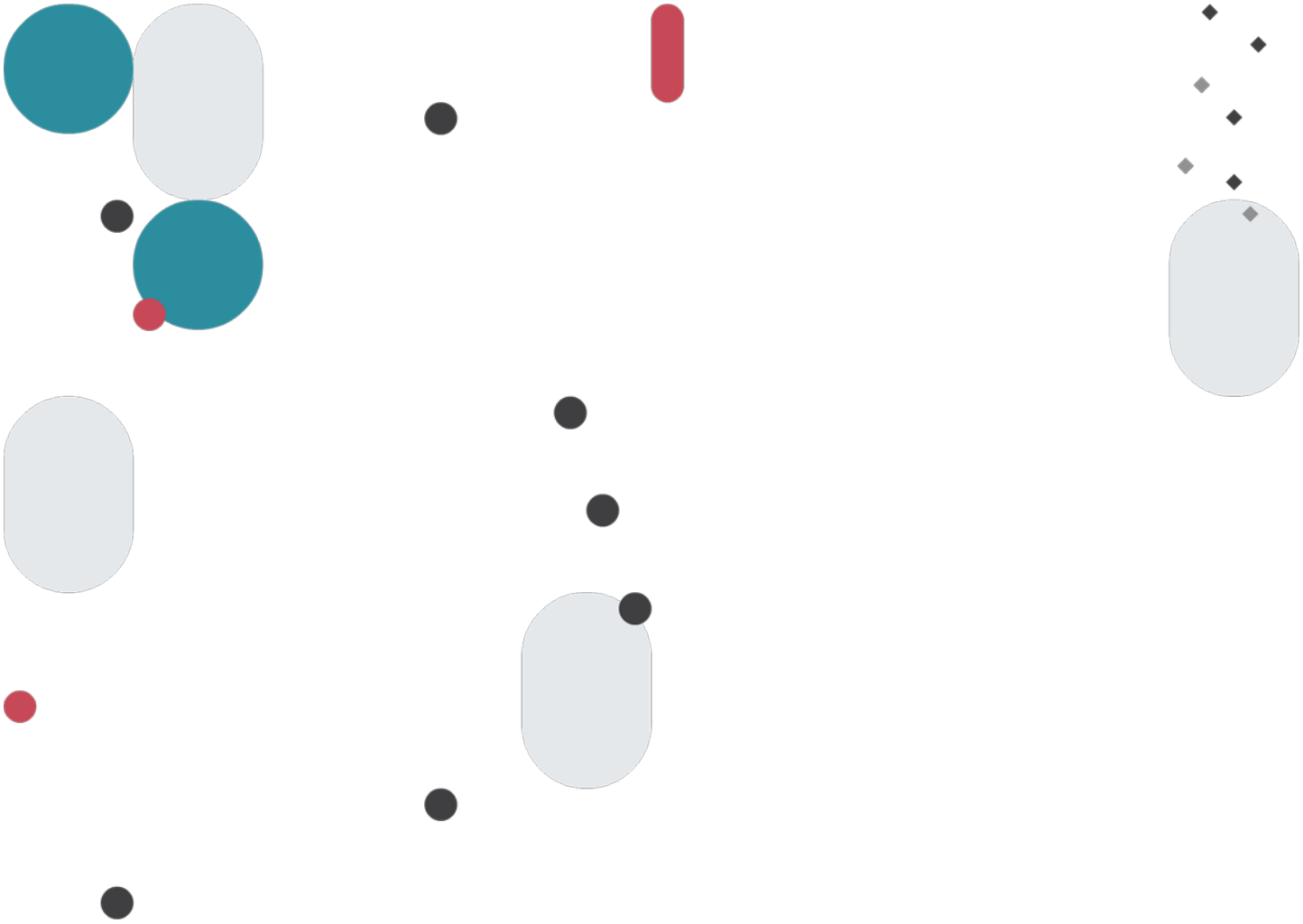

# A guide to understanding higher education R&D statistics in the Nordic countries

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Working Paper 9/2015

NIFU

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# Preface

The aim of this working paper is to provide information on the opportunities and challenges of R&D statistics in the higher education sectors of Denmark, Finland, Norway and Sweden. The working paper is a product of cooperation between the Nordic producers of R&D statistics on methodological issues. The working paper also includes information on the funding systems of the higher education sectors in the four Nordic countries.

NIFU initiated the work and Kaja Wendt (NIFU) wrote most of the text. Isabelle Söder at Statistics Sweden, Ari Leppälahti and Marianne Kaplas at Statistics Finland and Nils Galberg Enoksen and Casper Larsen at Statistics Denmark contributed by providing detailed statistics and by writing the national contributions. Ingrid Petterson and Marie Kahlroth at the Swedish Higher Education Authority (Universitetskanslersämbetet) and Leif Eriksson at NordForsk also provided valuable comments on preliminary drafts of the work. Svein Kyvik, Espen Solberg and Susanne L. Sundnes at NIFU also read and commented different parts of this working paper.

