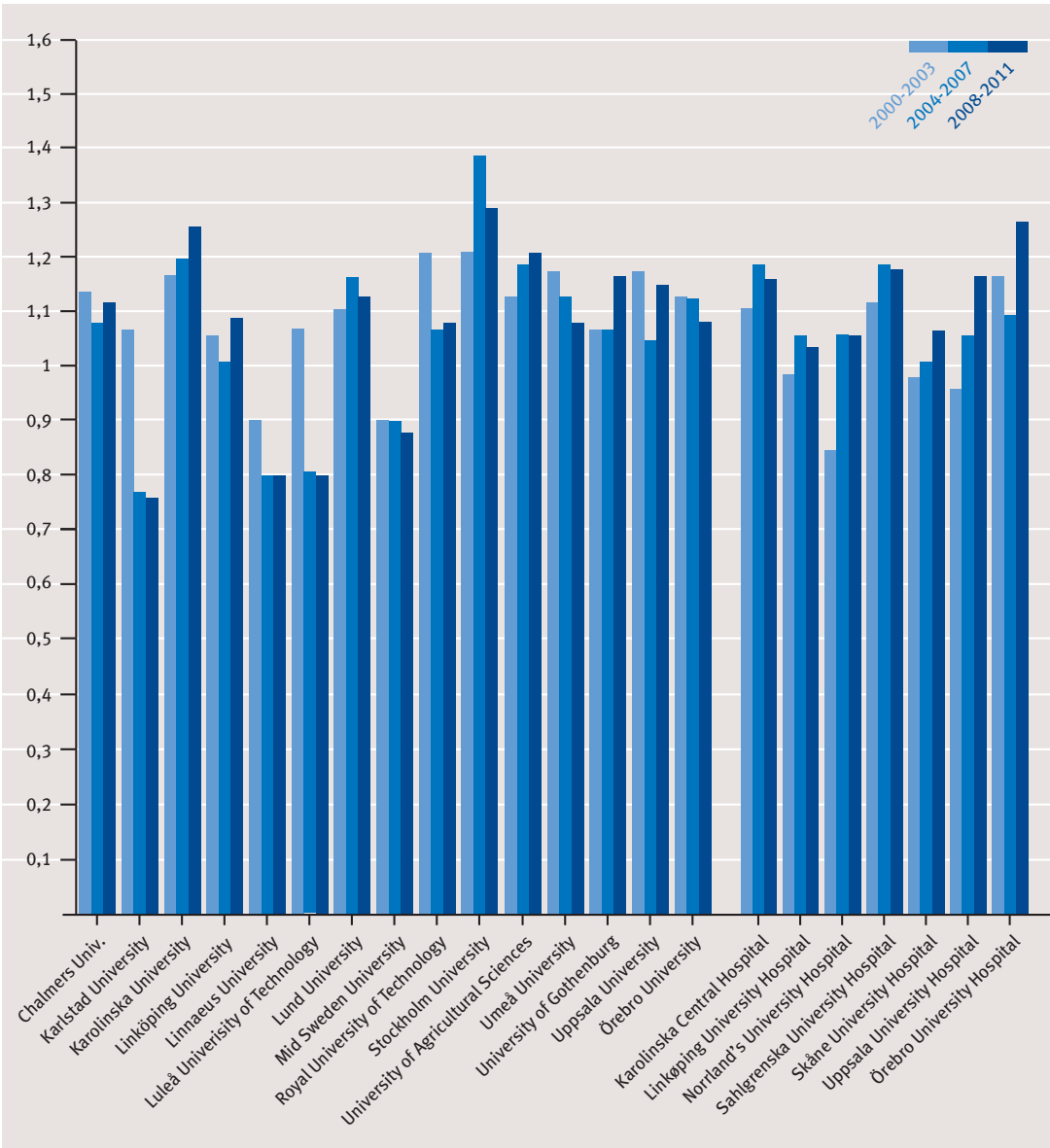
All of the larger Swedish institutions and some of the smaller ones have citation rates well above the average in all periods (Table 4.5). Indeed, Stockholm University is one of the most highly cited universities in the Nordic countries.

Table 4.5: Field normalized citation rates and share of top 10 publications (fractionalized), Sweden*

	Citation rate			Share of top 10 publications			Number of field normalized citations
	2000-2003	2004-2007	2008-2011	2000-2003	2004-2007	2008-2011	2008-2011
Sweden							
Chalmers University of Technology	1.14	1.08	1.12	1.12	0.95	1.16	2300
Karlstad University	1.07	0.77	0.76	1.06	0.59	0.49	178
Karolinska Institutet	1.17	1.20	1.26	1.28	1.32	1.40	6859
Linköping University	1.06	1.01	1.09	1.02	0.97	1.07	2334
Linnaeus University	0.90	0.80	0.80	0.75	0.74	0.66	325
Luleå University of Technology	1.07	0.81	0.80	0.86	0.63	0.66	508
Lund University	1.11	1.17	1.13	1.07	1.13	1.14	5772
Mid Sweden University	0.91	0.91	0.88	0.79	0.90	0.68	236
Royal Institute of Technology	1.21	1.07	1.08	1.15	1.02	1.11	3593
Stockholm University	1.21	1.39	1.29	1.15	1.44	1.27	3383
Swedish University of Agricultural Sciences	1.13	1.19	1.21	1.16	1.10	1.13	2541
Umeå University	1.18	1.13	1.08	1.23	1.16	1.05	2477
University of Gothenburg	1.07	1.07	1.17	1.04	0.99	1.15	3734
Uppsala University	1.18	1.05	1.15	1.17	1.10	1.16	5381
Örebro University	1.13	1.13	1.08	1.19	1.11	1.01	351
							(39972)
Karolinska University Hospital	1.11	1.19	1.16	1.09	1.27	1.21	2092
Linköping University Hospital	0.99	1.06	1.04	0.75	0.92	1.07	367
Norrland's University Hospital	0.85	1.06	1.06	0.79	1.13	1.11	306
Sahlgrenska University Hospital	1.12	1.19	1.18	1.07	1.16	1.29	1168
Skåne University Hospital	0.98	1.01	1.07	0.95	0.90	1.09	1469
Uppsala University Hospital	0.96	1.06	1.17	0.90	1.03	1.08	999
Örebro University Hospital	1.17	1.10	1.27	1.18	0.97	1.35	389
							(6790)
Averages and total for Sweden	1.12	1.12	1.15	1.11	1.11	1.16	46762

*Data from Science Citation Index – Thomson Reuters

Figure 4.4: Field normalized citation rates for Swedish institutions*



*Data from Science Citation Index – Thomson Reuters

Finally, we present the citation rates over time at the national levels (Table 4.6).

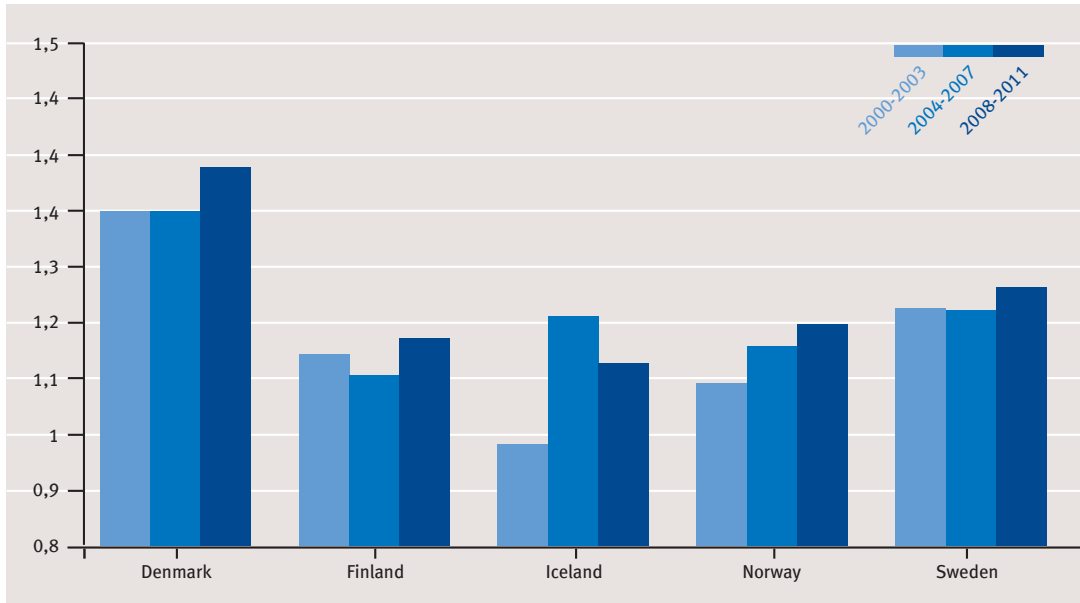
Table 4.6: Field normalized citation rates (fractionalized), Nordic countries (selected universities and university hospitals)*

	Citation rate			Share of top 10 publications			Number of field normalized citations
	2000-2003	2004-2007	2008-2011	2000-2003	2004-2007	2008-2011	2008-2011
All Nordic countries							
Denmark	1.25	1.25	1.31	1.30	1.34	1.41	31624
Finland	1.06	1.03	1.08	1.00	0.98	1.03	20707
Iceland	0.94	1.11	1.05	0.77	1.03	0.97	1176
Norway	1.02	1.07	1.10	0.95	1.04	1.08	17271
Sweden	1.12	1.12	1.15	1.11	1.12	1.16	46762
Averages and total for the Nordic countries	1.12	1.12	1.16	1.11	1.13	1.18	117541

*Data from Science Citation Index – Thomson Reuters

The numbers in Table 4.6 are visualized in Figure 4.5 to get an easier overview of trends over time.

Figure 4.5: Field normalized citation rates at the national levels*



*Data from Science Citation Index – Thomson Reuters

Denmark stands out among the Nordic countries with a substantially higher citation impact. The other countries are all above the world average and are about the same level as each other. All countries have increased their citation impact between the first and last period, but Iceland’s citation impact has decreased from the second to the third period. Finland’s tendency of decreasing citation rates observed in 2004-2007 has now changed.

4.1.1 Citation rates in publications with and without international co-authorship

In our earlier NORIA-net report on international research cooperation in the Nordic countries it was shown that much of the increase in citation rates for Denmark and Norway, identified at the national level, could be attributed to increased citation rates for national publications, i.e. publications where all authors represent the same country (Schneider et al. 2010). In contrast, Iceland’s increased citation rate was due to citation rates for international publications, i.e. publications where more than one country is represented among the authors. Finland and Sweden both saw their national-level citation rates decrease for international publications, while remaining constant for national publications. Although international cooperation is not the focus of this report, it is nevertheless worthwhile looking at how field normalised citation rates vary between national and international publications for the universities and university hospitals in this report.

Table 4.7: Average field normalized citation rates (fractionalized) in nationally and internationally co-authored publications, Nordic countries (selected universities and university hospitals) for the years 2000-2011*

	Citations to publications without international co-authorship			Citations to publications with international co-authorship			Proportion of publications with international co-authorship ¹		
	2000-2003	2004-2007	2008-2011	2000-2003	2004-2007	2008-2011	2000-2003	2004-2007	2008-2011
All Nordic countries									
Denmark	1.17	1.17	1.22	1.44	1.41	1.49	29 %	32 %	35 %
Finland	0.97	0.96	0.97	1.30	1.22	1.29	26 %	28 %	33 %
Iceland	0.73	0.84	0.67	1.25	1.46	1.45	40 %	43 %	48 %
Norway	0.92	0.96	0.99	1.26	1.31	1.31	28 %	32 %	35 %
Sweden	1.05	1.05	1.04	1.30	1.28	1.34	28 %	31 %	36 %
Averages and total for the Nordic countries	1.04	1.04	1.06	1.33	1.31	1.36	28 %	31 %	35 %

¹ These are proportions based on fractional counts. See Figure 2.6 in Gunnarsson et al. (2010) for whole counts statistics of international collaboration.

*Data from Science Citation Index – Thomson Reuters

Table 4.7 shows that national publications generally receive lower citation rates than publications involving international collaboration. This is particularly the case in Iceland, where a large proportion of international publications are found within Biomedicine and Health Sciences. A full list of the universities and university hospitals’ citation rates for national and international publications is found in Appendix 7. An interesting development observed in Table 4.7 is the increased citation rates for domestic papers in Denmark and Norway, whereas all countries except Finland have increased citation rates for international publications.

4.2 Citation impact in subject areas

Chapter 4.1 focused on citation rates at the aggregated university level only. In this section, we turn our attention to the eight subject fields (i.e. we do not calculate citation rates for SSH). We show the average field normalised citation rates over a four-year period (2008-2011) broken down at field level (Table 4.9), followed by separate analyses for each field over three time periods (Table 4.10 to Table 4.17). The citation rates are based on fractionalised publications. In Chapter 4.2.1 we present the universities' share of highly cited papers across the eight subject fields (Table 4.18).

It often becomes clear that we are dealing with a very limited number of publications when we study each field of research at the individual institutions. As already mentioned, citation indicators may become unreliable when they are based on small numbers. We therefore applied a minimum threshold of 50 fractionalised publications within a subject field over a four-year period in our analyses. Citation rates based on publication data below this threshold are not presented. This is in line with common practice in bibliometrics (see Moed et al., 1995, who suggested 50 publications as a minimum “in an oeuvre”). The result of applying this threshold is that 49 per cent of the cells in Table 4.9 are empty. However, the “Total” cells (Table 4.8) still represent the total for each university, regardless of whether a given subject field at that university has more or less than the 50 fractionalised publications required to produce subject-field specific results.

Table 4.8: Field normalized citation rates of Nordic universities and university hospitals (2000-2011) across subject fields (high scores are indicated by darkness of colour)*

Nordic Universities and University Hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
2000-2003	1.29	1.21	0.91	1.32	1.28	1.09	1.09	1.15
2004-2007	1.27	1.24	0.98	1.23	1.14	1.12	1.12	1.15
2008-2011	1.31	1.26	1.06	1.19	1.15	1.16	1.18	1.16

*Data from Science Citation Index – Thomson Reuters

At the Nordic level, there are mixed directions for the citation rate changes. From the first to the third period, Biology, Biomedicine, Geosciences and Health Sciences have increased substantially, whereas Agriculture, Fisheries & Forestry and Physics & Math have increased by a marginal 0.01. Citation rates in Chemistry and Engineering & Materials Sciences have decreased from the first to the third period.

Table 4.9: Field normalized citation rates of universities and university hospitals (2008-2011)¹ across subject fields (high scores are indicated by darkness of colour)*

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Denmark	1.42	1.33	1.14	1.35	1.45	1.30	1.28	1.48
Aalborg University	1.14		0.87	0.67	1.21		0.93	1.30
Aarhus University	1.34	1.36	1.06	1.66	1.41	1.24	1.36	1.48
Roskilde University								
Technical University of Denmark	1.63	1.44	1.26	1.65	1.66	1.24	1.27	1.57
University of Copenhagen	1.43	1.27	1.24	1.04	1.19	1.28	1.25	1.42
University of Southern Denmark	1.34	1.12	1.27	0.94	0.81		1.25	1.35
Aarhus University Hospitals			0.91				1.20	
Copenhagen University Hospitals		1.65	1.02				1.38	
University of Southern Denmark Hospitals			0.99				1.18	
Finland	1.09	1.16	1.05	1.00	1.00	1.11	1.11	1.10
Aalto University	1.00		0.80	1.14	1.10		0.86	1.08
Lappeenranta University of Technology					0.85			
Tampere University of Technology			0.84	0.88	0.90			0.89
University of Eastern Finland	1.00	1.00	0.98	0.84	1.04		1.18	0.91
University of Helsinki	1.17	1.24	1.26	1.12	1.17	1.22	1.12	1.33
University of Jyväskylä	0.88	0.99	0.69	1.07	1.35		0.80	1.34
University of Oulu	1.03	1.20	0.87	0.70	0.90	0.80	1.15	1.01
University of Tampere			0.84		0.56		1.02	
University of Turku	1.13	1.18	0.85	0.77	0.68		1.16	0.95
Åbo Akademi University			1.02	1.05	1.05		0.94	1.17
Helsinki University Central Hospital			1.18				1.17	
Kuopio University Hospital			1.08				1.15	
Oulu University Hospital							1.04	
Tampere University Hospital			0.91				1.06	
Turku University Hospital			0.96				1.30	

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Iceland	1.03	0.96	1.52		1.11	1.13	0.95	0.95
Reykjavik University					0.95			
University of Akureyri								
University of Iceland			1.31		1.27	1.12	1.00	0.94
Landspítali University hospital							0.89	
Norway	1.33	1.16	0.98	0.99	1.06	1.12	1.12	1.11
Norwegian University of Life Sciences	1.33	1.06	1.11					
Norwegian University of Science and Technology	1.23	1.15	1.06	1.03	1.07	0.54	1.07	1.33
University of Bergen	1.14	1.02	1.05	0.87	1.01	1.24	1.12	0.79
University of Oslo	1.53	1.25	0.93	1.00	1.12	1.26	1.15	1.08
University of Stavanger					0.92		0.82	
University of Tromsø	1.43	1.31	0.99	1.08		1.09	0.99	0.78
St.Olavs Hospital							1.12	
University Hospital North Norway							1.16	
University of Bergen Hospitals			0.84				1.23	
University of Oslo Hospitals			0.92				1.11	
Sweden	1.31	1.32	1.04	1.26	1.11	1.14	1.17	1.04
Chalmers University of Technology	1.53		0.92	1.27	1.09			1.11
Karlstad University					0.71		0.97	
Karolinska Institutet		1.39	1.22	1.62			1.26	
Linköping University	1.36	1.33	0.78	1.42	1.12		1.09	1.08
Linnaeus University			0.65		0.76		0.69	0.55
Luleå University of Technology				0.95	0.88		0.63	0.57
Lund University	1.40	1.26	0.96	1.18	1.26	1.25	1.07	1.17
Mid Sweden University					0.96		0.77	
Royal Institute of Technology	1.02		1.05	1.37	1.08	0.47	0.93	1.02
Stockholm University	1.48	1.32	1.22	1.44	1.43	1.34	1.06	1.24
Swedish University of Agricultural Sciences	1.30	1.31	0.85	0.96	1.20		0.95	
Umeå University	1.33	1.33	1.00	0.94	1.10		1.10	0.90
University of Gothenburg	1.32	1.35	0.93	0.96	1.20	1.26	1.27	1.00
Uppsala University	1.17	1.33	1.07	1.28	1.15	0.96	1.24	0.98
Örebro University							1.02	

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Karolinska University Hospital			1.05				1.19	
Linköping University Hospital							1.08	
Norrland's University Hospital							1.10	
Sahlgrenska University Hospital			0.90				1.23	
Skåne University Hospital			0.91				1.09	
Uppsala University Hospital			0.86				1.22	
Örebro University Hospital							1.28	
Nordic total	1.31	1.26	1.06	1.19	1.15	1.16	1.18	1.16

¹ Similar numbers for the periods 2000-2003 and 2004-2007 are found in Appendix 9.

