

## Policy Brief

## An initial bibliometric mapping of six higher education institutions undergoing structural changes

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**One objective of the Structural Reform introduced in Norwegian higher education in 2015 is to promote high quality of research and contribute to more academic environments performing at a high international level. Higher education institutions differ with regard to research capacity and in the volume of research carried out. This is reflected, amongst others, in the amount of funding and in the number of academic staff and scientific and scholarly publications. During the period between 2011 and 2019, NTNU, HVL, HINN, USN, Nord Univ and UiT all increased their publication volume, both when measured in number of publications and in the number of publication points. The general pattern is that the largest institutions have the lowest growth rates. Several of the smaller institutions have very high growth rates, which may reflect increased research ambitions and time devoted to such activities at these institutions. Furthermore, the institutions differ in terms of discipline profile and specialization. Scientific productivity is also very skewed at the level of individuals. In 2019, one quarter of the publishing personnel published more than 1.5 publication points and there were only minor differences in this proportion across institutions. In terms of citation impact, all the examined institutions contribute to high impact research, but overall, the figures are lower than the national average. Large differences prevail at the level of subject fields.**

### Structural reform in Norwegian higher education

In 2015, a structural reform was introduced in Norwegian higher education, resulting in a largescale organisational redesign of the higher education landscape. This process is ongoing. The reform has a variety of politically desirable, albeit not necessarily internally consistent, objectives (Vukasovic et al. 2020). Among the listed reform goals high-quality education and research, robust academic environments, good access to education and competence, regional development, world leading academic environments and efficient use of resources, the primary objective is high-quality education and research (Vukasovic et al. 2020). The reform interacts with previous change processes, indicating that an analysis of its results should take a historical and longitudinal approach.

The Structural reform process started in 2014, when the Ministry of Education and Research asked the higher education institutions to rethink their position in a future Norwegian higher education landscape characterised by fewer institutions (Frølich et al. 2016). In response, the institutions considered their preferred future strategic positions as well as the steps required to reach these positions. Based on inputs from higher education institutions, the 2015 White paper stipulated five mergers of 14 institutions. The White paper did not directly coerce institutions to merge. However, those that “did not fit into a voluntary merger were given the status of ‘mergers for further consideration’ or ‘future location based on new quality measures” (Frølich et al. 2016: 2). The Structural Reform also had

other reform measures aside merger processes, with an overarching aim to boost the quality and relevance of higher education. Consequently, change processes have taken place not only in the merged institutions, but across the whole sector.

### *The purpose of the brief*

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This brief forms part of the research-based evaluation of the Structural Reform. The project includes two key empirical lenses on the Structural Reform and the mergers that have taken place – (a) an outcome-oriented and (b) a process-oriented lens. To examine measurable developments regarding the intended outcomes of the reform, an extensive analysis of relevant indicators forms part of the project. The purpose of the outcome analysis is to identify system and institutional level changes in the performance of the higher education sector in relation to the reform objectives. Bibliometric data can help shed light on the extent to which the structural reform has contributed to increased research activity at the institutions and performances at a high international level. In this brief we examine the development in bibliometric data for six higher education institutions: Norwegian University of Science and Technology (NTNU), Nord University (Nord Univ), Inland Norway University of Applied Sciences (HINN), Western Norway University of Applied Sciences (HVL), UiT – The Arctic University of Norway (UiT) and University of South Eastern Norway (USN). The institutions have recently undergone the first phase of structural changes instigated by the reform, between the initiation in 2011 until 2019.

The purpose is to present institutional publication indicators for the six institutions. At this stage, the main priority has been to provide aggregated statistical data for the bibliometric profile of the institutions. Thus, descriptive results are presented in order to monitor the development during the aforementioned time period. From this we are able to analyze how the institutions perform using bibliometric indicators, making cross-institutional comparisons and identifying particular issues which might be of interest for later extended studies. To assess the institutions' profiles in the national landscape, we also present comparative statistics at sector level and for selected other Norwegian institutions. It should be noted that it is difficult to assess to what extent the observed developments are the results of the Structural Reform or other factors. Thus, the role and impact of the merger processes are not discussed. These issues will be addressed later.

### **Data sources**

The bibliometric study is primarily based on the publicly accessible database Cristin, which is a joint system for the registration of scientific/scholarly publications applied by Norwegian higher education institutions, research institutes and hospitals. The Cristin data of scientific/scholarly publications are summarised in the Database for Statistics on Higher Education (DBH) and are used for the calculation of the performance-based budgeting of the institutions (see the text box below).

The Cristin database contains data on a variety of bibliographic parameters, including publication type, publication channel, and publication language. In addition, it includes individual data on the authors, such as their institutional affiliations, age, and gender. Accordingly, statistics on many aspects of the publication activity can be provided.