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Oslo, April 2015

Sveinung Skule
Director

Susanne L. Sundnes
Head of Research

# Contents

# Summary

This working paper gives an overview of the higher education R&D statistics (HERD) of the Nordic countries: Denmark, Finland, Norway and Sweden. It draws upon updated 2013 R&D statistics from OECD Main Science and Technology Indicators (MSTI) 2014:2, supplemented with national data sources. It indicates recent developments, country differences and comparisons with OECD and EU 28 totals. The authors are all involved in producing the higher education sector (HES) R&D statistics in their country.[1] In the working paper, methodological differences and challenges in producing the higher education R&D (HERD) statistics are discussed. National characteristics of the higher education systems of the countries are also presented.

**High level of HERD expenditure in Nordic countries**

In general the Nordic countries are very R&D intensive and are world leaders regarding the level of total R&D as a share of Gross Domestic Product (GDP). Norway is an exception to this with an R&D/GDP ratio of less than half of the level in Sweden/Finland. Denmark is in the middle, while the Finnish share has declined in recent years.

HERD contributes strongly to the total R&D level. When it comes to HERD as share of GDP Denmark has been at the top since 2008, together with Sweden. Norway is above the OECD total, but its strong GDP makes it difficult to score high on this indicator. Measured per capita Denmark is top, followed by Sweden, Norway and Finland; all above the OECD and EU 28 levels.

HERD amounts to almost a third of national R&D in Denmark and Norway; 27 per cent in Sweden and 21 per cent in Finland. Important factors contributing to high national level is for Sweden a relatively small research institute sector. In Denmark, recent mergers of institutes and universities have given larger higher education institutions. In Finland, the HERD share of total R&D has been remarkably stable during the last two decades. In Norway, the research institute sector[2] is rather large, while the business enterprise sector is not very R&D intensive.

**Strong growth of Nordic HERD**

Looking at the development of HERD expenditure in a 20-year perspective, the R&D statistics reveal that the Nordic growth was about the same level as OECD and EU 28 growth from 1993 to 2003. In the decade from 2003 to 2013, the Nordic countries had a stronger growth than the international total,

[1] According to international guidelines of the OECD Frascati Manual (2002) there are four R&D performing sectors: The business enterprise sector (BES), the government sector (GOV), the higher education sector (HES) and the private non-profit sector (PNP).
[2] In Norwegian sector classification, the institute sector consists of the government sector and part of the business enterprise sector.

this goes especially for the 2010–2013 period. There are, however, clear differences between the Nordic countries. Growth in Denmark has been at a high level, even in recent years. Finland has gone from the highest growth of all the countries during the 1993–2003 period, to real decrease in the last couple of years. In Sweden, growth has been remarkably stable, while growth in Norway has decreased somewhat in the last couple of years.

**Type and size of institutions differs**

Higher education is the most heterogeneous of the R&D performing sectors as it includes very different institutions: universities, university colleges and hospitals. In all Nordic countries, universities dominate, but the definition of a university differs. Sweden has the highest university share of HERD, while Norway has the lowest. The university hospitals contribute to a substantial share of HERD expenditure in Denmark and Norway.

Ten of the twenty largest R&D performing HES institutions are Swedish, but the largest institution is the University of Copenhagen in Denmark. If we look at the share of total HERD performed by the three largest institutions in each country, the concentration is greatest in Denmark, followed by Norway, Finland and Sweden.

**Medical and health sciences is the largest field of science (FOS)**

Medical and health sciences is the largest field of science in Denmark, Norway and Sweden and has also had the strongest growth during the 2003-2013 period. In Finland, natural sciences dominates. Different methods assigning field of science to R&D expenditure may have some influence on these results.

**Basic funding is dominant**

In all the Nordic countries, public funding is the most important funding source for R&D in the HES. Block funding, so-called General University Funds (GUF), is the largest funding source for R&D in all countries, except Finland. GUF and public funding is especially high in Norway, and in many ways Finland and Norway are counterparts.

**External funding is increasing more than basic funding**

The distinction between funding from research council and sectoral funding varies in the different countries. However, in all countries, least in Norway, external funding has gained importance over the years. The business enterprise sector funds a small share of HERD in all the Nordic countries, while funding from other national private funds is relatively high in Denmark and Sweden. Funding from abroad is highest in Finland, followed by Denmark and Sweden; it is lowest in Norway.

**Funding systems are changing**

As in most European countries the Nordic countries' HES have over recent decades experienced a development with elements like more lump sum funding, increased autonomy, governance through different elements of result-based funding and increased attention towards outcomes of public research money. External funding of HERD has gained in importance.

**Production of R&D statistics follows the Frascati Manual**

Reflecting the heterogeneous institutions that constitute the HES, the OECD Frascati Manual (2002) allows for different methods producing high quality R&D statistics for the sector. The Nordic countries use different methods to produce the statistics, and this working paper discusses comparability. The quality of administrative data, resources for conducting R&D surveys and implementation of time-use survey are crucial elements here.