*Data from Science Citation Index – Thomson Reuters.

The citation rates vary a great deal between the universities, but just as importantly, they also vary *within* the universities depending on field. This underlines the suggestion that to get a better understanding of a university's performance, detailed analysis is needed alongside composite measures. However, as the aggregated university citation scores are broken down into the eight research fields, we also see more variations and uncertainties emerging in these specific indicators. Each subset will contain fewer publications upon which indicators are calculated, thus creating larger variation due to highly cited articles, which will tend to have disproportionate influence in smaller data sets. For this reason, one should be careful in interpreting the meaning of these differences.

Table 4.9 illustrates some of the difficulties that can emerge when combining high citation rates with low publication volumes; five out of the nine university values of 1.5 or above in the table are found at universities with less than 200 publications in the field, i.e. less than 40 papers published on average per year. Furthermore, no university exceeds a value of 1.5 in the larger, medical related fields, while the smaller field of Agriculture, Fisheries & Forestry has three universities with a value above 1.5. Biology has one university hospital exceeding this value, Chemistry has two universities and one university hospital, and Engineering & Materials Sciences and Physics and Mathematics have one university with a value above 1.5.

In the following tables we show changes in citation rates by eight subject fields over three time periods. In the tables, the universities are listed according to their citation rates in the latest period.

Table 4.10: Field normalized citation rates - Agriculture, Fisheries & Forestry*

	University	2000-2003	2004-2007	2008-2011
DEN	Technical University of Denmark	1,67	1,50	1,63
SWE	Chalmers University of Technology	1,13	1,10	1,53
NOR	University of Oslo	1,07	1,15	1,53
SWE	Stockholm University	2,08	1,73	1,48
NOR	University of Tromsø	1,15	1,33	1,43
DEN	University of Copenhagen	1,29	1,31	1,43
SWE	Lund University	1,13	1,10	1,40
SWE	Linköping University	0,99	0,91	1,36
DEN	Aarhus University	1,29	1,33	1,34
DEN	University of Southern Denmark			1,34
SWE	Umeå University	1,95	1,78	1,33
NOR	Norwegian University of Life Sciences	1,06	1,18	1,33
NOR	University of Stavanger			1,33
SWE	University of Gothenburg	1,15	1,27	1,32
SWE	Swedish University of Agricultural Sciences	1,26	1,26	1,30
NOR	Norwegian University of Science and Technology	1,08	1,07	1,23
FIN	University of Helsinki	1,40	1,23	1,17
NOR	Uppsala University	1,05	1,00	1,17
DEN	Aalborg University	1,42	1,32	1,14
NOR	University of Bergen	1,09	1,15	1,14
FIN	University of Turku	1,18	1,29	1,13
FIN	University of Oulu	0,83	0,76	1,03
SWE	Royal Institute of Technology	1,27	1,09	1,02
FIN	University of Eastern Finland	1,07	1,15	1,00
FIN	Aalto University			1,00
FIN	University of Jyväskylä	1,03	0,97	0,88

*Data from Science Citation Index – Thomson Reuters

Table 4.11: Field normalized citation rates – Biology*

	University/university hospital	2000-2003	2004-2007	2008-2011
DEN	Copenhagen University Hospitals			1.65
DEN	Technical University of Denmark	1.50	1.42	1.44
SWE	Karolinska Institutet	1.63	1.55	1.39
DEN	Aarhus University	1.26	1.42	1.36
SWE	University of Gothenburg	1.26	1.20	1.35
SWE	Linköping University		1.33	1.33
SWE	Uppsala University	1.38	1.36	1.33
SWE	Umeå University	1.58	1.24	1.33
SWE	Stockholm University	1.35	1.35	1.32
NOR	University of Tromsø	0.84	1.20	1.31
SWE	Swedish University of Agricultural Sciences	1.19	1.38	1.31
DEN	University of Copenhagen	1.13	1.11	1.27
SWE	Lund University	1.30	1.36	1.26
NOR	University of Oslo	1.05	1.27	1.25
FIN	University of Helsinki	1.14	1.23	1.24
FIN	University of Oulu	1.06	1.08	1.20
NOR	University of Stavanger			1.20
FIN	University of Turku	1.27	1.18	1.18
NOR	Norwegian University of Science and Technology	1.14	1.06	1.15
DEN	University of Southern Denmark	1.37	1.15	1.12
NOR	Norwegian University of Life Sciences	0.84	1.06	1.06
NOR	University of Bergen	1.05	1.04	1.02
FIN	University of Eastern Finland	1.03	0.97	1.00
FIN	University of Jyväskylä	1.04	1.09	0.99

*Data from Science Citation Index – Thomson Reuters

Table 4.12: Field normalized citation rates – Biomedicine*

	University/university hospital	2000-2003	2004-2007	2008-2011
ICE	University of Iceland	0.51	0.94	1.31
DEN	University of Southern Denmark	1.65	1.57	1.27
FIN	University of Helsinki	0.95	1.00	1.26
DEN	Technical University of Denmark	1.23	1.27	1.26
DEN	University of Copenhagen	0.89	1.03	1.24
SWE	Karolinska Institutet	1.09	1.12	1.22
SWE	Stockholm University	0.89	1.17	1.22
FIN	Helsinki University Central Hospital	0.97	1.00	1.18
NOR	Norwegian University of Life Sciences	0.84	0.78	1.11
FIN	Kuopio University Hospital	0.83	0.83	1.08
SWE	Uppsala University	0.96	0.97	1.07
NOR	Norwegian University of Science and Technology	0.94	1.14	1.06
DEN	Aarhus University	0.86	0.93	1.06
NOR	University of Bergen	0.74	0.89	1.05
SWE	Royal Institute of Technology	0.95	0.84	1.05
SWE	Karolinska University Hospital	0.87	0.96	1.05
DEN	Copenhagen University Hospitals	0.85	0.97	1.02
FIN	Åbo Akademi University	0.85	0.80	1.02
SWE	Umeå University	1.02	1.01	1.00
NOR	University of Tromsø	0.69	0.91	0.99
DEN	University of Southern Denmark Hospitals	0.82		0.99
FIN	University of Eastern Finland	0.76	0.84	0.98
SWE	Lund University	0.83	0.95	0.96
FIN	Turku University Hospital	0.90		0.96
SWE	University of Gothenburg	0.83	0.93	0.93
NOR	University of Oslo	0.99	1.07	0.93
NOR	University of Oslo Hospitals	0.97	1.00	0.92
SWE	Chalmers University of Technology	0.79	0.77	0.92
FIN	Tampere University Hospital	0.76	0.79	0.91
SWE	Skåne University Hospital	0.92	0.89	0.91
NOR	University of Stavanger			0.91
DEN	Aarhus University Hospitals	0.71	0.72	0.91
SWE	Sahlgrenska University Hospital	0.77	0.86	0.90
FIN	University of Oulu	0.82	0.84	0.87
DEN	Aalborg University	0.62	0.67	0.87
SWE	Uppsala University Hospital	0.66	0.79	0.86

	University/university hospital	2000-2003	2004-2007	2008-2011
SWE	Swedish University of Agricultural Sciences	0.70	0.83	0.85
FIN	University of Turku	0.78	0.78	0.85
NOR	University of Bergen Hospitals	0.57	0.62	0.84
FIN	University of Tampere	0.84	0.77	0.84
FIN	Tampere University of Technology			0.84
FIN	Aalto University	0.70	0.83	0.80
SWE	Linköping University	0.71	0.75	0.78
FIN	University of Jyväskylä	0.61	0.59	0.69
SWE	Linnaeus University		0.84	0.65
SWE	Linköping University Hospital	0.67	0.59	
SWE	Norrland's University Hospital	0.62	0.77	

*Data from Science Citation Index – Thomson Reuters

Table 4.13: Field normalized citation rates – Chemistry*

	University	2000-2003	2004-2007	2008-2011
DEN	Aarhus University	2.13	2.28	1.66
DEN	Technical University of Denmark	1.56	1.42	1.65
SWE	Karolinska Institutet	1.56	1.04	1.62
SWE	Stockholm University	1.47	2.04	1.44
SWE	Linköping University	1.48	1.25	1.42
SWE	Royal Institute of Technology	1.28	1.16	1.37
SWE	Uppsala University	1.68	1.42	1.28
SWE	Chalmers University of Technology	1.30	1.06	1.27
SWE	Lund University	1.41	1.28	1.18
NOR	University of Stavanger			1.15
FIN	Aalto University	1.32	1.15	1.14
FIN	University of Helsinki	1.29	1.26	1.12
NOR	University of Tromsø	1.53	1.15	1.08
FIN	University of Jyväskylä	0.92	0.93	1.07
FIN	Åbo Akademi University	0.90	0.97	1.05
DEN	University of Copenhagen	1.23	1.03	1.04
NOR	Norwegian University of Science and Technology	0.73	0.84	1.03
NOR	University of Oslo	1.06	0.98	1.00
SWE	Swedish University of Agricultural Sciences	1.10	1.14	0.96
SWE	University of Gothenburg	1.22	0.97	0.96
SWE	Luleå University of Technology	2.77	0.71	0.95
DEN	University of Southern Denmark	1.77	1.20	0.94
SWE	Umeå University	1.30	1.10	0.94
FIN	Tampere University of Technology	0.81		0.88
NOR	University of Bergen	0.95	0.92	0.87
FIN	University of Eastern Finland	0.75	0.65	0.84
FIN	University of Turku	0.77	0.86	0.77
FIN	University of Oulu	0.67	0.61	0.70
DEN	Aalborg University			0.67

*Data from Science Citation Index – Thomson Reuters

Table 4.14: Field normalized citation rates - Engineering & Materials Sciences*

	University	2000-2003	2004-2007	2008-2011
DEN	Technical University of Denmark	1.78	1.42	1.66
SWE	Stockholm University	1.64	1.56	1.43
DEN	Aarhus University	2.23	1.71	1.41
FIN	University of Jyväskylä	0.91	0.99	1.35
ICE	University of Iceland			1.27
SWE	Lund University	1.22	1.34	1.26
DEN	Aalborg University	1.21	1.06	1.21
SWE	Swedish University of Agricultural Sciences	1.20	1.28	1.20
SWE	University of Gothenburg	1.10	1.21	1.20
DEN	University of Copenhagen	1.64	1.54	1.19
FIN	University of Helsinki	1.47	1.38	1.17
SWE	Uppsala University	1.54	1.03	1.15
NOR	University of Oslo	1.19	1.15	1.12
SWE	Linköping University	1.16	1.08	1.12
SWE	Umeå University	1.46	1.03	1.10
FIN	Aalto University	1.23	1.09	1.10
SWE	Chalmers University of Technology	1.24	1.19	1.09
SWE	Royal Institute of Technology	1.33	1.14	1.08
NOR	Norwegian University of Science and Technology	1.20	1.02	1.07
FIN	Åbo Akademi University	1.24	1.39	1.05
FIN	University of Eastern Finland	0.81	0.92	1.04
NOR	University of Bergen	1.14	1.36	1.01
SWE	Mid Sweden University	0.75		0.96
ICE	Reykjavik University			0.95
FIN	Tampere University of Technology	0.86	0.77	0.90
FIN	University of Oulu	0.83	0.89	0.90
SWE	Luleå University of Technology	0.91	0.88	0.88
FIN	Lappeenranta University of Technology	0.73	0.92	0.85
DEN	University of Southern Denmark	0.98	0.82	0.81
SWE	Linnaeus University	0.81		0.76
SWE	Karlstad University	0.81		0.71
FIN	University of Turku	0.82	0.88	0.68
FIN	University of Tampere	0.76		0.56
NOR	University of Stavanger	0.76		

*Data from Science Citation Index – Thomson Reuters

Table 4.15: Field normalized citation rates – Geosciences*

	University	2000-2003	2004-2007	2008-2011
SWE	Stockholm University	1.00	1.33	1.34
DEN	University of Copenhagen	1.32	1.36	1.28
NOR	University of Oslo	1.06	1.15	1.26
SWE	University of Gothenburg	1.01	0.82	1.26
SWE	Lund University	1.14	1.05	1.25
NOR	University of Bergen	1.32	1.33	1.24
DEN	Technical University of Denmark	1.18	1.23	1.24
DEN	Aarhus University	1.04	1.30	1.24
FIN	University of Helsinki	1.20	1.12	1.22
ICE	University of Iceland	1.31	1.05	1.12
NOR	University of Tromsø	1.12	1.06	1.09
NOR	University of Stavanger			1.06
SWE	Uppsala University	0.94	0.79	0.96
FIN	University of Oulu	0.45	0.82	0.80
NOR	Norwegian University of Science and Technology	0.60	0.51	0.54
SWE	Royal Institute of Technology	0.67	0.47	

*Data from Science Citation Index – Thomson Reuters

Table 4.16: Field normalised citation rates - Health Sciences*

	University/university hospital	2000-2003	2004-2007	2008-2011
DEN	Copenhagen University Hospitals	1.24	1.33	1.38
DEN	Aarhus University	1.12	1.13	1.36
FIN	Turku University Hospital	0.98	1.01	1.30
SWE	Örebro University Hospital	1.21	1.15	1.28
SWE	University of Gothenburg	1.10	1.15	1.27
DEN	Technical University of Denmark	0.72	0.96	1.27
SWE	Karolinska Institutet	1.18	1.23	1.26
DEN	University of Copenhagen	1.14	1.22	1.25
DEN	University of Southern Denmark	1.24	1.09	1.25
SWE	Uppsala University	1.05	1.04	1.24
NOR	University of Bergen Hospitals	1.10	1.04	1.23
SWE	Sahlgrenska University Hospital	1.15	1.24	1.23
SWE	Uppsala University Hospital	1.00	1.10	1.22
DEN	Aarhus University Hospitals	1.09	1.07	1.20
SWE	Karolinska University Hospital	1.18	1.26	1.19
DEN	University of Southern Denmark Hospitals	1.09	1.01	1.18

	University/university hospital	2000-2003	2004-2007	2008-2011
FIN	University of Eastern Finland	1.41	1.14	1.18
FIN	Helsinki University Central Hospital	1.17	1.16	1.17
NOR	University Hospital North Norway	0.84	1.03	1.16
FIN	University of Turku	1.09	1.04	1.16
NOR	University of Oslo	0.99	1.08	1.15
FIN	Kuopio University Hospital	1.13	1.07	1.15
FIN	University of Oulu	1.06	0.98	1.15
NOR	University of Bergen	0.97	0.99	1.12
FIN	University of Helsinki	1.29	1.19	1.12
NOR	St. Olavs Hospital	0.96	1.13	1.12
NOR	University of Oslo Hospitals	1.07	1.13	1.11
SWE	Umeå University	1.09	1.13	1.10
SWE	Norrland's University Hospital	0.91	1.14	1.10
SWE	Linköping University	0.89	0.90	1.09
SWE	Skåne University Hospital	0.99	1.01	1.09
SWE	Linköping University Hospital	1.04	1.15	1.08
NOR	Norwegian University of Science and Technology	1.04	1.05	1.07
SWE	Lund University	1.01	0.99	1.07
SWE	Stockholm University	0.88	0.95	1.06
FIN	Tampere University Hospital	1.02	0.93	1.06
FIN	Oulu University Hospital	1.00	0.92	1.04
SWE	Örebro University	1.14	1.18	1.02
FIN	University of Tampere	1.06	1.08	1.02
ICE	University of Iceland	0.84	0.85	1.00
NOR	University of Tromsø	0.83	0.97	0.99
SWE	Karlstad University			0.97
NOR	University of Stavanger			0.97
SWE	Swedish University of Agricultural Sciences	0.83	0.86	0.95
FIN	Åbo Akademi University	0.78	0.84	0.94
SWE	Royal Institute of Technology		0.80	0.93
DEN	Aalborg University	0.70	0.82	0.93
ICE	Landspítali University hospital	1.26	1.22	0.89
FIN	Aalto University		0.85	0.86
FIN	University of Jyväskylä	0.96	0.95	0.80
SWE	Mid Sweden University			0.77
SWE	Linnaeus University		0.94	0.69
SWE	Luleå University of Technology			0.63