The analysis in this brief is limited to the publication categories included in the Norwegian performance-based funding system. These encompass monographs and contributions to anthologies (book articles) published at publishing houses classified as scientific/scholarly by the Norwegian Association of Higher Education Institutions (UHR), and articles in series and journals classified as scientific/scholarly by the UHR. The following publication types are considered: full-papers (regular articles, proceedings articles) and review articles published in journals or books (i.e. not short contributions like editorials, corrections, book-reviews, meeting abstracts, etc.) and books/monographs. Publications which are outside these channels are not included in our analysis, for example, unpublished PhD-dissertations, grey literature such as reports, as well as popular science articles. The analysis covers the publications primarily directed towards the scholarly community, but not other types of research dissemination. This needs to be taken into consideration when interpreting the results.

Publication data are available in Cristin for the 9-year period 2011–19 and the analysis covers this period. Both the number of publications, their weighted measure and the number of publication points are used as indicators in the report. Included are indicators on aspects such as:

- Publication volume
- Publication profile, level and language
- Collaboration as measured through co-publications with authors in other research institutes and higher education institutions; both national and international co-publications are included.

## The performance-based basic funding system – publications

The funding formula for publication activity includes two dimensions. First, articles in journals and series (ISSN-titles), articles in books and books/monographs (ISBN-titles) are given different weights. Moreover, publication outlets are divided into two levels in order to avoid an incentive to productivity only. The outlets given extra weight are those defined to be the leading and most selective international journals, series and publishers (limited to about 20 per cent of the publications). The national academic councils in each discipline or field of research participate annually in determining and revising the highest level under the guidance of the Norwegian Association of Higher Education Institutions (UHR). The table below shows the relative weights given the different types of publications at the two levels.

### Publication weights

Publication type	Outlets at normal level (level 1)	Outlets at high level (level 2)
Articles in ISSN-titles (journals and series)	1	3
Articles in ISBN-titles (books)	0.7	1
Books (ISBN-titles)	5	8

Note: Co-authored publications are shared among the participating institutions.

The formula only includes “scholarly publications”. The definition is that a scholarly publication must:

1. present new insight;
  2. be presented in a form that allows the research findings to be verified and/or used in new research activity;
  3. be written in a language and have a distribution that makes the publication accessible to most interested researchers;
  4. appear in a publication channel (journal, series, book publisher) that has routines for external peer review.
- (Source: “Vekt på forskning” English translation, UHR 2007).

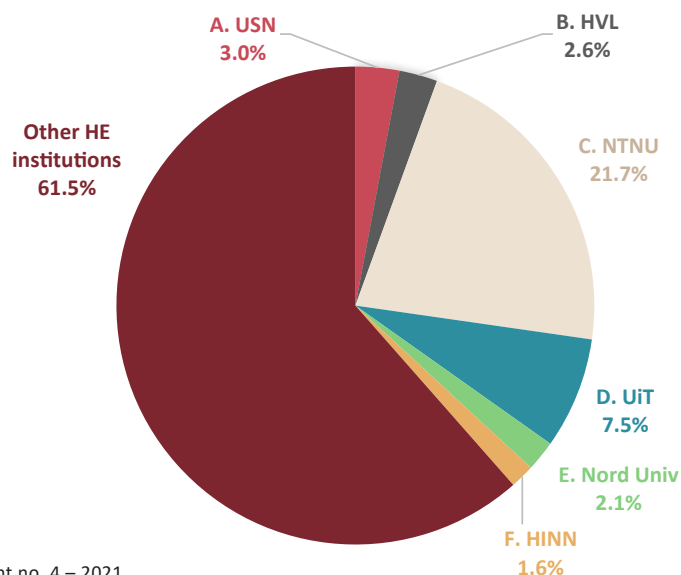
Co-authored publications are shared, and fractionalised publication points are calculated based on the number of author addresses. Publication points are used in the performance-based funding system for both the higher education sector, the institute sector and hospitals. The formula is (from 2015) identical across sectors. It should be noted that the formula for calculating publication points was changed in 2015. In the fractional counting method, the square root is now used for calculating institutional fractions and a factor of 1.3 is applied when the publication has co-authors affiliated with institutions in other countries.

## Overall increase in publication volume, but large differences between institutions

In terms of the volume of scientific and scholarly publishing, there are large differences between the six institutions. These differences in turn reflect that there are large variations in the volume of research carried out. Altogether the six institutions contributed to 38.5 per cent of the publication output in the HE sector in 2019 measured by publication points (Figure 1). NTNU is by far the largest contributor with 21.7 per cent, followed by UiT 7.5 per cent. The other institutions have proportions in the range of 1.6 to 3.0 per cent.

Over the period between 2011 and 2019 all institutions have increased their publication volume,

Figure 1. Proportion of publication points 2019 by institution, Norwegian HE-sector.



both measured in the number of publications and in the number of publication points. Figure 2 shows the relative increase in the number of publications from 2011 to 2019 for the selected institutions and four additional universities. Here the current institutional structure has been given retroactive status, which means that the merged institutions are analyzed as one unit over the entire period. The general pattern is that the largest institutions have the lowest growth rates. This applies to both NTNU and UiT, with 55 and 39 per

cent relative increase respectively, as well as for the University of Bergen (UiB) and the University of Oslo (UiO). Several of the smaller institutions have very high growth rates which might reflect increased research ambitions and time devoted for such activities at these institutions. The increase is highest for HVL where the publication number is more than doubled during the 9-year period. There are, however, large institutional variations which would be interesting to address in further studies.

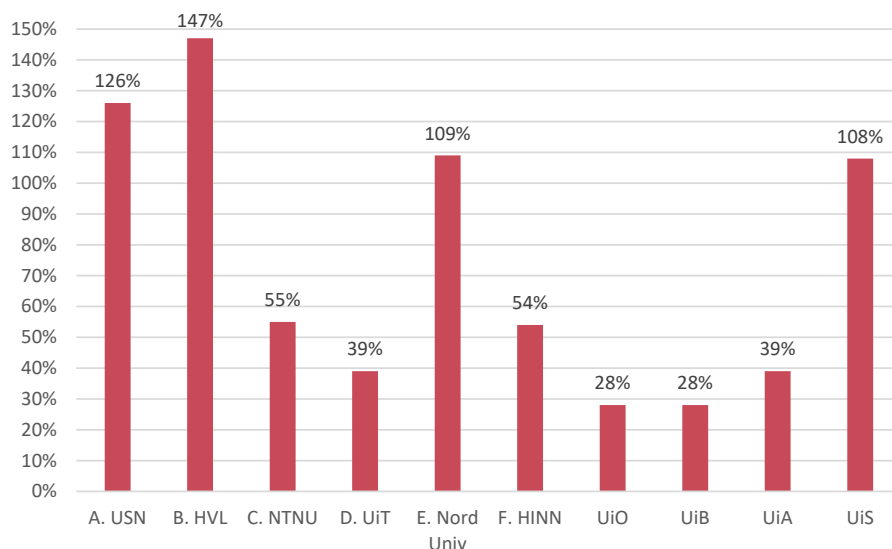


Figure 2. Relative increase in number of publications from 2011 to 2019 per institution, \* per cent

\*) Based on the current institutional structure which is given retroactive status. As a reference four additional universities are included.

Figure 3 (a and b) compares the number of publications by institution in the first year (2011) and last year (2019). From this figure it is evident that the restructuring process involved mergers of institutions which differed considerably in the volume of research measured by number of publications.

All HE institutions in Norway have, however, increased their publication output during the period. In order to adjust for this factor, we have compared the number of publication points for each institution with the total number of publication points in the Norwegian HE sector. For the two largest institutions (Figure 4a), there are relatively small annual differences. We nevertheless observe a declining pattern for UiT between 2016 and 2019, where the proportion has decreased from 8.5 to 7.7 per cent. For these institutions the structural reform has involved the merger of a large university with smaller university colleges, and this is even more distinct when only the research dimension is considered. Prior to the merging, the publication output of both UiT and NTNU was roughly 8 times as high

as for the merged university colleges taken together. Thus, the structural changes have in relative terms contributed little to the total research volume of the institutions measured by publication points. In contrast, the four other cases analyzed show a different pattern and this dimension should be taken into consideration in forthcoming studies.

Figure 4b shows the similar trend figures for the other four institutions. HVL has the strongest growth rate and the institution's proportion of the total HE-sector publishing has increased from 1.4 per cent in 2011 to 2.6 per cent in 2019. USN has overall increased its relative national contribution, but the annual figures show substantial annual fluctuations. For both Nord Univ and HINN the growth in publication points during the period has been on par with the national average, but for Nord Univ there is a notable increase in 2018.

Detailed statistics on the number of publications and publication points for each institution are presented in the [appendix tables A1 and A2](#).