*Data from Science Citation Index – Thomson Reuters

Table 4.17: Field normalized citation rates - Physics & Mathematics*

University		2000-2003	2004-2007	2008-2011
DEN	Technical University of Denmark	1.47	1.51	1.57
DEN	Aarhus University	1.57	1.50	1.48
DEN	University of Copenhagen	1.29	1.34	1.42
DEN	University of Southern Denmark	1.45	1.17	1.35
FIN	University of Jyväskylä	0.94	1.24	1.34
NOR	Norwegian University of Science and Technology	1.11	1.31	1.33
FIN	University of Helsinki	1.22	1.16	1.33
DEN	Aalborg University	0.91	1.36	1.30
SWE	Stockholm University	1.02	1.09	1.24
FIN	Åbo Akademi University	1.27	1.00	1.17
SWE	Lund University	1.25	1.54	1.17
SWE	Chalmers University of Technology	1.05	1.03	1.11
FIN	Aalto University	1.10	1.18	1.08
NOR	University of Oslo	1.20	1.19	1.08
SWE	Linköping University	1.21	1.15	1.08
SWE	Royal Institute of Technology	1.12	1.03	1.02
FIN	University of Oulu	0.64	0.62	1.01
SWE	University of Gothenburg	1.18	0.93	1.00
SWE	Uppsala University	1.12	0.94	0.98
FIN	University of Turku	0.66	0.77	0.95
ICE	University of Iceland	0.72	0.87	0.94
FIN	University of Eastern Finland	0.74	0.92	0.91
SWE	Umeå University	0.95	0.98	0.90
FIN	Tampere University of Technology	0.88	0.76	0.89
NOR	University of Stavanger			0.88
NOR	University of Bergen	1.01	1.02	0.79
NOR	University of Tromsø	0.82	0.88	0.78
SWE	Luleå University of Technology	0.58	0.63	0.57
SWE	Linnaeus University		0.56	0.55

*Data from Science Citation Index – Thomson Reuters

4.2.1 Share of highly cited papers

As mentioned above, citation distributions are typically skewed. A few publications tend to receive most of the citations. The issue of contribution to highly cited papers is therefore interesting to investigate, in addition to field normalised average scores. The final topic of Chapter 4 is our investigation of the Nordic universities’ shares of highly cited papers. We concentrate on the period 2008-2011 and consider these shares across the eight subject fields. The indicator is calculated based on the share each Nordic university has of the 10 per cent most highly cited papers in each subject field divided by the world share of the 10 per cent most highly cited papers in the same subject field. The world average therefore corresponds with a value of 1.00. Table 4.18 only includes universities with publications above the minimum threshold of 50 per subject field. Three Icelandic universities are left out due to their low numbers of publications in general.

Table 4.18 exhibits similar patterns of differences found in Table 4.9, although interestingly, these differences are more marked in this case, even in the case of country totals. Since this indicator is more highly dependent on the relatively small number of highly cited publications, this “satellite picture” of Nordic research might be an aid to focus more closely on the organisations where we can find researchers who fulfil an ambition to contribute substantially to research of wide interest and consequences.

Table 4.18: Universities’ and university hospitals’ normalized proportion of highly cited publications across subject field among top 10% in world production (2008-2011)¹ (1.00 equals the world average) (size level reflected by darkness of colour)*

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Denmark	1.57	1.48	1.14	1.46	1.44	1.41	1.39	1.70
Aalborg University	1.28		0.67	0.36	1.06		0.71	1.33
Aarhus University	1.29	1.58	1.10	2.15	1.91	1.34	1.51	1.80
Roskilde University								
Technical University of Denmark	1.95	1.70	1.34	1.79	1.60	1.33	1.41	1.71
University of Copenhagen	1.64	1.43	1.23	0.91	1.35	1.37	1.40	1.61
University of Southern Denmark	1.36	0.78	1.31	0.91	0.63		1.25	1.61
Aarhus University Hospitals			0.91				1.22	
Copenhagen University Hospitals		1.74	0.96				1.56	
University of Southern Denmark Hospitals			1.15				1.22	

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Finland	1.09	1.10	0.94	0.92	0.94	1.18	1.09	1.06
Aalto University	1.11		0.77	1.26	0.96		0.57	1.16
Lappeenranta University of Technology					0.64			
Tampere University of Technology			0.85	0.87	0.78			0.90
University of Eastern Finland	0.99	0.54	0.93	0.69	1.07		1.24	0.77
University of Helsinki	1.19	1.29	1.11	1.05	1.18	1.37	1.08	1.09
University of Jyväskylä	0.70	0.87	0.42	0.85	1.73		0.67	1.54
University of Oulu	1.07	1.30	0.83	0.69	0.96	0.65	1.16	0.82
University of Tampere			0.81		0.18		1.04	
University of Turku	1.07	0.95	0.71	0.58	0.60		1.15	0.88
Åbo Akademi University			0.76	0.84	1.06		0.77	0.99
Helsinki University Central Hospital			1.23				1.12	
Kuopio University Hospital			0.86				1.11	
Oulu University Hospital							1.04	
Tampere University Hospital			0.87				1.04	
Turku University Hospital			0.73				1.34	
Iceland	0.89	0.70	1.55		1.24	1.00	0.83	0.87
Agricultural University of Iceland								
Reykjavik University					1.01			
University of Akureyri								
University of Iceland			1.27		1.48	1.00	0.88	0.87
Landspítali University hospital							0.80	
Norway	1.45	1.15	0.90	1.01	0.98	1.19	1.11	1.07
Norwegian University of Life Sciences	1.37	0.87	1.50					
Norwegian University of Science and Technology	1.29	1.12	1.02	1.10	0.99	0.47	1.01	1.42
University of Bergen	1.33	0.98	0.99	0.62	0.98	1.26	1.14	0.53
University of Oslo	1.76	1.37	0.77	1.05	1.18	1.46	1.16	0.98
University of Stavanger					0.59		0.65	
University of Tromsø	1.63	1.25	0.86	1.30		1.04	0.97	0.68
St.Olavs Hospital							1.16	
University Hospital North Norway							1.28	
University of Bergen Hospitals			0.63				1.24	
University of Oslo Hospitals			0.88				1.04	

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Sweden	1.34	1.42	1.00	1.30	1.11	1.18	1.19	1.05
Chalmers University of Technology	2.04		0.90	1.39	1.10			1.15
Karlstad University					0.51		0.63	
Karolinska Institutet		1.68	1.30	0.78			1.37	
Linköping University	1.31	1.45	0.63	1.51	1.07		1.02	1.28
Linnaeus University			0.42		0.43		0.26	0.42
Luleå University of Technology				0.77	0.76		0.51	0.58
Lund University	1.44	1.35	0.92	1.32	1.30	1.41	1.01	1.22
Mid Sweden University					0.84		0.46	
Royal Institute of Technology	0.96		1.18	1.58	1.05	0.37	0.99	1.01
Stockholm University	1.52	1.30	0.95	1.59	1.79	1.40	0.95	1.23
Swedish University of Agricultural Sciences	1.31	1.24	0.78	0.44	1.19		1.00	
Umeå University	1.37	1.33	0.99	0.55	1.19		1.12	0.83
University of Gothenburg	1.24	1.50	0.83	0.84	1.23	1.34	1.34	1.08
Uppsala University	1.18	1.64	1.04	1.33	1.22	0.76	1.25	0.92
Örebro University							0.93	
Karolinska University Hospital			0.91				1.23	
Linköping University Hospital							1.10	
Norrland's University Hospital							1.16	
Sahlgrenska University Hospital			1.11				1.29	
Skåne University Hospital			0.87				1.07	
Uppsala University Hospital			0.59				1.12	
Örebro University Hospital							1.34	
All Nordic countries	1.37	1.32	1.02	1.22	1.12	1.22	1.20	1.19

5 Conclusions





5. Conclusions

This report is an update of our original report, “Comparing Research at Nordic Universities using Bibliometric Indicators” (Piro et al., 2011), which covered the period 2000-2009 (with citation rates up to 2008). The methods in the present report are the same, but we have extended the period to 2000-2012 (with citation rates up to 2011) and included a ninth subject category (SSH) for analysis of production. We have divided these 13 years into three sections (2000-2003, 2004-2007, 2008-2012 (2011)), thereby allowing for more focus on trends. On the other hand, the figures in the present report are not directly comparable to the figures in the former report. In this respect, the new report replaces the former by presenting a longer perspective with new figures and a broader perspective on production. It also captures the more recent developments. As we conclude the report, the evident question to discuss is, of course: Have there been any significant changes, to the extent that we can detect them with bibliometric methods, in the research profiles and performance of Nordic universities and university hospitals?

With a few exceptions, the answer is no. We find relatively stable differences between the Nordic universities and university hospitals.

Some of these differences represent an expected diversity. We find different research profiles and specialisations, and we find institutions with different volumes of research activity. By describing these differences, we want to bring attention to dimensions that one-dimensional “world” rankings of universities cannot capture.

On the other hand, we also find relatively stable differences with regard to citation impact. With our method of field normalising the citation rates, we can in fact compare universities of different sizes and research profiles using the citation indicator. We observe that some Nordic universities and university hospitals score on a very high international level with regard to citation impact, at least in some of the major areas of research, while most Nordic universities and university hospitals do not, although the majority of them are above the world average. Hence, we have a relatively stable picture which shows that “world class” research is being conducted at a few Nordic institutions, but not at most of them. This observation raises new questions, of course, that this report is not intended to answer: How can we explain such stable differences? What have the few most-cited institutions done to achieve their high impact on international research? What can other Nordic institutions do to achieve the same?

As mentioned, this report does not present new methods. Our work with the former report was experimental and developed within a specific project for Nordic collaboration in bibliometrics with timely and efficient funding from NordForsk. If the present updating is experienced as useful, we suggest further updating in the future, but also further indicator development, partly because the traditional bibliometric data sources are now expanding and being supplemented by new types of data sources. These developments may improve the representation of the Social Sciences and Humanities in future versions of this report.

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Appendixes





Appendixes

Appendix 1: Methodological considerations

The data source for the present report is the bibliometric database at the Swedish Research Council, which contains data from the Thomson Reuters indices Science Citation Index Expanded, Social Sciences Citation Index and Arts & Humanities Citation Index.¹⁷ The analyses cover a 13-year time period from 2000-2012. Publications have been restricted to include only research articles, letters and reviews, as defined by Thomson Reuters. At the Swedish Research Council, the Thomson Reuters' publication type *letter* is re-classified and grouped, and normalised together with the original research articles since letters can contain significant findings and can be well-cited in some scientific areas. We use the data cleaning techniques developed at the Swedish Research Council.¹⁸

Bibliometric indicators play a crucial role in most university rankings, especially rankings that rely upon publication and citation indicators. A main challenge when constructing these rankings, however, involves the allocation of publications at institution levels. The allocation is based on the information given in the author addresses in each publication. In these addresses, a particular institution name may be spelled in a variety of different ways or it may be lacking entirely. As a consequence, it is difficult to provide a correct and reliable allocation of articles at the institution level. Knowledge of countries' research systems is required in order to do this in a satisfactory way. All the examples below are addresses that belong to the University of Oslo (Norway) but would most likely not have been picked up by outsiders:

- IASAM, Inst Gen Practice & Prevent Med, Oslo, Norway
- Fredrik Holsts Hus, Sect Med Eth, N-0318 Oslo, Norway
- Akershus Fac Div, Akershus, Norway
- Hlth Econ Res Programme Oslo, Ctr Hlth Adm, NO-0027 Oslo, Norway

The data cleaning method developed in Sweden has been an important asset to this report, and offers a good approach to handling the address difficulties seen above. Network members from each country have manually checked all addresses from their respective countries and assigned them to the relevant universities and university hospitals according to a set of rules developed in Sweden. This has enabled the network to get a complete picture of the universities' research that would not have been possible if data were retrieved by researchers from outside the Nordic countries, as they would not have similar knowledge of the institutions and "hidden content" in many of the hard-to-identify addresses used by the universities over a 13-year period.

The 257 journal subject classes used by Thomson Reuters have been grouped into eight main subject groups (see Appendix 2): Agriculture, Fisheries & Forestry (includes 14 subject classes), Biology (13 subjects), Biomedicine (18 subjects), Chemistry (10 subjects), Engineering & Materials Sciences (46 subjects), Geosciences (8 subjects), Health Sciences¹⁹ (64 subjects), and Physics & Mathematics (19 subjects). A ninth subject class consisting of the remaining 65 subject classes from Social Sciences and Humanities has been used for analysis of publication volume, as well as some multidisciplinary subjects that have been included only in the parts of the report that deal with publication volumes. One methodological difficulty of comparing countries by the subject fields used here, or indeed by using any such grouping of subjects, is that there may be large variations within each subject field. This is particularly significant in the subject field *Agriculture, Fisheries & Forestry*, which has different meaning for the Nordic countries.

¹⁷ Certain data included herein are derived from the *Science Citation Index Expanded*, *Social Science Citation Index* and *Arts & Humanities Citation Index*, prepared by Thomson Reuters®, Philadelphia, Pennsylvania, USA, © Copyright Thomson Reuters® 2013. All rights reserved.

¹⁸ A full documentation of the Swedish Research Council database, data cleaning procedures and indicator calculations can be found in Kronman et al. (2010).

¹⁹ Health Sciences includes the subject area Psychology.

Table A.1: Proportion of Agriculture, Fisheries & Forestry fields in the Nordic countries*

Agriculture, Fisheries & Forestry	Denmark	Finland	Iceland	Norway	Sweden
Agricultural Economics & Policy	0 %	0 %	1 %	1 %	0 %
Agricultural Engineering	2 %	1 %	0 %	1 %	2 %
Agriculture, Dairy & Animal Science	11 %	3 %	5 %	9 %	6 %
Agriculture, Multidisciplinary	3 %	3 %	10 %	2 %	2 %
Agronomy	4 %	2 %	1 %	2 %	3 %
Environmental Sciences	18 %	26 %	15 %	22 %	28 %
Fisheries	4 %	3 %	16 %	15 %	2 %
Food Science & Technology	15 %	11 %	15 %	9 %	6 %
Forestry	3 %	19 %	3 %	7 %	12 %
Horticulture	2 %	1 %	0 %	2 %	1 %
Plant Sciences	13 %	17 %	9 %	18 %	17 %
Soil Science	6 %	4 %	3 %	4 %	5 %
Water Resources	4 %	3 %	5 %	5 %	5 %
Veterinary Sciences	14 %	7 %	17 %	4 %	10 %
Total	100 %	100 %	100 %	100 %	100 %

*Data from Science Citation Index – Thomson Reuters

Table A.1 illustrates how the dominant themes in Agriculture, Fisheries & Forestry differ in the Nordic countries. As expected, Fisheries is Iceland’s second largest sub-field (16 per cent) and Norway’s third largest (15 per cent), but is of limited importance in Denmark, Finland and Sweden. Similarly, Forestry is an important sub-field in Finland (19 per cent) and Sweden (12 per cent), but is less so in the other countries. Environmental Sciences; Food Science and Technology; Plant Sciences and Veterinary Sciences all make large contributions to this broad area in all Nordic countries, although to varying degree. To very roughly summarise the key differences within Agriculture, Fisheries & Forestry, it can be said that Denmark is more focused on food; Finland on forestry, Iceland and Norway on fish (and veterinary and plant sciences, respectively), and Sweden on plant sciences, while all countries share an interest in Environmental Sciences.

Many publications are nationally or internationally co-authored, and are the result of collaborative efforts involving more than one university. Different principles and counting methods can be applied in bibliometric studies to deal with this. The most common is “whole” counting, i.e. with no fractional attribution of credit (every university gets full credit for all papers co-authored with another institution). An alternative is fractionalised counting where the credit is divided equally between all the contributing author addresses. For example, if an article has one author address from Aarhus University and one from Aalborg University, each university will receive a value of 0.5 papers. One can argue that these counting methods are complementary: the whole or integer count gives the number of papers in which the university “participated”. We apply a fractionalised counting scheme where all the basic units (addresses) in a publication share one credit, and where a university gets one fraction each time it appears in the address list. For example, in an article with three addresses from the University of Helsinki, one from Lund University and one from Harvard University, the University of Helsinki receives three-fifths, Lund University one-fifth and Harvard one-fifth of the credit for the article. Citations to the articles are allocated in the same way.

A fractional count gives a sense of the number of papers “creditable” to the university, assuming that all authors made equal contributions to a co-authored paper and that all contributions add up to one (Moed, 2005). Contrary to most large-scale national bibliometric analyses, we apply fractionalised

counting. The figures in our report will therefore deviate from some other published indicators, such as those presented in institutional reports, which are often based on whole counts of each university's contributions to nationally and internationally co-authored articles. The number of publications is much lower when each university only receives its fractionalised share of each publication.²⁰ This also holds for the citation indicators (Chapter 4).

Another note of caution relates to small data sets, which are more vulnerable to fluctuations due to larger variability. Highly skewed distributions, which are common in bibliometrics, influence relative citation rates, meaning that a few highly cited papers can influence average citation rates considerably, especially when the data set is small. Changes in small research areas or at small universities may be more visible, but less important. Increases and decreases in publication and citation patterns may also be influenced by changes in the selection of journals indexed in the citation databases, which determines the "world size" of the research area.

University hospitals

During the address matching, we decided to include the university hospitals, but kept separate tags for them. Many medical doctors have dual positions; they carry out research both in the hospital and at the university. However, university hospitals are separate units, often with different funding systems, and should be kept as far from the analysis of standard universities as possible. Some of the university hospitals were aggregated into groups according to Table A.2.

²⁰ When whole counts are used, a university with a high share of national or international co-publications will have a higher publication count than a university with a low share of external co-publications, all other things being equal.

Table A.2: University hospitals included in the report

Country	University	Affiliated hospitals
Denmark	Aarhus University	Aarhus University Hospitals ¹
	University of Copenhagen	Copenhagen University Hospitals ²
	University of Southern Denmark	Odense University Hospitals ³
Finland	University of Helsinki	Helsinki University Central Hospital ⁴
	University of Kuopio	Kuopio University Hospital ⁵
	University of Oulu	Oulu University Hospital
	University of Tampere	Tampere University Hospital ⁶
	University of Turku	Turku University Hospital ⁷
Iceland	University of Iceland	Landspítali University Hospital
Norway	Norwegian University of Science and Technology	St. Olavs Hospital
	University of Bergen	Haukeland University Hospital
		Stavanger University Hospital
		Akershus University Hospital
	University of Oslo	Diakonhjemmet Hospital
		Oslo University Hospital
Sweden	University of Tromsø	University Hospital North Norway
	Karolinska Institutet	Karolinska University Hospital
	Linköping University	Linköping University Hospital
	Lund University	Skåne University Hospital
	Sahlgrenska University	Sahlgrenska University Hospital
	Umeå University	Norrland's University Hospital
	Uppsala University	Uppsala University Hospital

¹ Aarhus University Hospitals include: Amtssygehuset, Børne- og Ungdomspsykiatrisk Hospital, Kommunehospitalet, Marselisborg Hospital, Psykiatrisk Hospital Risskov, Skejby Sygehus, Århus Sygehus, Aalborg Psykiatriske Sygehus, Aalborg Sygehus.

² Copenhagen University Hospitals include: Amager, Bispebjerg, Frederiksberg, Gentofte, Glostrup, Herlev, Hillerød (Hørsholm), Holbæk, Hovedstaden Psykiatri, Hvidovre, Kommunehospitalet, Køge, Næstved, Rigshospitalet, Roskilde, Sct. Hans.

³ Odense University Hospitals include: Odense Universitetshospital, Svenborg sygehus.

⁴ Helsinki University Central Hospital includes: Aurora Hospital, Children's Castle, Children's Hospital, Department of Oncology, Eye and Ear Hospital, Hospital for Children and Adolescents, Jorvi Hospital, Kättilöopisto Maternity Hospital, Meilahti Tower Hospital, Peijas Hospital, Psychiatrycenter, Skin and Allergy Hospital, Surgical Hospital, Töölö Hospital and Women's Hospital.

⁵ Kuopio University Hospital includes: Puijo Hospital, Alava Hospital, Julkula Hospital and Tarina Hospital.

⁶ Tampere University Hospital includes: Tampere University Central Hospital, Pitkämäki Hospital, Lahti Radiotherapy Unit, and Heart Center.

⁷ Turku University Hospital includes: Surgical Hospital in Turku, Raisio Hospital and Paimio Hospital.

Self-citations

The citation analyses in this report are based on citation data in which self-citations have been excluded. Author names in the citing and the cited publications are compared, and a citation is considered a self-citation and excluded if any of the names are the same in the publication (see Kronman et al., 2010, for more details). In our previous report based on the time period 2000-2009, we investigated differences in citation rates when self-citations were included/excluded (Piro et al., 2011). There were large differences in (field normalised) self-citations for some universities, but overall the difference was relatively small for the whole Nordic data set (1.8 per cent). The pattern observed then is consistent in our new data.

Appendix 2: Main subject areas

Among 257 subject classes used by Thomson Reuters, 192 were grouped into eight main groupings for our analyses. Multidisciplinary disciplines have been re-assigned into other subfields. The remaining 65 subject classes labelled “SSH”, mostly within Social Sciences and Humanities (see: <http://science.thomsonreuters.com/mjl/scope/>), are only used in parts of the report dealing with publication volumes.

Code	Thomson name	NORIA subject
AD	Agriculture, Dairy & Animal Science	Agriculture, Fisheries & Forestry
AE	Agricultural Engineering	Agriculture, Fisheries & Forestry
AF	Agricultural Economics & Policy	Agriculture, Fisheries & Forestry
AH	Agriculture, Multidisciplinary	Agriculture, Fisheries & Forestry
AM	Agronomy	Agriculture, Fisheries & Forestry
DE	Plant Sciences	Agriculture, Fisheries & Forestry
JA	Environmental Sciences	Agriculture, Fisheries & Forestry
JU	Fisheries	Agriculture, Fisheries & Forestry
JY	Food Science & Technology	Agriculture, Fisheries & Forestry
KA	Forestry	Agriculture, Fisheries & Forestry
MU	Horticulture	Agriculture, Fisheries & Forestry
XE	Soil Science	Agriculture, Fisheries & Forestry
ZC	Veterinary Sciences	Agriculture, Fisheries & Forestry
ZR	Water Resources	Agriculture, Fisheries & Forestry
ZM	Zoology	Biology
PI	Marine & Freshwater Biology	Biology
RQ	Mycology	Biology
TA	Ornithology	Biology
WF	Reproductive Biology	Biology
OU	Limnology	Biology
HT	Evolutionary Biology	Biology
HY	Developmental Biology	Biology
IY	Entomology	Biology
CU	Biology	Biology
CX	Biology, Miscellaneous	Biology
BD	Biodiversity Conservation	Biology
GU	Ecology	Biology
FQ	Cytology & Histology	Biomedicine
DX	Chemistry, Medicinal	Biomedicine
DA	Biophysics	Biomedicine
DB	Biotechnology & Applied Microbiology	Biomedicine
AY	Anatomy & Morphology	Biomedicine
CO	Biochemical Research Methods	Biomedicine
CQ	Biochemistry & Molecular Biology	Biomedicine
CT	Cell & Tissue engineering	Biomedicine

DR	Cell Biology	Biomedicine
KM	Genetics & Heredity	Biomedicine
MC	Mathematical & Computational Biology	Biomedicine
NI	Immunology	Biomedicine
TI	Parasitology	Biomedicine
TU	Pharmacology & Pharmacy	Biomedicine
UM	Physiology	Biomedicine
RU	Neurosciences	Biomedicine
QU	Microbiology	Biomedicine
RA	Microscopy	Biomedicine
UY	Polymer Science	Chemistry
XQ	Spectroscopy	Chemistry
HQ	Electrochemistry	Chemistry
DY	Chemistry, Multidisciplinary	Chemistry
EA	Chemistry, Analytical	Chemistry
EC	Chemistry, Inorganic & Nuclear	Chemistry
EE	Chemistry, Organic	Chemistry
EI	Chemistry, Physical	Chemistry
DW	Chemistry, Applied	Chemistry
FI	Crystallography	Chemistry
FA	Construction & Building Technology	Engineering & Materials Sci.
EV	Computer Science, Interdisciplinary Applications	Engineering & Materials Sci.
EW	Computer Science, Software Engineering	Engineering & Materials Sci.
EX	Computer Science, Theory & Methods	Engineering & Materials Sci.
EP	Computer Science, Artificial Intelligence	Engineering & Materials Sci.
ER	Computer Science, Cybernetics	Engineering & Materials Sci.
ES	Computer Science, Hardware & Architecture	Engineering & Materials Sci.
ET	Computer Science, Information Systems	Engineering & Materials Sci.
AC	Automation & Control Systems	Engineering & Materials Sci.
AI	Engineering, Aerospace	Engineering & Materials Sci.
ID	Energy & Fuels	Engineering & Materials Sci.
IF	Engineering, Multidisciplinary	Engineering & Materials Sci.
IG	Engineering, Biomedical	Engineering & Materials Sci.
IH	Engineering, Environmental	Engineering & Materials Sci.
II	Engineering, Chemical	Engineering & Materials Sci.
IJ	Engineering, Industrial	Engineering & Materials Sci.
IK	Engineering, Manufacturing	Engineering & Materials Sci.
IL	Engineering, Marine	Engineering & Materials Sci.
IM	Engineering, Civil	Engineering & Materials Sci.
IO	Engineering, Ocean	Engineering & Materials Sci.
IP	Engineering, Petroleum	Engineering & Materials Sci.
IQ	Engineering, Electrical & Electronic	Engineering & Materials Sci.
IU	Engineering, Mechanical	Engineering & Materials Sci.
IX	Engineering, Geological	Engineering & Materials Sci.
JI	Ergonomics	Engineering & Materials Sci.

NS	Nanoscience & Nanotechnology	Engineering & Materials Sci.
PE	Operations Research & Management Science	Engineering & Materials Sci.
OA	Instruments & Instrumentation	Engineering & Materials Sci.
YE	Telecommunications	Engineering & Materials Sci.
YQ	Transportation	Engineering & Materials Sci.
YR	Transportation Science & Technology	Engineering & Materials Sci.
ZQ	Mining & Mineral Processing	Engineering & Materials Sci.
UE	Imaging Science & Photographic Technology	Engineering & Materials Sci.
RB	Robotics	Engineering & Materials Sci.
QM	Metallurgy & Mining	Engineering & Materials Sci.
SR	Remote Sensing	Engineering & Materials Sci.
PJ	Materials Science, Paper & Wood	Engineering & Materials Sci.
PK	Materials Science, Ceramics	Engineering & Materials Sci.
PM	Materials Science, Multidisciplinary	Engineering & Materials Sci.
PU	Mechanics	Engineering & Materials Sci.
PZ	Metallurgy & Metallurgical Engineering	Engineering & Materials Sci.
QE	Materials Science, Biomaterials	Engineering & Materials Sci.
QF	Materials Science, Characterization, Testing	Engineering & Materials Sci.
QG	Materials Science, Coatings & Films	Engineering & Materials Sci.
QH	Materials Science, Composites	Engineering & Materials Sci.
QJ	Materials Science, Textiles	Engineering & Materials Sci.
QQ	Meteorology & Atmospheric Sciences	Geosciences
RE	Mineralogy	Geosciences
SI	Oceanography	Geosciences
TE	Paleontology	Geosciences
KV	Geography, Physical	Geosciences
KY	Geology	Geosciences
LE	Geosciences, Multidisciplinary	Geosciences
GC	Geochemistry & Geophysics	Geosciences
GM	Substance Abuse	Health Sciences
HI	Psychology, Educational	Health Sciences
HL	Health Care Sciences & Services	Health Sciences
IA	Endocrinology & Metabolism	Health Sciences
LI	Geriatrics & Gerontology	Health Sciences
LJ	Gerontology	Health Sciences
LQ	Health Policy & Services	Health Sciences
MA	Hematology	Health Sciences
KI	Gastroenterology & Hepatology	Health Sciences
OI	Integrative & Complementary Medicine	Health Sciences
OO	Medical Ethics	Health Sciences
OP	Medicine, Legal	Health Sciences
NN	Infectious Diseases	Health Sciences
NQ	Psychology, Applied	Health Sciences
MY	Psychology, Developmental	Health Sciences
NE	Public, Environmental & Occupational Health	Health Sciences

ML	Primary Health Care	Health Sciences
AQ	Allergy	Health Sciences
DS	Critical Care Medicine	Health Sciences
DM	Oncology	Health Sciences
DQ	Cardiac & Cardiovascular System	Health Sciences
AZ	Andrology	Health Sciences
BA	Anesthesiology	Health Sciences
BV	Psychology, Biological	Health Sciences
CL	Audiology & Speech-Language Pathology	Health Sciences
EQ	Psychology, Clinical	Health Sciences
CN	Behavioral Sciences	Health Sciences
FF	Emergency Medicine	Health Sciences
FY	Dentistry, Oral Surgery & Medicine	Health Sciences
GA	Dermatology	Health Sciences
TM	Pathology	Health Sciences
TQ	Pediatrics	Health Sciences
WC	Rehabilitation	Health Sciences
VE	Psychiatry	Health Sciences
WE	Respiratory System	Health Sciences
WH	Rheumatology	Health Sciences
VI	Psychology	Health Sciences
VJ	Psychology, Multidisciplinary	Health Sciences
VP	Psychology, Psychoanalysis	Health Sciences
WQ	Psychology, Social	Health Sciences
VS	Psychology, Mathematical	Health Sciences
WV	Social Sciences, Biomedical	Health Sciences
VX	Psychology, Experimental	Health Sciences
VY	Radiology, Nuclear Medicine & Medical Imaging	Health Sciences
RT	Clinical Neurology	Health Sciences
SU	Ophthalmology	Health Sciences
TC	Orthopedics	Health Sciences
TD	Otorhinolaryngology	Health Sciences
RX	Neuroimaging	Health Sciences
RZ	Nursing	Health Sciences
SA	Nutrition & Dietetics	Health Sciences
SD	Obstetrics & Gynecology	Health Sciences
QA	Medicine, Research & Experimental	Health Sciences
PW	Medical Laboratory Technology	Health Sciences
PY	Medicine, General & Internal	Health Sciences
PT	Medical Informatics	Health Sciences
YO	Toxicology	Health Sciences
YP	Transplantation	Health Sciences
ZA	Urology & Nephrology	Health Sciences
YU	Tropical Medicine	Health Sciences
ZD	Peripheral Vascular Disease	Health Sciences

ZE	Virology	Health Sciences
YA	Surgery	Health Sciences
XW	Sport Sciences	Health Sciences
XY	Statistics & Probability	Physics & Math
UR	Physics, Mathematical	Physics & Math
UB	Physics, Applied	Physics & Math
UN	Physics, Nuclear	Physics & Math
UP	Physics, Particles & Fields	Physics & Math
UF	Physics, Fluids & Plasmas	Physics & Math
UH	Physics, Atomic, Molecular & Chemical	Physics & Math
UI	Physics, Multidisciplinary	Physics & Math
UK	Physics, Condensed Matter	Physics & Math
RY	Nuclear Science & Technology	Physics & Math
SY	Optics	Physics & Math
PN	Mathematics, Applied	Physics & Math
PO	Mathematics, Interdisciplinary Applications	Physics & Math
PQ	Mathematics	Physics & Math
QL	Logic	Physics & Math
MO	Mathematics, General	Physics & Math
DT	Thermodynamics	Physics & Math
BU	Astronomy & Astrophysics	Physics & Math
AA	Acoustics	Physics & Math
BF	Anthropology	SSH
BI	Archaeology	SSH
BK	Architecture	SSH
BM	Area Studies	SSH
BP	Art	SSH
BQ	Humanities, Multidisciplinary	SSH
DI	Business	SSH
DK	Business, Finance	SSH
FE	Criminology & Penology	SSH
FS	Dance	SSH
FU	Demography	SSH
GY	Economics	SSH
HA	Education & Educational Research	SSH
HB	Education, Scientific Disciplines	SSH
HE	Education, Special	SSH
HF	Ethics	SSH
EU	Communication	SSH
EN	Cultural Studies	SSH
EO	Classics	SSH
MM	History	SSH
MW	Hospitality, Leisure, Sport & Tourism	SSH
MQ	History & Philosophy of Science	SSH
MR	History of Social Sciences	SSH

NM	Industrial Relations & Labor	SSH
NU	Information Science & Library Science	SSH
OQ	Oriental Studies	SSH
OR	Asian Studies	SSH
OT	Linguistics	SSH
OM	Law	SSH
OE	International Relations	SSH
PF	Literature, American	SSH
PG	Literature, British Isles	SSH
PH	Literature, German, Dutch, Scandinavian	SSH
OX	Literary Theory & Criticism	SSH
OY	Language & Linguistics	SSH
OZ	Literary Reviews	SSH
PA	Literature	SSH
PC	Management	SSH
PD	Literature, African, Australian, Canadian	SSH
KU	Geography	SSH
JM	Ethnic Studies	SSH
JO	Family Studies	SSH
JS	Film, Radio, Television	SSH
JW	Folklore	SSH
JB	Environmental Studies	SSH
QC	Literature, Romance	SSH
QD	Literature, Slavic	SSH
QK	Medieval & Renaissance Studies	SSH
PS	Social Sciences, Mathematical Methods	SSH
RO	Multidisciplinary Sciences	SSH
RP	Music	SSH
WY	Social Work	SSH
XA	Sociology	SSH
WU	Social Sciences, Interdisciplinary	SSH
VM	Public Administration	SSH
WM	Social Issues	SSH
UA	Philosophy	SSH
UQ	Planning & Development	SSH
UT	Poetry	SSH
UU	Political Science	SSH
UL	Politics & Policy	SSH
YG	Theater	SSH
YI	Religion	SSH
ZK	Women's Studies	SSH
YY	Urban Studies	SSH

Appendix 3: The total production in the world in the different subject fields*

Subject field	Volume 2000	Volume 2012	Volume 2000-2003	Volume 2004-2007	Volume 2008-2012	Share 2008-2012	Annual growth rate
Agriculture, Fisheries & Forestry	49735	92692	208362	253272	429689	7 %	5 %
Biology	29640	49909	122844	147446	246007	4 %	4 %
Biomedicine	127234	191593	513615	581508	873829	14 %	3 %
Chemistry	84417	131513	351394	424082	621565	10 %	4 %
Engineering & Materials Science	108956	208517	460914	604859	930809	15 %	6 %
Geosciences	21990	36955	92224	111201	172693	3 %	4 %
Health Sciences	229603	381726	924435	1078897	1755983	28 %	4 %
Physics & Math	118011	174562	486606	575268	838939	13 %	3 %
SSH	54083	99076	212268	236483	471871	7 %	5 %
Total	823668	1366543	3372661	4013016	6341385	100 %	4 %

*Data from Science Citation Index – Thomson Reuters

Appendix 4: The universities' contribution to the national level

Table A.3 – A.7 provides two types of information at the national level. First, it shows each university/university hospital's contribution to the scientific output within the nine subject fields; second, it shows each university/university hospital's contribution to the total publication output for their respective country (in the column Total). The darker the colour, the larger is the contribution of each university (or hospital) to the national publication output, both within each subject area and in terms of the national level output in total.