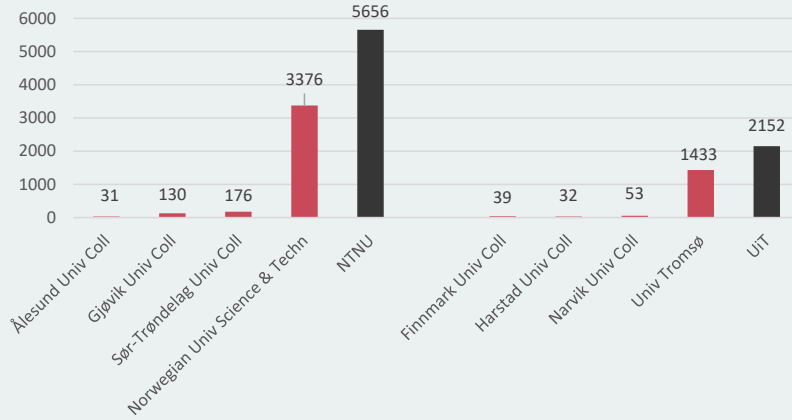


Figure 3a. Number of publications by institution 2011 and 2019

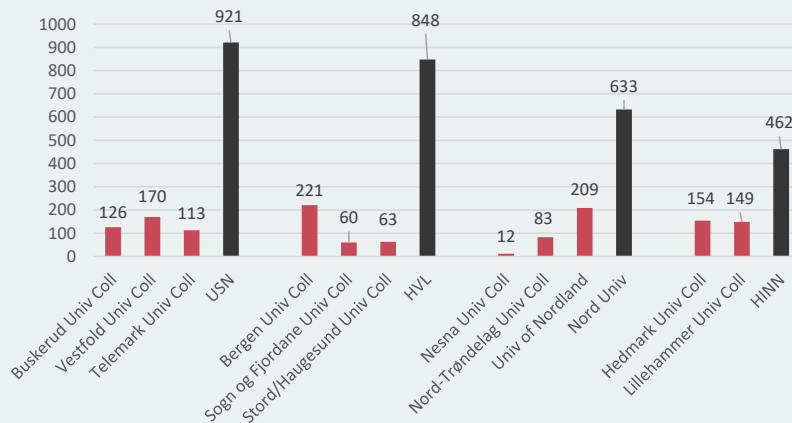


Figure 3b. Number of publications by institution 2011 and 2019

■ 2011 ■ 2019

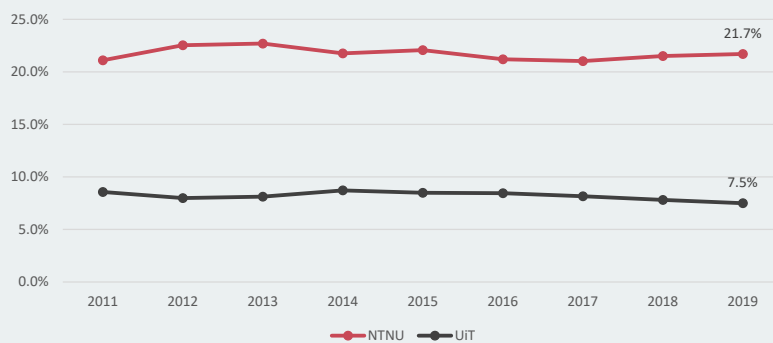


Figure 4a. Proportion of publication points 2011-2019 by institution\* relative to the total number of publication points in the Norwegian HE-sector.

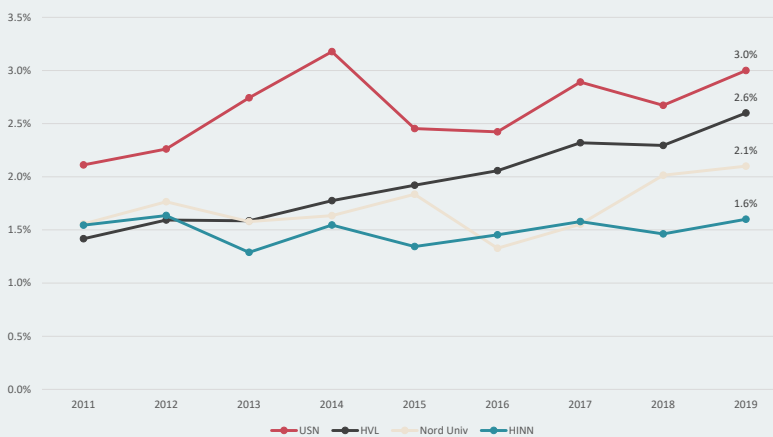


Figure 4b. Proportion of publication points 2011-2019 by institution\* relative to the total number of publication points in the Norwegian HE-sector.

\*) Based on the current institutional structure which is given retroactive status.

## Scientific productivity skewed at the level of individuals

In this section we present statistics on the number of people who have published during the time period. All people affiliated with the institutions are included regardless of the type of positions (e.g. PhD students, assistant professors, full professors). However, personnel above 70 years old have been excluded.

These data are useful for assessing whether the institutions have increased their research activities in terms of engaging more staff in such activities. In further analyses, statistics on the number of employees by academic positions and year should be added. This will allow a more nuanced examination of the research intensity at the institutions. These data will be added later.

The results are shown in Figure 5 a/b and [appendix table A3](#). In this analysis, the current institutional structure has been given retroactive status, which means that the merged institutions are analyzed as one unit over the entire period. The two largest institutions, NTNU and UiT, have the lowest relative increase in the number of publication-active people. However, NTNU has a much stronger growth than UiT, 57 and 37 per cent, respectively.

The increase is particularly strong for HVL where the number of publishing personnel has increased from 190 to almost 600 (204 per cent increase) (Figure 5b).