Table A.3: Danish universities and university hospitals' share of the publication volume (fractionalized) in 2008-2012 within each subject area (size level reflected by darkness of colour)*

Danish universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH	Total
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Aalborg University	5 %	1 %	3 %	4 %	22 %	2 %	2 %	6 %	12 %	6 %
Aarhus University	31 %	30 %	16 %	25 %	10 %	24 %	10 %	22 %	30 %	18 %
Roskilde University	1 %	2 %	1 %	2 %	1 %	1 %	0 %	2 %	7 %	1 %
Technical University of Denmark	19 %	11 %	11 %	30 %	52 %	22 %	2 %	34 %	2 %	15 %
University of Copenhagen	40 %	41 %	38 %	27 %	9 %	46 %	21 %	28 %	36 %	28 %
University of Southern Denmark	3 %	6 %	8 %	10 %	5 %	4 %	7 %	8 %	13 %	7 %
Aarhus University Hospitals	1 %	2 %	6 %	0 %	1 %	0 %	18 %	0 %	0 %	8 %
Copenhagen University Hospitals	1 %	5 %	14 %	1 %	1 %	0 %	34 %	1 %	1 %	15 %
University of Southern Denmark Hospitals	0 %	1 %	2 %	1 %	0 %	0 %	5 %	0 %	0 %	2 %

*Data from Science Citation Index – Thomson Reuters

The University of Copenhagen is the largest university in *Denmark* with 28 per cent of the research output in the period 2008-2012. Aarhus University and the Technical University of Denmark are the second and third largest universities with 18 per cent and 15 per cent, respectively. In fourth place is the conglomerate of Copenhagen University Hospitals, with 15 per cent of the national production. Here, Rigshospitalet in Copenhagen emerges as by far the most significant institution in terms of output. The universities in Copenhagen and Aarhus have comparable profiles based on research output. They have a relatively high share of the national output in most fields indicating the diversity, size and also reflecting the age and status of these “old” universities. On the surface the Technical University can be considered a specialised institution with a very strong emphasis on Engineering & Materials Sciences. However, as Table A.3 demonstrates, the Technical University actually has the largest research output in Denmark in Physics & Mathematics as well as Chemistry, making the university profile more complex. The “youngest” universities in Denmark, Aalborg, Southern Denmark and Roskilde, have a low share of the overall research production, although their shares in other disciplines (i.e. Social Sciences and Humanities) are all in the region 7-13 per cent. Aalborg University also has a strong research output in Engineering & Materials Sciences.

Table A.4: Finnish universities and university hospitals’ share of the publication volume (fractionalized) in 2008-2012 within each subject area (size level reflected by darkness of colour)*

Finnish universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH	Total
Total	100 %	100%	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Aalto University	5 %	1 %	4 %	17 %	32 %	6 %	1 %	27 %	13 %	12 %
Lappeenranta University of Technology	2 %	0 %	0 %	3 %	7 %	1 %	0 %	2 %	2 %	2 %
Tampere University of Technology	1 %	1 %	2 %	6 %	15 %	2 %	0 %	8 %	1 %	4 %
University of Eastern Finland	20 %	7 %	12 %	10 %	6 %	7 %	8 %	6 %	6 %	9 %
University of Helsinki	49 %	46 %	36 %	24 %	7 %	55 %	18 %	20 %	32 %	25 %
University of Jyväskylä	5 %	12 %	4 %	12 %	5 %	1 %	4 %	13 %	11 %	7 %
University of Oulu	7 %	10 %	7 %	6 %	11 %	20 %	7 %	10 %	7 %	8 %
University of Tampere	0 %	1 %	5 %	0 %	2 %	0 %	8 %	1 %	10 %	5 %
University of Turku	8 %	16 %	11 %	10 %	5 %	6 %	10 %	11 %	11 %	10 %
Åbo Akademi University	3 %	3 %	4 %	12 %	9 %	3 %	1 %	2 %	5 %	4 %
Helsinki University Central Hospital	0 %	2 %	7 %	0 %	0 %	0 %	19 %	0 %	0 %	7 %
Kuopio University Hospital	0 %	0 %	3 %	0 %	0 %	0 %	5 %	0 %	0 %	2 %
Oulu University Hospital	0 %	0 %	1 %	0 %	0 %	0 %	5 %	0 %	0 %	2 %
Tampere University Hospital	0 %	1 %	3 %	0 %	0 %	0 %	6 %	0 %	0 %	2 %
Turku University Hospital	0 %	0 %	2 %	0 %	0 %	0 %	5 %	0 %	0 %	2 %

*Data from Science Citation Index – Thomson Reuters

The dominant position of the University of Helsinki in *Finnish* research is clearly demonstrated in Table A.4. In five of the eight subject fields under consideration (six when SSH is also considered), the University of Helsinki holds the top position in terms of research output in Finland. In Geosciences, the University of Helsinki produces over half of all publications in Finland and almost half in Agriculture, Fisheries & Forestry and Biology. Helsinki University Central Hospital is, by a narrow margin, the largest contributor to Health Sciences, just ahead of the University of Helsinki. The only other university that stands out as the most prolific in any particular fields is Aalto University, with its strong output in Engineering & Materials Sciences and Physics & Mathematics. The University of Turku show double digit figures in six subjects, reflecting its versatility (seven when SSH is included).

Table A.5: Icelandic universities and university hospitals’ share of the publication volume (fractionalized) in 2005-2009 within each subject area (size level reflected by darkness of colour)*

Icelandic universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH	Total
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Agricultural University of Iceland	19 %	4 %	0 %	0 %	0 %	3 %	0 %	0 %	0 %	2 %
Reykjavik University	3 %	3 %	3 %	1 %	46 %	1 %	2 %	18 %	10 %	9 %
University of Akureyri	6 %	1 %	3 %	7 %	2 %	3 %	4 %	1 %	11 %	4 %
University of Iceland	68 %	89 %	74 %	91 %	50 %	93 %	49 %	80 %	76 %	66 %
Landspítali University hospital	5 %	4 %	20 %	1 %	2 %	0 %	44 %	1 %	3 %	19 %

*Data from Science Citation Index – Thomson Reuters

In *Iceland*, there are two organisations responsible for producing 85 per cent of all publications in the table; the University of Iceland (with 66 per cent) and the university hospital (with 19 per cent). This indicates the importance of health research in this comparison. The university hospital has produced about one-fifth of all the Biomedicine publications and about half of the publications related to Health Sciences in Iceland. The publication output of the other three universities is fairly low in most research areas, although the University of Reykjavik is visible in Engineering & Materials Sciences, and to a lesser extent, in Physics & Mathematics.

Table A.6: Norwegian universities and university hospitals’ share of the publication volume (fractionalised) in 2005-2009 within each subject area (size level reflected by darkness of colour)*

Norwegian universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH	Total
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Norwegian University of Life Sciences	41 %	13 %	6 %	4 %	3 %	3 %	1 %	1 %	4 %	5 %
Norwegian University of Science and Technology	19 %	14 %	11 %	34 %	58 %	12 %	10 %	35 %	19 %	20 %
University of Bergen	12 %	25 %	16 %	12 %	11 %	38 %	14 %	15 %	18 %	16 %
University of Oslo	16 %	27 %	32 %	38 %	17 %	35 %	25 %	40 %	42 %	29 %
University of Stavanger	2 %	1 %	1 %	1 %	7 %	2 %	1 %	2 %	6 %	2 %
University of Tromsø	10 %	15 %	8 %	9 %	2 %	10 %	7 %	6 %	10 %	8 %
St. Olavs Hospital	0 %	0 %	2 %	0 %	0 %	0 %	5 %	0 %	0 %	2 %
University Hospital North Norway	0 %	1 %	1 %	0 %	0 %	0 %	4 %	0 %	0 %	2 %
University of Bergen Hospitals	0 %	1 %	6 %	0 %	0 %	0 %	10 %	0 %	0 %	5 %
University of Oslo Hospitals	1 %	3 %	16 %	2 %	1 %	0 %	24 %	1 %	1 %	12 %

*Data from Science Citation Index – Thomson Reuters

In Norway, the university hospitals contribute to 21 per cent of the total production. Within Health Sciences they contribute to 43 per cent and in Biomedicine 25 per cent. Three universities (those in Oslo Bergen, and the Norwegian University of Science and Technology) make a strong contribution to all subject areas, whereas the Norwegian University of Life Sciences has strong contributions concentrated in Agriculture, Fisheries & Forestry and Biology. The largest single contributor to a subject area is the Norwegian University of Science and Technology, which dominates publication output in Engineering & Materials Sciences (58 per cent). In terms of overall size (measured by fractionalised publications), the University of Oslo is Norway’s largest university (29 per cent of all publications), followed by the Norwegian University of Science and Technology (20 per cent) and the University of Bergen (16 per cent).

Table A.7: Swedish universities and university hospitals' share of the publication volume (fractionalised) in 2005-2009 within each subject area (size level reflected by darkness of colour)*

Swedish universities and university hospitals	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH	Total
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Chalmers University of Technology	2 %	1 %	2 %	11 %	18 %	4 %	0 %	13 %	2 %	5 %
Karlstad University	1 %	0 %	0 %	1 %	1 %	0 %	0 %	1 %	2 %	1 %
Karolinska Institutet	1 %	7 %	23 %	3 %	1 %	0 %	22 %	1 %	2 %	12 %
Linköping University	2 %	2 %	4 %	5 %	10 %	1 %	5 %	8 %	7 %	6 %
Linnaeus University	1 %	2 %	1 %	1 %	1 %	2 %	1 %	2 %	3 %	1 %
Luleå University of Technology	2 %	0 %	0 %	2 %	7 %	3 %	0 %	2 %	2 %	2 %
Lund University	11 %	17 %	14 %	15 %	12 %	15 %	11 %	13 %	15 %	13 %
Mid Sweden University	1 %	0 %	0 %	0 %	2 %	1 %	1 %	1 %	2 %	1 %
Royal Institute of Technology	4 %	1 %	3 %	18 %	26 %	8 %	1 %	21 %	5 %	8 %
Stockholm University	9 %	12 %	6 %	14 %	3 %	28 %	2 %	11 %	18 %	7 %
Swedish University of Agricultural Sciences	46 %	19 %	4 %	3 %	2 %	4 %	1 %	0 %	2 %	5 %
Umeå University	6 %	7 %	6 %	5 %	3 %	4 %	6 %	6 %	8 %	6 %
University of Gothenburg	5 %	11 %	9 %	6 %	3 %	10 %	10 %	5 %	16 %	9 %
Uppsala University	6 %	16 %	15 %	16 %	10 %	20 %	8 %	16 %	13 %	12 %
Örebro University	1 %	0 %	0 %	1 %	1 %	0 %	1 %	0 %	3 %	1 %
Karolinska University Hospital	0 %	1 %	5 %	0 %	0 %	0 %	9 %	0 %	0 %	4 %
Linköping University Hospital	0 %	0 %	0 %	0 %	0 %	0 %	2 %	0 %	0 %	1 %
Norrland's University Hospital	0 %	0 %	0 %	0 %	0 %	0 %	1 %	0 %	0 %	1 %
Sahlgrenska University Hospital	0 %	0 %	2 %	0 %	0 %	0 %	5 %	0 %	0 %	2 %
Skåne University Hospital	0 %	1 %	3 %	0 %	0 %	0 %	7 %	0 %	0 %	3 %
Uppsala University Hospital	0 %	0 %	1 %	0 %	0 %	0 %	4 %	0 %	0 %	2 %
Örebro University Hospital	0 %	0 %	1 %	0 %	0 %	0 %	2 %	0 %	0 %	1 %

*Data from Science Citation Index – Thomson Reuters

In Sweden, the universities with an image of focusing on technology and a comprehensive engineering education (Chalmers University of Technology, Royal Institute of Technology, Linköping University and Luleå University of Technology) clearly dominate the subject fields related to engineering and natural sciences. There has, however, been a broadening of their publishing output in terms of subject fields, following a change of focus among these institutions. Similarly, Sweden's only exclusively medical university, Karolinska Institutet, primarily publishes within the fields Biomedicine and Health Sciences, as would be expected. The more general universities, which tend to be larger institutions, have a distributed profile with publications within all fields. The largest relative contribution to the subject fields is made by the Swedish University of Agricultural Sciences in the Agriculture, Fisheries & Forestry field, with 46 per cent of all Swedish output. The second largest percentage in the Swedish section of Table A.7 is the 28 per cent contribution made to Geosciences from Stockholm University. There are also a number of universities contributing to 20-25 per cent of the national output in different fields.

Appendix 5: Number of fractionalised publications

Table A.8: Number of fractionalised publications (2000-2003)*

Country, university	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH	Total
Denmark	1977.6	1090.3	3629.2	1209.7	1671.1	567.4	5939.3	2177.6	806.3	19068.5
Aalborg University	160.3	13.3	120.3	27.5	333.5	6.3	102.2	97.9	100.7	962.0
Aarhus University	528.7	326.5	559.2	248.7	219.7	135.3	658.7	582.1	180.2	3439.1
Roskilde University	23.3	33.1	25.4	26.1	21.7	4.5	16.3	20.5	46.7	217.7
Technical University of Denmark	407.3	100.2	448.7	401.5	815.9	103.2	96.4	690.8	32.0	3096.2
University of Copenhagen	810.7	491.0	1411.5	330.6	178.2	298.7	1153.0	625.2	355.7	5654.5
University of Southern Denmark	32.5	75.3	296.5	158.8	73.0	19.4	283.7	149.7	84.9	1173.7
Aarhus University Hospitals	5.2	8.8	186.1	3.3	16.8		1187.3	4.7	1.0	1413.2
Copenhagen University Hospitals	6.5	36.5	539.3	12.3	9.9		2107.0	6.2	3.2	2720.9
University of Southern Denmark Hospitals	3.1	5.6	42.3	0.9	2.4		334.7	0.4	1.8	391.3
Finland	1138.7	937.7	2952.1	1332.4	2237.0	255.5	6465.9	2105.3	754.1	18178.6
Aalto University	42.6	3.1	87.1	194.2	783.7	18.0	49.0	560.5	68.1	1806.3
Lappeenranta University of Technology	12.5	0.4	1.8	14.6	115.7	0.7	0.5	23.3	5.1	174.5
Tampere University of Technology	17.0	0.7	14.8	47.4	338.3	2.8	25.4	120.9	6.8	574.0
University of Eastern Finland	244.6	109.7	332.7	145.5	111.4	25.0	450.4	106.9	35.7	1562.0
University of Helsinki	527.4	357.5	957.7	395.6	191.0	114.2	1041.5	503.3	293.1	4381.3
University of Jyväskylä	65.7	108.2	68.7	123.4	90.2	3.1	178.0	287.1	74.6	999.1
University of Oulu	76.3	111.3	284.1	87.9	211.8	57.4	597.2	209.0	34.4	1669.3
University of Tampere	6.3	6.1	114.2	2.5	48.5	0.6	388.5	14.3	93.8	674.9
University of Turku	112.3	173.9	419.5	159.0	127.5	23.4	741.6	216.2	93.8	2067.1
Åbo Akademi University	28.0	25.5	94.3	155.6	174.6	10.3	61.6	56.7	39.5	646.2
Helsinki University Central Hospital	2.6	23.9	265.1	2.5	21.3		1396.2	1.9	4.5	1718.1
Kuopio University Hospital	1.3	7.2	126.9	1.6	9.8		520.2	3.0	2.2	672.2
Oulu University Hospital		4.0	21.6	0.1	2.1		261.7	1.1	0.6	291.3
Tampere University Hospital	1.4	3.9	110.0	1.1	5.5		468.9	0.1	0.6	591.4
Turku University Hospital	0.8	2.4	53.5	1.3	5.8		284.9	1.0	1.1	350.9

Iceland	42.0	23.7	91.9	28.2	26.2	65.5	229.7	63.2	53.5	623.8
Agricultural University of Iceland	10.4	1.3	0.3			1.2	0.1			13.3
Reykjavik University					2.0	0.1	0.9			3.0
University of Akureyri	0.7		1.0	2.3	0.3	0.4	3.9		5.5	14.0
University of Iceland	30.5	19.8	61.2	25.3	23.9	63.8	98.5	63.1	47.3	433.5
Landspítali University hospital	0.4	2.6	29.4	0.5		0.1	126.3	0.1	0.8	160.1
Norway	723.1	739.6	1658.1	588.4	838.8	527.1	4032.4	830.8	629.1	10567.3
Norwegian University of Life Sciences	290.1	72.9	71.0	17.5	18.2	11.0	12.9	11.3	15.2	520.1
Norwegian University of Science and Technology	90.1	107.9	188.3	164.6	470.5	52.1	298.1	240.8	108.6	1721.1
University of Bergen	127.4	178.0	267.5	78.6	107.5	192.8	599.2	169.5	115.8	1836.3
University of Oslo	116.1	251.5	542.3	258.0	158.9	189.2	942.9	338.0	305.1	3102.0
University of Stavanger	4.9	3.3	5.8	9.2	44.9	7.1	18.4	10.1	23.1	126.8
University of Tromsø	85.4	104.0	129.3	53.8	25.9	74.9	244.5	53.4	57.3	828.4
St. Olavs Hospital	1.9	1.8	43.1	0.1	1.5		196.5	2.9	0.4	248.3
University Hospital North Norway	0.3	0.4	19.1		0.2		152.8	0.4	0.9	174.0
University of Bergen Hospitals	2.2	2.6	83.9	0.5	2.3		429.4	1.6	0.5	523.0
University of Oslo Hospitals	4.7	17.2	307.9	6.1	8.8		1137.7	2.8	2.2	1487.3
Sweden	2335.6	1832.5	7630.3	2995.3	4290.1	822.0	13858.1	4802.5	1344.6	39910.9
Chalmers University of Technology	54.4	10.3	74.5	334.6	741.6	29.3	25.3	805.7	40.3	2116.1
Karlstad University	5.6	3.0	11.2	12.5	29.9	2.0	28.9	26.4	19.9	139.3
Karolinska Institutet	36.1	68.3	1757.0	88.8	34.7	0.1	2371.9	22.8	29.3	4409.1
Linköping University	50.7	21.1	211.1	139.2	507.8	9.6	497.1	392.4	59.4	1888.3
Linnaeus University	22.2	25.2	31.3	7.0	13.2	6.1	25.3	32.6	26.9	189.8
Luleå University of Technology	41.4	1.4	6.2	63.1	251.8	27.3	23.5	86.7	32.8	534.2
Lund University	308.1	319.6	1135.2	577.0	587.0	142.2	1031.5	722.7	196.2	5019.5
Mid Sweden University	22.2	17.4	13.2	28.4	41.5	4.0	27.0	30.3	15.6	199.5
Royal Institute of Technology	63.9	13.2	170.4	435.2	1029.2	40.2	34.3	901.5	47.5	2735.5
Stockholm University	163.7	213.1	404.8	389.0	125.8	196.5	273.8	393.4	274.0	2434.1
Swedish University of Agricultural Sciences	1118.9	311.4	309.8	91.7	90.8	29.4	99.4	13.6	20.7	2085.8
Umeå University	82.3	162.1	423.0	128.7	94.2	17.9	673.4	212.6	114.7	1908.9
University of Gothenburg	128.4	262.1	620.2	194.1	150.0	133.2	1164.6	336.4	210.3	3199.3
Uppsala University	190.1	333.5	1024.8	465.3	500.3	182.9	981.8	796.8	223.2	4698.9
Örebro University	13.2	4.4	7.4	3.0	22.9	1.1	51.4	8.9	15.1	127.4
Karolinska University Hospital	7.1	30.6	623.7	14.8	11.5		1867.4	4.8	5.0	2564.8
Linköping University Hospital	0.8	2.6	66.5	6.5	6.0		362.9	2.1	3.5	450.8
Norrland's University Hospital	0.6	2.2	66.4	2.0	7.9	0.1	375.5	0.2	0.1	454.9
Sahlgrenska University Hospital	3.8	13.5	180.1	6.2	11.3		1280.8	3.5	0.8	1499.9
Skåne University Hospital	15.1	12.7	303.8	7.4	20.8	0.2	1550.7	7.8	5.7	1924.1
Uppsala University Hospital	4.1	4.0	164.7	0.9	10.4		920.8	1.1	1.7	1107.8
Örebro University Hospital	2.8	0.6	25.0		1.5		191.0	0.1	1.9	222.9

*Data from Science Citation Index – Thomson Reuters

Table A.9: Number of fractionalised publications (2004-2007)*

Country, university	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH	Total
Denmark	2083.1	1082.9	3946.0	1356.6	2275.9	532.5	6939.4	2155.7	997.1	21369.2
Aalborg University	187.5	12.0	165.9	32.6	505.6	6.9	127.2	140.7	152.0	1330.5
Aarhus University	577.4	325.0	617.8	323.8	238.6	117.3	760.1	528.4	215.0	3703.3
Roskilde University	21.1	21.7	43.0	34.1	33.8	6.4	14.7	26.6	73.1	274.4
Technical University of Denmark	412.3	108.2	501.7	461.1	1113.5	109.7	151.2	714.1	24.2	3595.9
University of Copenhagen	829.2	484.4	1383.6	300.5	235.6	268.9	1301.6	573.1	404.2	5781.1
University of Southern Denmark	35.8	70.5	361.4	186.2	100.9	22.9	418.1	157.6	118.6	1471.9
Aarhus University Hospitals	4.7	13.7	225.7	7.0	29.1		1364.3	5.5	3.6	1653.8
Copenhagen University Hospitals	12.1	43.0	566.7	10.5	16.4	0.3	2431.6	9.4	6.3	3096.4
University of Southern Denmark Hospitals	3.0	4.4	80.1	1.0	2.3		370.6	0.3	0.1	461.8
Finland	1242.7	940.8	3047.8	1472.3	2958.0	327.2	6081.2	2395.2	984.1	19449.3
Aalto University	48.8	8.0	94.3	232.8	997.5	13.2	66.7	629.1	113.9	2204.4
Lappeenranta University of Technology	20.5	0.9	4.0	28.9	177.9	0.7	0.6	40.5	22.2	296.3
Tampere University of Technology	22.0	2.0	33.9	55.9	413.3	4.1	25.3	179.6	8.7	744.8
University of Eastern Finland	241.9	84.6	369.6	168.5	158.3	29.3	441.6	143.1	34.6	1671.4
University of Helsinki	575.4	410.2	1045.3	374.5	245.4	171.0	1077.3	546.2	326.1	4771.3
University of Jyväskylä	74.5	102.4	96.0	138.2	100.7	2.3	204.9	298.1	75.7	1093.0
University of Oulu	88.4	103.8	234.8	98.3	306.1	78.3	463.4	245.6	51.4	1670.1
University of Tampere	10.8	6.5	117.5	1.8	90.9	0.1	402.4	18.9	136.3	785.1
University of Turku	106.3	161.0	402.0	169.1	199.2	21.7	646.3	227.6	143.6	2076.7
Åbo Akademi University	44.4	29.2	110.0	197.6	223.4	6.4	54.2	56.8	64.3	786.3
Helsinki University Central Hospital	3.9	16.5	268.3	3.8	19.5	0.1	1364.7	2.1	3.9	1682.6
Kuopio University Hospital	2.5	3.7	87.0	1.1	7.3		388.8	3.0	0.3	493.7
Oulu University Hospital	0.3	3.9	25.6	0.4	5.4	0.1	272.0	1.7	0.9	310.4
Tampere University Hospital	1.5	5.8	112.2	1.1	9.5		386.6	1.9	1.4	519.9
Turku University Hospital	1.5	2.1	47.4	0.4	3.7		286.5	1.0	0.7	343.3
Iceland	54.0	43.0	133.3	27.3	50.3	95.0	291.7	71.6	62.3	828.5
Agricultural University of Iceland	12.2	2.0	0.2	0.1		1.2	0.1			15.8
Reykjavik University			1.8	0.5	9.6	0.2	2.5	3.5	3.4	21.5
University of Akureyri	1.1	0.8	0.4	0.7	3.0	3.4	4.1		11.2	24.7
University of Iceland	38.5	38.9	93.3	24.9	36.8	90.0	141.5	68.1	43.8	575.7
Landspítali University hospital	2.2	1.3	37.6	1.1	1.0	0.2	143.5		3.9	190.8

Norway	823.7	812.7	1864.4	761.7	1362.7	654.5	4909.7	1162.5	961.3	13313.1
Norwegian University of Life Sciences	354.6	112.5	101.5	26.2	33.8	16.5	25.7	17.9	29.9	718.6
Norwegian University of Science and Technology	114.4	143.6	211.4	261.2	775.5	77.7	445.0	360.7	164.5	2554.0
University of Bergen	112.4	198.5	311.8	85.4	200.6	268.6	719.4	177.4	186.3	2260.3
University of Oslo	129.4	223.2	580.9	298.8	249.1	209.8	1137.4	521.1	442.2	3791.9
University of Stavanger	9.0	3.2	8.3	12.8	52.5	7.8	39.5	10.9	50.6	194.6
University of Tromsø	94.3	113.0	164.0	63.3	29.1	73.9	261.1	60.6	80.3	939.7
St. Olavs Hospital	1.8	4.3	39.8	2.3	2.8	0.1	250.9	4.3	0.2	306.3
University Hospital North Norway	0.6	0.9	26.3	0.6	0.9		180.6	0.7	2.7	213.2
University of Bergen Hospitals	1.0	3.6	100.0	1.1	3.0		520.4	3.3	1.4	633.7
University of Oslo Hospitals	6.3	9.9	320.3	10.1	15.5	0.1	1329.6	5.6	3.4	1700.8
Sweden	2492.8	1851.7	7509.1	3127.3	4887.1	893.0	14415.3	5010.7	1785.2	41972.2
Chalmers University of Technology	63.0	12.4	96.1	340.0	907.7	39.3	28.8	732.6	56.1	2276.1
Karlstad University	11.9	5.3	13.5	19.1	84.2	5.6	39.7	41.3	28.6	249.3
Karolinska Institutet	33.9	76.0	1666.3	72.6	46.8	1.4	2895.2	28.3	46.6	4867.2
Linköping University	61.5	23.1	235.7	128.4	483.2	9.1	592.0	420.1	102.5	2055.5
Linnaeus University	37.8	37.8	60.5	20.4	51.6	9.5	50.7	86.3	40.5	395.2
Luleå University of Technology	47.4	1.1	5.5	60.0	270.2	28.3	36.3	103.1	31.0	582.9
Lund University	361.4	332.5	1129.8	586.2	623.2	150.5	1327.5	762.1	264.6	5538.0
Mid Sweden University	27.1	8.8	9.4	21.7	73.2	3.5	38.2	44.8	25.0	251.6
Royal Institute of Technology	97.2	17.5	175.8	529.2	1164.1	63.4	86.1	1024.1	78.5	3236.0
Stockholm University	200.0	230.3	477.3	434.0	145.6	222.1	323.1	373.4	336.0	2741.8
Swedish University of Agricultural Sciences	1047.3	326.1	295.3	85.4	90.8	23.9	97.1	15.7	34.9	2016.6
Umeå University	115.9	158.1	428.1	131.7	128.5	33.5	746.8	232.3	123.5	2098.4
University of Gothenburg	133.7	245.6	643.8	166.1	139.4	123.7	1255.6	271.5	298.3	3277.8
Uppsala University	173.9	306.7	1083.6	477.5	563.8	177.0	1021.4	841.5	262.8	4908.2
Örebro University	36.0	6.3	21.2	22.2	48.8	1.7	115.6	14.1	35.6	301.4
Karolinska University Hospital	7.5	27.3	488.3	10.7	9.7		1694.1	2.2	4.9	2244.6
Linköping University Hospital	1.6	2.7	66.2	3.7	5.6		362.2	1.4	1.6	445.1
Norrland's University Hospital	0.7	1.5	50.4	1.3	6.3		284.3		0.5	345.0
Sahlgrenska University Hospital	7.6	9.1	157.9	4.1	9.3	0.3	1065.8	4.2	2.7	1261.1
Skåne University Hospital	16.6	18.3	240.5	8.0	23.0	0.1	1384.7	10.2	5.9	1707.2
Uppsala University Hospital	6.1	2.6	127.5	4.8	9.4	0.1	728.5	0.7	2.9	882.5
Örebro University Hospital	4.6	2.3	36.5	0.2	2.7		241.5	0.8	2.1	290.6

*Data from Science Citation Index – Thomson Reuters

Table A.10: Number of fractionalised publications (2008-2012)*

Country, university	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH	Total
Denmark	2827	1611	5657	1981	3267	787	11992	3199	2701	34023
Aalborg University	132	22	198	71	707	14	239	195	312	1889
Aarhus University	888	477	924	499	313	190	1191	706	801	5989
Roskilde University	26	27	48	37	32	10	32	61	180	455
Technical University of Denmark	538	183	624	592	1700	176	268	1077	60	5219
University of Copenhagen	1125	661	2143	543	294	363	2539	881	966	9515
University of Southern Denmark	83	104	437	205	153	33	851	245	350	2463
Aarhus University Hospitals	17	36	359	8	35	1	2190	9	13	2667
Copenhagen University Hospitals	16	88	802	13	25	0	4038	21	16	5021
University of Southern Denmark Hospitals	4	12	122	11	6	0	644	3	3	806
Finland	1690	1448	3737	1831	3699	511	8092	3272	2459	26739
Aalto University	78	14	136	306	1202	31	116	889	313	3085
Lappeenranta University of Technology	29	1	12	51	273	4	8	51	60	489
Tampere University of Technology	20	8	71	111	553	8	40	268	29	1108
University of Eastern Finland	330	107	438	181	225	36	610	201	150	2278
University of Helsinki	825	662	1329	436	261	279	1475	645	793	6707
University of Jyväskylä	84	168	133	225	168	6	355	431	264	1834
University of Oulu	120	142	280	111	396	103	588	318	179	2237
University of Tampere	5	15	170	6	67	0	664	39	251	1218
University of Turku	134	237	413	176	191	29	838	349	277	2643
Åbo Akademi University	54	49	137	218	317	14	104	68	127	1089
Helsinki University Central Hospital	2	24	271	3	14	0	1552	4	5	1875
Kuopio University Hospital	3	6	112	2	12		426	4	3	568
Oulu University Hospital	1	7	35	1	4		390	1	3	443
Tampere University Hospital	2	8	126	3	10		493	2	2	644
Turku University Hospital	1	2	74	1	6	0	433	1	3	521
Iceland	93	70	175	52	158	147	587	178	189	1648
Agricultural University of Iceland	18	2	1		0	4	0		0	25
Reykjavik University	3	2	5	0	72	1	14	32	20	150
University of Akureyri	5	1	4	4	4	4	24	2	21	70
University of Iceland	63	62	130	47	79	137	288	143	144	1092
Landspítali University hospital	4	2	35	0	3	0	261	1	5	311

Norway	1188	1180	2832	938	2360	1219	8467	1772	2244	22200
Norwegian University of Life Sciences	482	150	173	34	66	32	50	22	82	1092
Norwegian University of Science and Technology	221	169	316	320	1378	149	812	616	417	4399
University of Bergen	143	291	459	113	255	461	1224	269	413	3629
University of Oslo	189	321	900	354	408	429	2119	703	937	6362
University of Stavanger	22	12	19	13	166	22	105	40	130	529
University of Tromsø	117	181	240	82	42	126	606	99	226	1719
St. Olavs Hospital	2	5	60	1	8		402	4	4	485
University Hospital North Norway	1	8	41	1	4		323	2	6	386
University of Bergen Hospitals	3	10	161	3	5		808	3	8	1003
University of Oslo Hospitals	8	32	462	16	27	1	2018	13	21	2597
Sweden	3134	2744	9048	3465	6345	1279	19594	6025	4636	56270
Chalmers University of Technology	75	20	200	379	1115	52	70	764	98	2773
Karlstad University	23	13	21	18	82	5	78	57	91	387
Karolinska Institutet	46	189	2061	87	61	3	4379	38	98	6961
Linköping University	71	67	326	162	617	13	1019	502	334	3112
Linnaeus University	43	58	80	19	70	23	107	107	135	643
Luleå University of Technology	61	3	15	71	429	40	72	135	79	905
Lund University	346	465	1230	535	779	197	2142	769	692	7156
Mid Sweden University	30	14	15	17	125	7	106	42	92	446
Royal Institute of Technology	141	33	269	636	1665	100	147	1285	213	4489
Stockholm University	267	333	546	497	208	357	433	647	834	4123
Swedish University of Agricultural Sciences	1433	514	356	91	119	57	131	28	113	2842
Umeå University	193	205	555	156	191	49	1229	335	352	3264
University of Gothenburg	163	304	856	195	164	122	1945	298	740	4786
Uppsala University	177	433	1349	543	613	253	1640	979	598	6586
Örebro University	30	5	38	27	50	3	253	18	142	566
Karolinska University Hospital	4	40	475	11	9		1677	3	8	2228
Linköping University Hospital	1	3	45	5	5		362	1	3	424
Norrland's University Hospital	1	2	35	2	6	0	278	0	0	325
Sahlgrenska University Hospital	6	9	155	4	11	0	1000	5	4	1194
Skåne University Hospital	12	20	233	7	15		1387	11	5	1690
Uppsala University Hospital	8	12	135	3	6		829	0	4	996
Örebro University Hospital	4	2	51	1	5	0	310	1	3	377