Scientific productivity is very skewed at the level of individuals. Appendix table A4 show the number of people who annually published at least 1.0 publication point during the period 2011 to 2014 or 1.5 publication points or more during the period 2015 to 2019. Different criteria have been applied as the for-

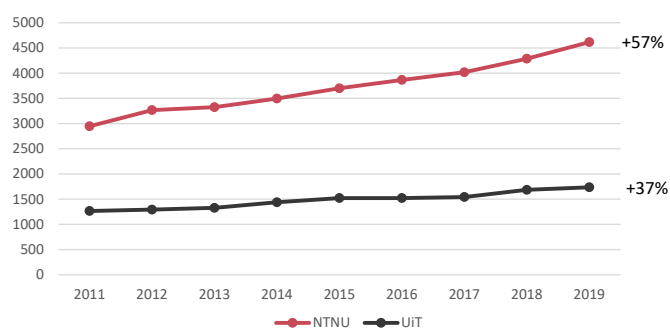
mula for calculating publication points was changed in 2015. Generally, the number of publication points per person has increased due to this change. However, it is not possible to adjust for this change in a way that make the statistics over the periods strictly comparable. Generally, the people above the thresholds may be considered as the more research active personnel at the institutions, whereas the personnel below may be more peripheral when it comes to research activities. In 2019, one quarter of the publishing personnel published more than 1.5 publication points and there were only small differences in this proportion across institutions.

## Traditional universities publish comparably more in level 2 channels

As described above, the journals and publishers are classified into two levels in the performance-based funding model. The highest level (level 2) includes only the leading and most selective international journals and publishers (on average accounting for 20 per cent of the publication output in each discipline). In our analysis, we identified the proportion of publications (measured as author shares) at level 2 for each institution and year. Figure 6 shows the results of this analysis.

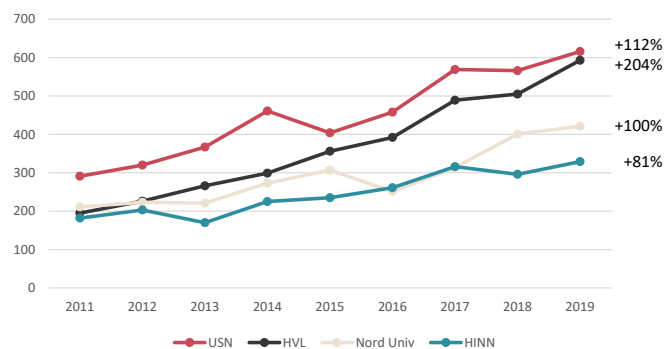
Based on the premise that level 2 includes the leading and most selective international journals and publishers, high shares here may indicate a high level of ambition when selecting journals for publication and a high quality of research. At the same time, it should be noted that the research profile will influence the patterns. For example, publishing in the Norwegian language or in channels related to a vocational audience will typically imply low proportions of level 2 publishing.

Figure 5a. Number of people affiliated with the institutions\* who have published at least one publication, 2011-2019



\*) Based on the current institutional structure which is given retroactive status.

Figure 5b. Number of people affiliated with the institutions\* who have published at least one publication, 2011-2019



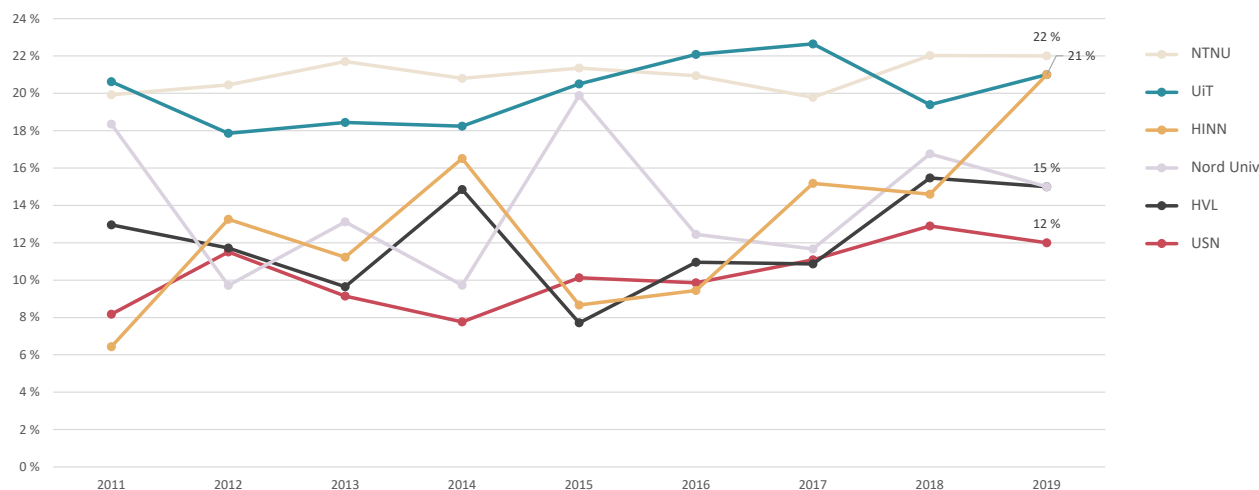
\*) Based on the current institutional structure which is given retroactive status.



Overall, NTNU, UiT and HINN have considerably higher proportion of level 2 publishing than the other institutions. In 2019, 22, 21 and 21 per cent of the institutions' respective publication output appeared in level 2 channels. For the other institutions this proportion

ranged from 12 per cent (USN) to 15 per cent (Nord Univ). For some of the institutions there are relatively large annual variations. Further details on the annual figures may be found in appendix table A5.

Figure 6. Proportion of level 2 publications by institution\* (author shares), 2011-2019



\*) Based on the current institutional structure which is given retroactive status.