*Data from Science Citation Index – Thomson Reuters

Appendix 6: Relative Specialisation Index (RSI) in 2008-2012

(Size level reflected by darkness of colour)*

Country, university	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math	SSH
Denmark									
Aalborg University	0.02	-0.55	-0.14	-0.44	0.44	-0.58	-0.37	-0.12	0.38
Aarhus University	0.37	0.34	0.06	-0.08	-0.47	0.08	-0.16	-0.06	0.28
Roskilde University	-0.09	0.21	-0.13	-0.09	-0.35	-0.09	-0.59	0.01	0.68
Technical University of Denmark	0.21	-0.05	-0.07	0.07	0.38	0.11	-0.69	0.22	-0.73
University of Copenhagen	0.27	0.28	0.24	-0.26	-0.65	0.17	-0.02	-0.18	0.15
University of Southern Denmark	-0.34	0.04	0.13	-0.08	-0.40	-0.34	0.11	-0.14	0.31
Aarhus University Hospitals	-0.83	-0.48	-0.01	-0.94	-0.84	-0.99	0.50	-0.95	-0.88
Copenhagen University Hospitals	-0.91	-0.38	0.07	-0.95	-0.93	-1.00	0.49	-0.94	-0.92
University of Southern Denmark Hospitals	-0.87	-0.44	0.05	-0.76	-0.90		0.49	-0.94	-0.91
Finland									
Aalto University	-0.45	-0.79	-0.51	0.01	0.45	-0.46	-0.76	0.37	0.15
Lappeenranta University of Technology	-0.06	-0.95	-0.70	0.03	0.58	-0.52	-0.89	-0.12	0.25
Tampere University of Technology	-0.57	-0.70	-0.36	0.01	0.55	-0.59	-0.77	0.29	-0.48
University of Eastern Finland	0.36	0.10	0.16	-0.10	-0.19	-0.27	-0.02	-0.20	-0.06
University of Helsinki	0.29	0.44	0.18	-0.20	-0.58	0.21	-0.11	-0.16	0.23
University of Jyväskylä	-0.19	0.40	-0.31	0.11	-0.23	-0.80	-0.18	0.28	0.32
University of Oulu	-0.12	0.24	-0.05	-0.33	0.09	0.26	-0.03	0.04	0.04
University of Tampere	-0.88	-0.51	0.01	-0.91	-0.45	-0.98	0.33	-0.61	0.47
University of Turku	-0.14	0.40	0.06	-0.19	-0.34	-0.43	0.07	0.00	0.17
Åbo Akademi University	-0.16	0.07	-0.04	0.34	0.33	-0.34	-0.49	-0.36	0.22
Helsinki University Central Hospital	-0.96	-0.51	0.02	-0.97	-0.91	-0.99	0.50	-0.97	-0.93
Kuopio University Hospital	-0.86	-0.57	0.18	-0.93	-0.74		0.46	-0.89	-0.87
Oulu University Hospital	-0.92	-0.43	-0.26	-0.97	-0.87		0.52	-0.96	-0.84
Tampere University Hospital	-0.93	-0.52	0.17	-0.91	-0.81		0.47	-0.96	-0.94
Turku University Hospital	-0.93	-0.80	0.02	-0.98	-0.85	-0.98	0.50	-0.96	-0.88
Iceland									
Agricultural University of Iceland	0.82	0.43	-0.69		-0.96	0.71	-0.92		-0.99
Reykjavik University	-0.54	-0.54	-0.59	-0.96	0.53	-0.55	-0.49	0.24	0.28
University of Akureyri	0.06	-0.47	-0.36	-0.30	-0.45	0.39	0.11	-0.64	0.60
University of Iceland	-0.08	0.19	-0.07	-0.39	-0.34	0.64	-0.03	-0.01	0.28
Landspítali University hospital	-0.66	-0.66	-0.10	-0.97	-0.89	-0.99	0.50	-0.95	-0.65

Norway									
Norwegian University of Life Sciences	0.73	0.56	0.07	-0.51	-0.41	0.04	-0.72	-0.73	0.00
Norwegian University of Science and Technology	-0.15	0.00	-0.31	-0.15	0.36	0.11	-0.20	0.03	0.12
University of Bergen	-0.26	0.35	-0.04	-0.52	-0.35	0.65	0.10	-0.28	0.21
University of Oslo	-0.39	0.13	0.01	-0.28	-0.39	0.42	0.09	-0.09	0.33
University of Stavanger	-0.25	-0.26	-0.58	-0.59	0.36	0.20	-0.16	-0.28	0.54
University of Tromsø	0.00	0.46	0.01	-0.35	-0.72	0.46	0.12	-0.39	0.28
St. Olavs Hospital	-0.91	-0.59	-0.05	-0.94	-0.81		0.50	-0.88	-0.80
University Hospital North Norway	-0.95	-0.28	-0.13	-0.97	-0.85		0.50	-0.93	-0.65
University of Bergen Hospitals	-0.91	-0.60	0.08	-0.93	-0.93		0.49	-0.95	-0.81
University of Oslo Hospitals	-0.91	-0.52	0.13	-0.88	-0.87	-0.98	0.47	-0.93	-0.80
Sweden									
Chalmers University of Technology	-0.43	-0.69	-0.31	0.17	0.47	-0.19	-0.83	0.35	-0.36
Karlstad University	-0.06	-0.07	-0.44	-0.36	0.18	-0.40	-0.16	0.06	0.52
Karolinska Institutet	-0.82	-0.18	0.36	-0.77	-0.89	-0.97	0.39	-0.92	-0.68
Linköping University	-0.50	-0.28	-0.14	-0.30	0.15	-0.73	0.08	0.10	0.18
Linnaeus University	0.00	0.40	-0.05	-0.54	-0.15	0.13	-0.25	0.12	0.48
Luleå University of Technology	0.00	-0.83	-0.78	-0.11	0.53	0.24	-0.55	0.06	0.08
Lund University	-0.17	0.25	0.11	-0.13	-0.15	0.01	0.04	-0.10	0.13
Mid Sweden University	-0.01	-0.12	-0.61	-0.45	0.31	-0.30	-0.08	-0.16	0.47
Royal Institute of Technology	-0.37	-0.68	-0.39	0.18	0.43	-0.10	-0.79	0.37	-0.22
Stockholm University	-0.02	0.35	-0.02	0.10	-0.49	0.52	-0.45	0.09	0.46
Swedish University of Agricultural Sciences	0.76	0.65	-0.05	-0.51	-0.56	-0.16	-0.71	-0.86	-0.30
Umeå University	-0.07	0.24	0.10	-0.34	-0.43	-0.29	0.15	-0.13	0.18
University of Gothenburg	-0.33	0.24	0.13	-0.41	-0.62	-0.03	0.19	-0.36	0.35
Uppsala University	-0.43	0.26	0.20	-0.09	-0.22	0.17	-0.05	0.06	0.10
Örebro University	-0.13	-0.61	-0.34	-0.34	-0.25	-0.70	0.24	-0.62	0.54
Karolinska University Hospital	-0.94	-0.37	0.22	-0.90	-0.95		0.46	-0.98	-0.91
Linköping University Hospital	-0.92	-0.70	-0.13	-0.79	-0.85		0.51	-0.96	-0.85
Norrland's University Hospital	-0.89	-0.74	-0.12	-0.89	-0.78	-0.98	0.51	-0.98	-0.98
Sahlgrenska University Hospital	-0.86	-0.67	-0.03	-0.94	-0.88	-0.98	0.50	-0.94	-0.91
Skåne University Hospital	-0.81	-0.53	0.00	-0.92	-0.89		0.50	-0.91	-0.93
Uppsala University Hospital	-0.79	-0.53	-0.01	-0.95	-0.93		0.50	-1.00	-0.91
Örebro University Hospital	-0.71	-0.72	-0.01	-0.96	-0.83	-0.97	0.50	-0.98	-0.79

*Data from Science Citation Index – Thomson Reuters

The higher activity (compared to the world average) a university or university hospital has, the greener the colour. The lower activity (compared to the world average), the more yellow the colour is.

Appendix 7: Field normalised citation rates (2008-2011) from national and international publications*

Some numbers (from Iceland) have been excluded (due to small publication counts below the minimum threshold). Data in Appendix 7 from Science Citation Index – Thomson Reuters.

Country, university	Volume		Proportion international publications	Citation rate	
	Publications without international co-authors	Publications with international co-authors		Publications without international co-authors	Publications with international co-authors
Denmark	15555	8511	35 %	1.22	1.49
Aalborg University	732	464	39 %	0.95	1.34
Aarhus University	2309	1665	42 %	1.27	1.45
Roskilde University	151	69	31 %	1.11	1.13
Technical University of Denmark	2609	1402	35 %	1.56	1.53
University of Copenhagen	3950	2652	40 %	1.14	1.48
University of Southern Denmark	955	678	41 %	1.09	1.41
Aarhus University Hospitals	1514	534	26 %	1.03	1.53
Copenhagen University Hospitals	2891	923	24 %	1.21	1.70
University of Southern Denmark Hospitals	443	124	22 %	1.02	1.66
Finland	12871	6367	33 %	0.97	1.29
Aalto University	1453	720	33 %	0.94	1.33
Lappeenranta University of Technology	228	97	30 %	0.74	0.93
Tampere University of Technology	606	238	28 %	0.82	1.08
University of Eastern Finland	1173	551	32 %	0.96	1.21
University of Helsinki	2857	1818	39 %	1.12	1.34
University of Jyväskylä	815	428	34 %	0.97	1.23
University of Oulu	1065	586	35 %	0.87	1.22
University of Tampere	571	205	26 %	0.84	1.15
University of Turku	1142	709	38 %	0.94	1.11
Åbo Akademi University	485	274	36 %	0.90	1.33
Helsinki University Central Hospital	1130	367	25 %	1.02	1.61
Kuopio University Hospital	361	98	21 %	0.99	1.57
Oulu University Hospital	287	64	18 %	0.87	1.63
Tampere University Hospital	391	117	23 %	0.92	1.35
Turku University Hospital	306	95	24 %	1.07	1.79
Iceland	579	542	48 %	0.67	1.45
Agricultural University of Iceland	9	7	47 %	1.34	0.81
Reykjavik University	33	67	67 %	0.30	1.31
University of Akureyri	24	14	36 %	0.94	0.61
University of Iceland	363	361	50 %	0.73	1.40
Landspítali University hospital	150	92	38 %	0.54	1.92

Norway	10269	5422	35 %	0.99	1.31
Norwegian University of Life Sciences	501	287	36 %	1.18	1.16
Norwegian University of Science and Technology	2083	987	32 %	0.99	1.35
University of Bergen	1476	1086	42 %	0.92	1.29
University of Oslo	2657	1613	38 %	1.01	1.31
University of Stavanger	233	96	29 %	0.88	0.96
University of Tromsø	754	434	37 %	1.04	1.11
St. Olavs Hospital	283	95	25 %	0.93	1.57
University Hospital North Norway	221	74	25 %	1.14	1.32
University of Bergen Hospitals	554	246	31 %	1.03	1.49
University of Oslo Hospitals	1506	505	25 %	0.95	1.43
Sweden	26215	14580	36 %	1.04	1.34
Chalmers University of Technology	1350	710	34 %	1.08	1.19
Karlstad University	167	66	28 %	0.66	1.02
Karolinska Institutet	3170	2262	42 %	1.14	1.44
Linköping University	1513	621	29 %	1.05	1.20
Linnaeus University	295	113	28 %	0.67	1.11
Luleå University of Technology	454	179	28 %	0.75	0.94
Lund University	3094	2024	40 %	1.02	1.29
Mid Sweden University	217	51	19 %	0.87	0.94
Royal Institute of Technology	2081	1237	37 %	0.97	1.28
Stockholm University	1513	1104	42 %	1.11	1.54
Swedish University of Agricultural Sciences	1317	785	37 %	1.18	1.26
Umeå University	1515	770	34 %	1.01	1.22
University of Gothenburg	2120	1079	34 %	1.06	1.38
Uppsala University	2888	1809	39 %	1.05	1.30
Örebro University	228	97	30 %	0.92	1.45
Karolinska University Hospital	1206	595	33 %	1.01	1.46
Linköping University Hospital	294	60	17 %	0.96	1.42
Norrland's University Hospital	205	84	29 %	0.93	1.38
Sahlgrenska University Hospital	731	261	26 %	1.04	1.57
Skåne University Hospital	995	377	27 %	0.94	1.41
Uppsala University Hospital	625	228	27 %	1.01	1.62
Örebro University Hospital	239	67	22 %	1.14	1.72
Total	65489	35423	35 %	1.06	1.36

Appendix 8: Number of fractionalised publications

Table A.11: Number of fractionalised publications, Denmark*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	491	641	1978	2083	2827
Biology	278	334	1090	1083	1611
Biomedicine	891	1263	3629	3946	5657
Chemistry	298	450	1210	1357	1981
Engineering & Materials Sci.	390	780	1671	2276	3267
Geosciences	117	174	567	532	787
Health Sciences	1479	2898	5939	6939	11992
Physics & Math	557	715	2178	2156	3199
SSH	195	639	806	997	2701
Total	4696	7895	19069	21369	34023

*Data from Science Citation Index – Thomson Reuters

Table A.12: Number of fractionalised publications, Finland*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	263	345	1139	1243	1690
Biology	218	306	938	941	1448
Biomedicine	762	757	2952	3048	3737
Chemistry	329	356	1332	1472	1831
Engineering & Materials Sci.	489	798	2237	2958	3699
Geosciences	55	111	255	327	511
Health Sciences	1703	1708	6466	6081	8092
Physics & Math	499	662	2105	2395	3272
SSH	152	524	754	984	2459
Total	4470	5565	18179	19449	26739

*Data from Science Citation Index – Thomson Reuters

Table A.13: Number of fractionalised publications, Iceland*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	8	21	42	54	93
Biology	6	16	24	43	70
Biomedicine	22	44	92	133	175
Chemistry	6	12	28	27	52
Engineering & Materials Sci.	6	36	26	50	158
Geosciences	15	30	65	95	147
Health Sciences	50	134	230	292	587
Physics & Math	14	44	63	72	178
SSH	12	44	54	62	189
Total	140	382	624	828	1648

*Data from Science Citation Index – Thomson Reuters

Table A.14: Number of fractionalised publications, Norway*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	164	242	723	824	1188
Biology	189	231	740	813	1180
Biomedicine	419	582	1658	1864	2832
Chemistry	166	206	588	762	938
Engineering & Materials Sci.	199	549	839	1363	2360
Geosciences	121	275	527	654	1219
Health Sciences	1015	1795	4032	4910	8467
Physics & Math	199	385	831	1162	1772
SSH	141	477	629	961	2244
Total	2612	4742	10567	13313	22200

*Data from Science Citation Index – Thomson Reuters

Table A.15: Number of fractionalised publications, Sweden*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	584	692	2336	2493	3134
Biology	469	517	1832	1852	2744
Biomedicine	1920	1823	7630	7509	9048
Chemistry	702	700	2995	3127	3465
Engineering & Materials Sci.	1050	1511	4290	4887	6345
Geosciences	190	262	822	893	1279
Health Sciences	3526	4141	13858	14415	19594
Physics & Math	1158	1191	4803	5011	6025
SSH	301	1083	1345	1785	4636
Total	9902	11921	39911	41972	56270

*Data from Science Citation Index – Thomson Reuters

Table A.16: Number of fractionalised publications, All Nordic Countries*

Subject field	2000	2012	2000-2003	2004-2007	2008-2012
Agriculture, Fisheries & Forestry	1511	1942	6217	6696	8933
Biology	1160	1404	4624	4731	7053
Biomedicine	4014	4469	15962	16500	21449
Chemistry	1500	1724	6154	6745	8266
Engineering & Materials Sci.	2133	3674	9063	11534	15829
Geosciences	498	851	2237	2502	3944
Health Sciences	7773	10676	30525	32637	48732
Physics & Math	2428	2997	9979	10796	14445
SSH	802	2768	3588	4790	12230
Total	21820	30506	88349	96932	140881

*Data from Science Citation Index – Thomson Reuters

Appendix 9: Field normalised citation rates of universities and university hospitals subject fields

Table A.17: Field normalised citation rates of universities and university hospitals (2000-2003) across subject fields*

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Denmark	1.38	1.23	0.96	1.57	1.65	1.28	1.15	1.42
Aalborg University	1.42		0.62		1.21		0.70	0.91
Aarhus University	1.29	1.26	0.86	2.13	2.23	1.04	1.12	1.57
Roskilde University								
Technical University of Denmark	1.67	1.50	1.23	1.56	1.78	1.18	0.72	1.47
University of Copenhagen	1.29	1.13	0.89	1.23	1.64	1.32	1.14	1.29
University of Southern Denmark		1.37	1.65	1.77	0.98		1.24	1.45
Aarhus University Hospitals			0.71				1.09	
Copenhagen University Hospitals			0.85				1.24	
University of Southern Denmark Hospitals							1.09	
Finland	1.23	1.14	0.85	1.03	1.07	0.92	1.14	0.98
Aalto University			0.70	1.32	1.23			1.10
Lappeenranta University of Technology					0.73			
Tampere University of Technology					0.86			0.88
University of Eastern Finland	1.07	1.03	0.76	0.75	0.81		1.41	0.74
University of Helsinki	1.40	1.14	0.95	1.29	1.47	1.20	1.29	1.22
University of Jyväskylä	1.03	1.04	0.61	0.92	0.91		0.96	0.94
University of Oulu	0.83	1.06	0.82	0.67	0.83	0.45	1.06	0.64
University of Tampere			0.84				1.06	
University of Turku	1.18	1.27	0.78	0.77	0.82		1.09	0.66
Åbo Akademi University			0.85	0.90	1.24		0.78	1.27
Helsinki University Central Hospital			0.97				1.17	
Kuopio University Hospital			0.83				1.13	
Oulu University Hospital							1.00	
Tampere University Hospital			0.76				1.02	
Turku University Hospital			0.90				0.98	

Iceland			0.82			1.32	1.06	0.72
Agricultural University of Iceland								
Reykjavik University								
University of Akureyri								
University of Iceland			0.51			1.31	0.84	0.72
Landspítali University hospital							1.26	
Norway	1.08	1.01	0.88	1.01	1.14	1.11	1.01	1.10
Norwegian University of Life Sciences	1.06	0.84	0.84					
Norwegian University of Science and Technology	1.08	1.14	0.94	0.73	1.20	0.60	1.04	1.11
University of Bergen	1.09	1.05	0.74	0.95	1.14	1.32	0.97	1.01
University of Oslo	1.07	1.05	0.99	1.06	1.19	1.06	0.99	1.20
University of Tromsø	1.15	0.84	0.69	1.53		1.12	0.83	0.82
St. Olavs Hospital							0.96	
University Hospital North Norway							0.84	
University of Bergen Hospitals			0.57				1.10	
University of Oslo Hospitals			0.97				1.07	
Sweden	1.30	1.32	0.91	1.43	1.27	1.00	1.08	1.11
Chalmers University of Technology	1.11		0.79	1.30	1.24			1.05
Karolinska Institutet		1.63	1.09	1.56			1.18	
Linköping University	0.99		0.71	1.48	1.16		0.89	1.21
Luleå University of Technology				2.77	0.91			0.58
Lund University	1.13	1.30	0.83	1.41	1.22	1.14	1.01	1.25
Royal Institute of Technology	1.27		0.95	1.28	1.33			1.12
Stockholm University	2.08	1.35	0.89	1.47	1.64	1.00	0.88	1.02
Swedish University of Agricultural Sciences	1.26	1.19	0.70	1.10	1.20		0.83	
Umeå University	1.95	1.58	1.02	1.30	1.46		1.09	0.95
University of Gothenburg	1.15	1.26	0.83	1.22	1.10	1.01	1.10	1.18
Uppsala University	1.05	1.38	0.96	1.68	1.54	0.94	1.05	1.12
Örebro University							1.14	
Karolinska University Hospital			0.87				1.18	
Linköping University Hospital			0.67				1.04	
Norrland's University Hospital			0.62				0.91	
Sahlgrenska University Hospital			0.77				1.15	
Skåne University Hospital			0.92				0.99	
Uppsala University Hospital			0.66				1.00	
Örebro University Hospital							1.21	
Nordic total	1.29	1.21	0.91	1.32	1.28	1.09	1.09	1.15

*Data from Science Citation Index – Thomson Reuters

Table A.18: Field normalised citation rates of universities and university hospitals (2004-2007) across subject fields*

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Denmark	1.36	1.25	1.05	1.48	1.33	1.36	1.19	1.43
Aalborg University	1.32		0.67		1.06		0.82	1.36
Aarhus University	1.33	1.42	0.93	2.28	1.71	1.30	1.13	1.50
Roskilde University								
Technical University of Denmark	1.50	1.42	1.27	1.42	1.42	1.23	0.96	1.51
University of Copenhagen	1.31	1.11	1.03	1.03	1.54	1.36	1.22	1.34
University of Southern Denmark		1.15	1.57	1.20	0.82		1.09	1.17
Aarhus University Hospitals			0.72				1.07	
Copenhagen University Hospitals			0.97				1.33	
University of Southern Denmark Hospitals			0.82				1.01	
Finland	1.15	1.15	0.89	0.98	1.02	1.05	1.08	1.02
Aalto University			0.83	1.15	1.09		0.85	1.18
Lappeenranta University of Technology					0.92			
Tampere University of Technology				0.81	0.77			0.76
University of Eastern Finland	1.15	0.97	0.84	0.65	0.92		1.14	0.92
University of Helsinki	1.23	1.23	1.00	1.26	1.38	1.12	1.19	1.16
University of Jyväskylä	0.97	1.09	0.59	0.93	0.99		0.95	1.24
University of Oulu	0.76	1.08	0.84	0.61	0.89	0.82	0.98	0.62
University of Tampere			0.77		0.76		1.08	
University of Turku	1.29	1.18	0.78	0.86	0.88		1.04	0.77
Åbo Akademi University			0.80	0.97	1.39		0.84	1.00
Helsinki University Central Hospital			1.00				1.16	
Kuopio University Hospital			0.83				1.07	
Oulu University Hospital							0.92	
Tampere University Hospital			0.79				0.93	
Turku University Hospital							1.01	
Iceland	1.63		1.17		1.47	1.12	1.03	0.88
Agricultural University of Iceland								
Reykjavik University								
University of Akureyri								
University of Iceland			0.94			1.05	0.85	0.87
Landspítali University hospital							1.22	

Norway	1.19	1.14	0.97	0.92	1.08	1.12	1.06	1.19
Norwegian University of Life Sciences	1.18	1.06	0.78					
Norwegian University of Science and Technology	1.07	1.06	1.14	0.84	1.02	0.51	1.05	1.31
University of Bergen	1.15	1.04	0.89	0.92	1.36	1.33	0.99	1.02
University of Oslo	1.15	1.27	1.07	0.98	1.15	1.15	1.08	1.19
University of Stavanger					0.76			
University of Tromsø	1.33	1.20	0.91	1.15		1.06	0.97	0.88
St. Olavs Hospital							1.13	
University Hospital North Norway							1.03	
University of Bergen Hospitals			0.62				1.04	
University of Oslo Hospitals			1.00				1.13	
Sweden	1.26	1.32	0.98	1.30	1.13	1.00	1.12	1.09
Chalmers University of Technology	1.10		0.77	1.06	1.19			1.03
Karlstad University					0.81			
Karolinska Institutet		1.55	1.12	1.04			1.23	
Linköping University	0.91		0.75	1.25	1.08		0.90	1.15
Linnaeus University			0.84		0.81		0.94	0.56
Luleå University of Technology				0.71	0.88			0.63
Lund University	1.10	1.36	0.95	1.28	1.34	1.05	0.99	1.54
Mid Sweden University					0.75			
Royal Institute of Technology	1.09		0.84	1.16	1.14	0.67	0.80	1.03
Stockholm University	1.73	1.35	1.17	2.04	1.56	1.33	0.95	1.09
Swedish University of Agricultural Sciences	1.26	1.38	0.83	1.14	1.28		0.86	
Umeå University	1.78	1.24	1.01	1.10	1.03		1.13	0.98
University of Gothenburg	1.27	1.20	0.93	0.97	1.21	0.82	1.15	0.93
Uppsala University	1.00	1.36	0.97	1.42	1.03	0.79	1.04	0.94
Örebro University							1.18	
Karolinska University Hospital			0.96				1.26	
Linköping University Hospital			0.59				1.15	
Norrland's University Hospital			0.77				1.14	
Sahlgrenska University Hospital			0.86				1.24	
Skåne University Hospital			0.89				1.01	
Uppsala University Hospital			0.79				1.10	
Örebro University Hospital							1.15	
Nordic total	1.27	1.24	0.98	1.23	1.14	1.12	1.12	1.15

*Data from Science Citation Index – Thomson Reuters

Appendix 10: Universities’ and university hospitals’ normalised proportion of highly cited publications across subject field among the top 10 per cent in world production

Table A.19: Universities’ and university hospitals’ normalised proportion of highly cited publications across subject field among the top 10 per cent in world production (2000-2003)
(1.00 equals the world average)*

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Denmark	1.46	1.26	0.88	1.81	1.73	1.37	1.20	1.53
Aalborg University	1.51		0.33		1.07		0.41	0.72
Aarhus University	1.33	1.23	0.74	2.57	2.10	0.90	1.15	1.59
Roskilde University								
Technical University of Denmark	1.79	1.75	1.23	1.87	2.00	1.38	0.65	1.70
University of Copenhagen	1.35	1.12	0.77	1.33	1.83	1.45	1.26	1.40
University of Southern Denmark		1.71	1.89	2.00	1.13		1.41	1.70
Aarhus University Hospitals			0.66				1.19	
Copenhagen University Hospitals			0.72				1.23	
University of Southern Denmark Hospitals							1.24	
Finland	1.23	1.18	0.74	0.87	1.03	0.81	1.10	0.96
Aalto University			0.44	1.24	1.21			1.20
Lappeenranta University of Technology					0.53			
Tampere University of Technology					0.89			0.80
University of Eastern Finland	0.99	0.69	0.54	0.40	0.64		1.53	0.68
University of Helsinki	1.41	1.34	0.84	1.39	1.72	1.14	1.38	1.38
University of Jyväskylä	0.90	0.89	0.18	0.54	0.83		0.77	0.65
University of Oulu	0.89	1.26	0.70	0.12	0.73	0.16	1.02	0.37
University of Tampere			0.78				0.97	
University of Turku	1.36	1.28	0.67	0.57	0.64		1.00	0.49
Åbo Akademi University			0.75	0.56	1.07		0.32	1.43
Helsinki University Central Hospital			1.08				1.09	
Kuopio University Hospital			0.62				1.15	
Oulu University Hospital							0.87	
Tampere University Hospital			0.74				0.90	
Turku University Hospital			0.83				0.92	

Iceland			0.71			1.20	0.78	0.76
Agricultural University of Iceland								
Reykjavik University								
University of Akureyri								
University of Iceland			0.20			1.20	0.41	0.76
Landspítali University hospital							1.09	
Norway	1.14	0.92	0.76	0.94	1.13	1.24	0.88	1.12
Norwegian University of Life Sciences	1.18	0.50	0.66					
Norwegian University of Science and Technology	0.95	1.03	0.94	0.51	1.19	0.59	1.04	1.10
University of Bergen	1.06	1.14	0.54	0.61	1.02	1.56	0.84	0.90
University of Oslo	1.26	0.91	0.91	1.11	1.29	1.15	0.86	1.34
University of Tromsø	1.15	0.74	0.26	1.83		1.13	0.55	0.50
St. Olavs Hospital							0.86	
University Hospital North Norway							0.63	
University of Bergen Hospitals			0.32				0.95	
University of Oslo Hospitals			0.96				0.98	
Sweden	1.44	1.37	0.81	1.55	1.30	0.99	1.02	1.12
Chalmers University of Technology	1.16		0.53	1.49	1.23			1.04
Karolinska Institutet		1.80	1.11	1.11			1.26	
Linköping University	0.91		0.63	1.70	1.14		0.71	1.42
Luleå University of Technology				3.10	0.68			0.44
Lund University	1.18	1.26	0.71	1.44	1.17	1.31	0.85	1.39
Royal Institute of Technology	1.54		0.63	1.34	1.41			1.06
Stockholm University	1.89	1.29	0.71	1.60	1.66	1.08	0.86	1.07
Swedish University of Agricultural Sciences	1.39	1.23	0.59	0.96	1.19		0.84	
Umeå University	2.89	1.85	1.07	1.26	1.82		1.08	0.81
University of Gothenburg	1.48	1.16	0.67	1.27	1.35	0.82	1.08	1.28
Uppsala University	1.18	1.59	0.74	2.13	1.65	0.95	0.93	1.05
Örebro University							1.15	
Karolinska University Hospital			0.74				1.14	
Linköping University Hospital			0.51				0.76	
Norrland's University Hospital			0.32				0.85	
Sahlgrenska University Hospital			0.64				1.06	
Skåne University Hospital			0.80				0.94	
Uppsala University Hospital			0.62				0.89	
Örebro University Hospital							1.18	
All Nordic countries	1.37	1.23	0.81	1.39	1.29	1.13	1.05	1.18

*Data from Science Citation Index – Thomson Reuters

Table A.20: Universities' and university hospitals' normalised proportion of highly cited publications across subject field among the top 10 per cent in world production (2004-2007)(1.00 equals the world average)*

University	Agriculture, Fisheries & Forestry	Biology	Biomedicine	Chemistry	Engineering & Materials Sci.	Geosciences	Health Sciences	Physics & Math
Denmark	1.47	1.44	1.05	1.58	1.45	1.39	1.24	1.72
Aalborg University	1.45		0.49		1.03		0.53	1.27
Aarhus University	1.41	1.69	0.89	2.68	1.75	1.37	1.07	1.68
Roskilde University								
Technical University of Denmark	1.68	1.76	1.35	1.59	1.66	1.12	0.99	1.98
University of Copenhagen	1.39	1.20	1.05	0.89	1.62	1.43	1.30	1.65
University of Southern Denmark		1.23	1.76	1.18	0.59		0.98	1.37
Aarhus University Hospitals			0.48				1.07	
Copenhagen University Hospitals			0.96				1.50	
University of Southern Denmark Hospitals			0.81				1.02	
Finland	1.06	1.12	0.81	0.88	1.01	1.12	1.02	1.05
Aalto University			0.72	1.10	1.07		0.67	1.42
Lappeenranta University of Technology					0.70			
Tampere University of Technology				0.46	0.74			0.66
University of Eastern Finland	1.21	0.59	0.66	0.47	0.71		1.21	0.86
University of Helsinki	1.12	1.28	0.99	1.28	1.55	1.22	1.20	1.13
University of Jyväskylä	0.82	1.13	0.41	0.62	1.08		0.63	1.40
University of Oulu	0.36	1.08	0.79	0.27	1.02	0.75	0.90	0.29
University of Tampere			0.60		0.48		0.97	
University of Turku	1.31	1.09	0.60	0.88	0.71		0.99	0.75
Åbo Akademi University			0.63	0.83	1.50		0.95	0.98
Helsinki University Central Hospital			1.04				1.14	
Kuopio University Hospital			0.76				0.96	
Oulu University Hospital							0.83	
Tampere University Hospital			0.61				0.73	
Turku University Hospital							0.96	
Iceland	1.61		0.84		1.38	0.84	1.04	1.12
Agricultural University of Iceland								
Reykjavik University								
University of Akureyri								
University of Iceland			0.66			0.69	0.71	1.12
Landspítali University hospital							1.37	

Norway	1.21	1.23	0.93	0.82	1.10	1.06	0.98	1.22
Norwegian University of Life Sciences	1.20	1.16	0.65					
Norwegian University of Science and Technology	1.15	1.14	0.96	0.84	0.98	0.15	1.00	1.30
University of Bergen	1.22	1.11	0.84	0.64	1.54	1.55	0.96	1.04
University of Oslo	1.14	1.34	1.06	0.81	1.20	0.86	0.98	1.26
University of Stavanger					0.72			
University of Tromsø	1.31	1.28	0.79	1.27		1.02	0.77	0.85
St. Olavs Hospital							1.03	
University Hospital North Norway							0.81	
University of Bergen Hospitals			0.58				1.06	
University of Oslo Hospitals			1.07				1.01	
Sweden	1.28	1.48	0.92	1.35	1.12	0.95	1.10	1.09
Chalmers University of Technology	1.16		0.47	0.99	1.12			0.94
Karlstad University					0.77			
Karolinska Institutet		1.82	1.07	0.81			1.34	
Linköping University	0.81		0.69	1.38	1.09		0.76	1.32
Linnaeus University			1.06		0.77		0.80	0.46
Luleå University of Technology				0.42	0.72			0.37
Lund University	0.94	1.66	0.90	1.22	1.37	1.03	0.85	1.63
Mid Sweden University					0.75			
Royal Institute of Technology	1.18		0.70	1.17	1.10	0.64	0.66	1.03
Stockholm University	1.90	1.39	1.20	2.60	2.01	1.26	0.84	1.03
Swedish University of Agricultural Sciences	1.22	1.47	0.71	0.71	0.95		0.60	
Umeå University	2.17	1.39	1.03	1.02	1.05		1.18	0.98
University of Gothenburg	1.29	1.25	0.80	0.86	1.14	0.63	1.16	0.77
Uppsala University	0.96	1.57	0.97	1.61	1.04	0.85	1.00	0.96
Örebro University							1.21	
Karolinska University Hospital			0.93				1.29	
Linköping University Hospital			0.29				0.98	
Norrland's University Hospital			0.71				1.19	
Sahlgrenska University Hospital			0.73				1.16	
Skåne University Hospital			0.77				0.86	
Uppsala University Hospital			0.67				1.02	
Örebro University Hospital							1.01	
All Nordic countries	1.29	1.35	0.93	1.23	1.15	1.09	1.09	1.22

*Data from Science Citation Index – Thomson Reuters

Comparing Research at Nordic Universities using Bibliometric Indicators

Second report, covering the years 2000 – 2012

This report is an extended version of the previous report from 2011, basically building on the same methodology, but adding more information.

As the previous, this report also aims to demonstrate how bibliometric indicators can be used at the level of universities in the Nordic countries, in describing university performance in a more nuanced way than in the many international university rankings. In contrast to most such rankings, this report uses transparent methods and describes differences in university research profiles. Numbers are not used in this report to indicate rankings, but to represent real measurements and to give more specific information. The focus is on providing reliable and recognizable descriptions of similarities and differences in the institutions' activities, profiles, and impacts of research.

In this Second report, publications from the social sciences and the humanities are included (not in citation analysis), and new time intervals are applied.