### Citation rates below the national average

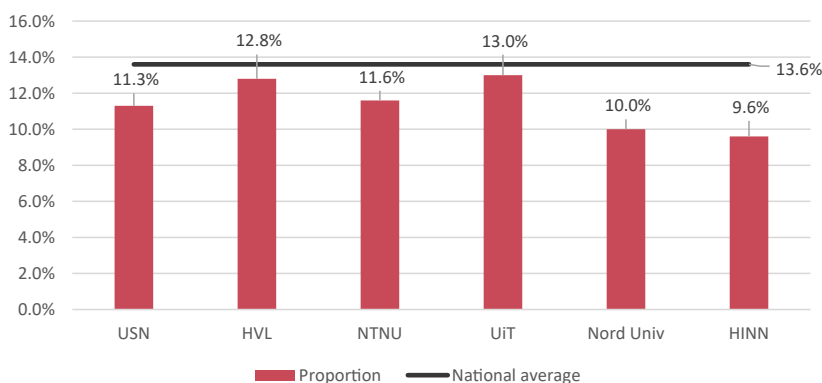
The extent to which the publications have been referred to or cited in the subsequent scientific literature is often used as an indicator of scientific impact and international visibility. In absolute numbers, the institutions with the largest number of articles also receive the highest number of citations. It is however common to use a size-independent measure to assess whether the articles have been highly or poorly cited. One such indicator is the relative citation index showing whether the scientific publications have been cited above or below the world average (=100). Another is the proportion of highly cited articles defined as articles within the top 10 percentile within their fields. The latter indicator has been calculated here.

It should be noted that only articles indexed in the Web of Science are included in the analysis. With respect to the social sciences and humanities in particular, the coverage is therefore limited and this affect many of the institutions significantly. Nevertheless, it is interesting to analyse this dimension.

On average, 13.6 per cent of all articles with coauthors from Norway are within the top 10 percentile in terms of citation rate. All institutions analysed perform below the national average. In particular, Nord Univ and HINN have relatively low proportion of highly cited papers, 10.0 and 9.6, respectively.

Further details by year are given in appendix table A6. It should be noted that there are quite large annual fluctuations, particularly for the smaller institutions with few articles per year.

Figure 7. Proportion of articles within the top 10 percentile in terms of citation rate per institution, 2011-2018



\*) Based on the current institutional structure which is given retroactive status.

## Unique institutional field profiles

In the database, all publications are classified by domain and field. These data make it possible to analyse the research specialisation profile of the institutions. Figure 8 shows the profile for each institution by major areas and selected disciplines. Only disciplines that account for 6 per cent or more of the publication output at least one of the institutions are shown separately. However, a complete overview for all disciplines is presented in appendix table A7.

The field profile of the institutions differs considerably. Engineering accounts for a large share of the publication of NTNU (37.5 per cent) but is marginal for the HINN (1.6 per cent). To the contrary, HINN has a much higher share of their publications in Education and Educational research than NTNU (16.8 vs 3.3 per cent). Similarly, business and finance is quite a large

field at Nord Univ, accounting for 10.9 per cent of their publication output, relating to the business school of the university.

In appendix table A8 citation indicators have been calculated by field and institution. The indicator applied is the relative citation index, in other words a field and year normalized indicator where 100 corresponds to the world average. Selected results are presented in Table 1 showing which fields the publications have been cited 50 per cent more than the world average.

It should be noted that in some fields, the number of underlying articles is relatively low. Thus, just few articles may influence significantly on the average, particularly due to the fact that citation distributions are highly skewed. On the other hand, for the larger institutions (NTNU and UiT), highly cited groups may be disguised by large article numbers.

Figure 8. Distribution of publications by major areas and disciplines, 2011-2019. Relative shares by institution.

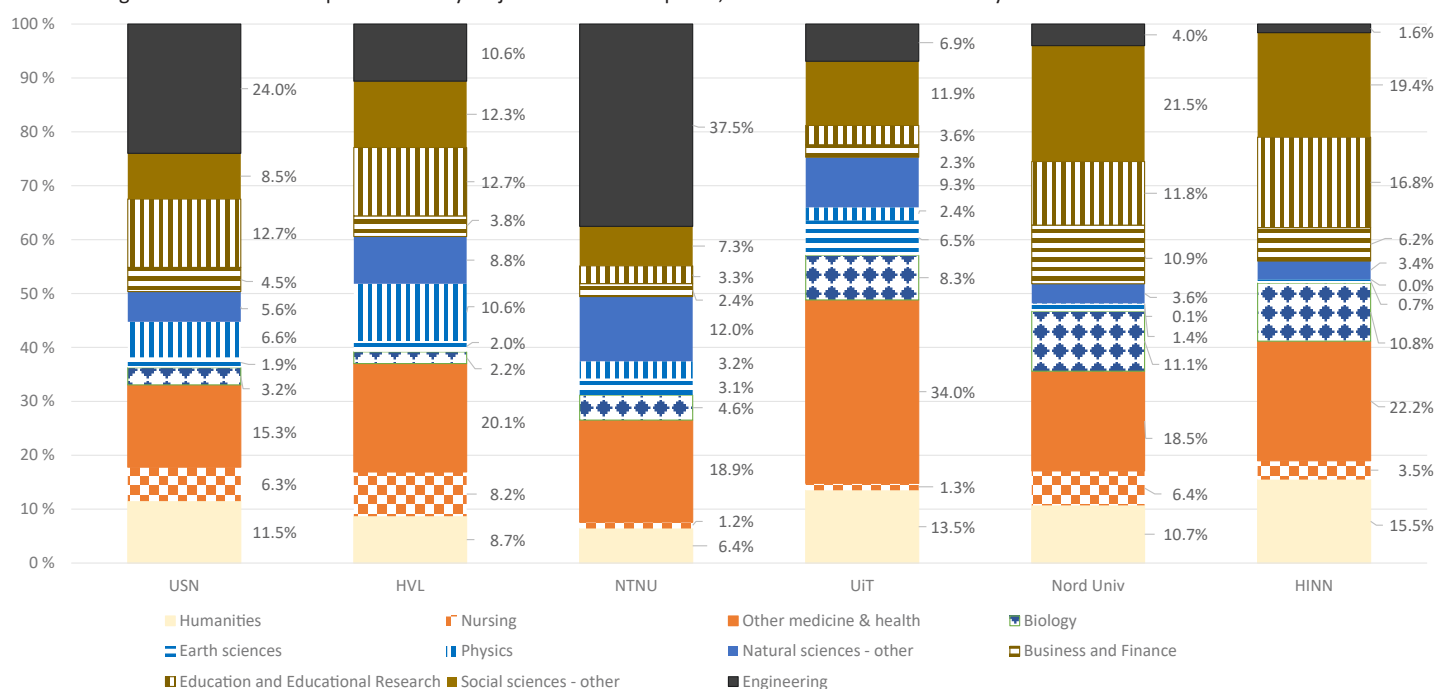


Table 1. Disciplines where the institutions obtain high citation impact\*, 2011-2018.

USN	HVL	NTNU	UiT	Nord Univ	HINN
Earth sciences Physics	Surgical sciences Physics Business & finance	Biomedicine Cardiovascular & respiratory syst Dermatology & venerology Gynecology & obstetrics Haematology Nephrology Oncology Pediatrics Political science Environmental tech & industrial ecology	Biomedicine Gastroenterology & Hepatology Nephrology Pediatrics Surgical Sciences Veterinary medicine Sociology Environmental tech & industrial ecology	Nursing Veterinary medicine Environmental tech & industrial ecology	Business & finance

\*) Fields where the publications have been cited 50 per cent more than the world average and where the institutions have at least 20 publications during the period. Humanities not included.



## Traditional universities publish comparably more for an international audience

In this section, the publication language is analyzed. Generally, almost all scientific publications in the natural sciences and engineering are written in English, while Norwegian as publication language is more important in the social sciences and humanities and to some extent in medicine and health. Given the societal role and mandate that university colleges have, one might expect more emphasis on Norwegian language publishing compared with the traditional universities. At the same time, a recurrent theme in the evaluations previously carried out of social science and humanities

research in Norway has been that too much of the research is published in Norwegian. For example, this was emphasized in the evaluation of educational research (Research Council of Norway, 2018).

Figure 9 shows the proportion of Norwegian language publications for the two broad areas humanities and social sciences (2011–2019), while detailed statistics at the fields level are shown in appendix table A9. In addition to figures for each institution, the Norwegian average is shown. Generally, we observe that NTNU and UiT publish less in Norwegian than the other institutions, thus they tend to publish more for an international audience.

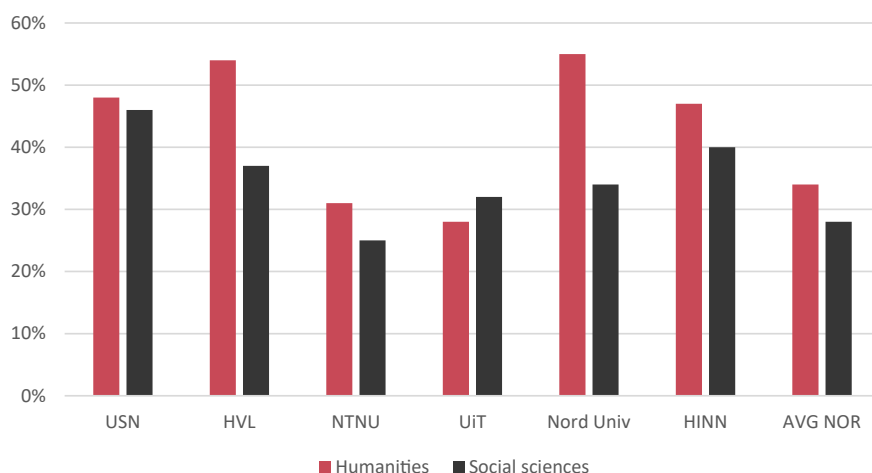


Figure 9. Proportion of publications in Norwegian language. Distribution by area and institutions,\* 2011-2019.

\*) Based on the current institutional structure which is given retroactive status.

## National institutional collaboration differs by subject fields

We have also analysed the collaboration patterns using data on co-authorship. Generally, co-authorship is much more common in natural sciences/medicine than in social sciences/humanities. In many humani-

ties fields, the proportion of co-authored publications is generally very low, and it is less common to write a publication together with other researchers. It should be added, however, that co-authorship data have limitations as indicators of collaboration. For example, the writing of anthologies may involve collaboration, but

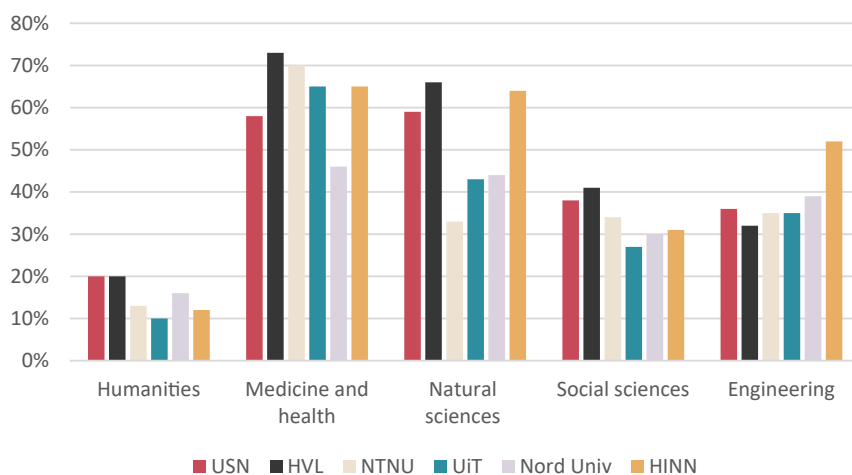


Figure 10. Proportion of publications with co-authors from other Norwegian institutions. Distribution by fields and institutions,\* 2011-2019.

\*) Based on the current institutional structure which is given retroactive status.

this is not necessarily reflected through the writing of jointly co-authored articles.

Figure 10 shows the proportions of publications with co-authors from other Norwegian institutions by main area. This indicator thus reflects the extent of national inter-institutional collaboration. Further details by discipline are given in appendix table A10. Overall, we see that such collaboration is particularly prevalent within medicine and health.

### Significant differences in international collaboration across institutions and subject fields

Figure 11 shows the proportion of publications with co-authors affiliated with institutions in other countries. This is an indicator of the extent of international research collaboration. Instances of international collaboration varies significantly across the individual institutions and fields. Further details by fields are given in appendix table A11.

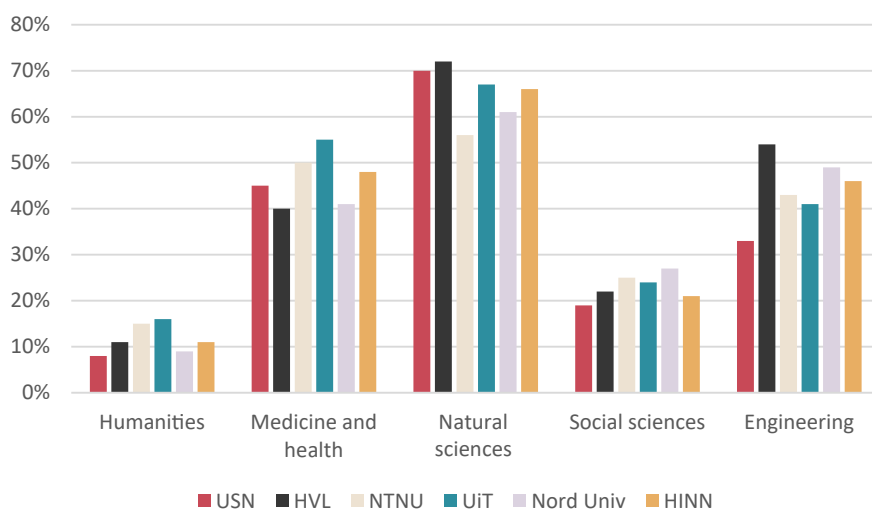


Figure 11. Proportion of publications with co-authors affiliated with institutions in other countries. Distribution by fields and institutions,\* 2011-2019.

\*) Based on the current institutional structure which is given retroactive status.

### Appendix tables

Appendix tables are available for download in [NIFUs Open Access repository](#).

# NIFU

Nordisk institutt for studier av innovasjon, forskning og utdanning

Nordic Institute for Studies in Innovation, Research and Education

NIFU is an independent social science research institute, organized as a non-profit foundation. The institute aims to be a leading European research organization for studies of innovation, research and education at all levels. NIFU collect, analyze and disseminate national statistics and indicators for R&D and innovation, and are active participants in statistical cooperation at European and international levels.

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