**Policy recommendations**

The recent years of cooperation on statistical methodology in the Nordic countries has increased mutual understanding on how R&D statistics are compiled. However, these methods are constantly revised. In order to decrease divergence, secure quality and comparability continuing cooperation within the field is necessary. An active international role could include some concrete initiatives:

- Develop a common Nordic report on R&D statistics, issued (in English) for instance every second year
- A set of coordinated pilot studies, with the aim of exploring issues with high policy relevance and where existing data is insufficient for comparative studies
- Improvements of common web-page for communication and dissemination of Nordic R&D statistics, possibly also including news on R&D policy developments in Nordic countries
- An annual Nordic conference on trends and developments in Nordic R&D (and innovation)

A permanent Nordic funding of this cooperation to ensure that all statistical offices can participate at meetings and joint developmental work is highly important. This could be funded through a common effort by ministries and/or national research councils of the five Nordic countries or by a Nordic organisation like NordForsk.

# 1 Introduction to higher education R&D (HERD) in the Nordic countries

**The important role of the higher education sector**

The higher education sector (HES) has a central role in a modern knowledge economy, educating students and performing research. During the last decades the HES has gone through several large reforms regarding autonomy, organisation, management/control and funding structure. The sector has also experienced increased attention and societal demands regarding dissemination, relevance, market orientation and not least the use of public funding. The latter has gained importance with the recent economic and financial crisis. This working paper gives an overview of the status and recent changes of HERD and of the HES funding system of the four Nordic countries: Denmark, Finland, Norway and Sweden. In this working paper, Nordic countries means these four countries. Iceland is not part of this study due to restructuring of its R&D production, and no updates of data since 2011.

**Early Nordic engagement for international R&D statistical guidelines**

All modern nations produce R&D statistics, and the OECD recommendations in the Frascati Manual are crucial to ensure international comparability of the statistics. The first edition of the manual came in 1963 and has been revised many times since. The present sixth edition is the 2002 version.[3] From the outset the Nordic countries were active in the international work on R&D statistics. Partial investigations of R&D resources were conducted from the end of the 1950s in Norway and Sweden and from the beginning of the 1960s in Denmark and Finland.[4]

HES is the most heterogeneous of the R&D performing sectors, hence the guidelines are more general for this sector. This is necessary given the different units that are included and the different sources of information that can be drawn on to produce R&D statistics for the sector.

**Exploitation of R&D statistics, input from the national statistical producers**

In this working paper, HERD data of Denmark, Finland, Norway and Sweden are presented and discussed along with information on methodological issues. We have a special focus on funding patterns and funding mechanisms over the last 20 years.[5] The working paper also draws on data

[3] OECD (2002): Frascati Manual. The manual is currently under revision. Germany and Norway are leading the revision group for the higher education sector. Sweden and Finland are participating in the group of countries commenting on this work. A new version of the manual is expected by the end of 2015.
[4] Søgnen and Wendt: *50 år med forskningsstatistikk. FoU-begrepet under press*, in: Søgnen and Brofoss (ed) (2012): p. 20.
[5] The article *Funding research. Funding university research in the Nordic countries,* by Svein Kyvik (1997) with focus on the years 1981–1993 was an inspiring starting point of this working paper.

regarding fields of science (FOS), full time-equivalents (FTE) and institutional data to shed light upon differences in the Nordic countries' institutional systems and to understand and interpret the different systems. Time-series data are discussed as well as changes in the public funding policy in each of the countries. In this study, we exploit the R&D statistics to their limits, to see what conclusions can be drawn on the higher education funding structure of the Nordic countries. International data at aggregated level relating expenditure to Gross Domestic Product (GDP) give an overview of R&D resources. In the study, we try to go beyond the aggregated level.

When it comes to more detailed national data, explanations and quality control, the involvement of the national R&D statistical producers is central to the working paper. The study examines differences between the four countries and reasons for changes in the 20-year time series of data. The working paper includes the perspective of methodological differences in how the statistics are produced.

**Result-based funding**

All the Nordic countries have to some degree been influenced by result-based funding trends and have introduced this in their HES during the last two decades. In the working paper, background information on these changes is included. Here, we present time series, describing recent developments in funding of R&D in the HES using R&D statistics, and indicate methodological challenges in the data.

**Need for more cooperation on methodology work in R&D statistics**

In all the Nordic countries, the statistics are generally developed according to the international guidelines of the OECD Frascati Manual. The use of different data sources and combinations of R&D surveys, time-use surveys, administrative registers and accounting data is described in the manual. There are recommendations for best practice and description of methods adjusted to different levels of resources for conducting the statistics. The challenging issues of the R&D measurement in the HES originate in the large heterogeneity of the HES between countries, and correspondingly different methodologies for producing the data. The working paper points at areas where more knowledge on these methodological aspects are needed.

Crucial points are the national adjustments in how the R&D coefficient of the resources is determined; how often and at what level a time-use survey is conducted; implementation of the R&D survey; collection of data on R&D personnel and calculations of FTE; design of the questionnaires; quality of administrative data; interpretations and resources for producing the statistics. Other critical questions in the production of R&D statistics are the contribution of support services in R&D, and treatment of capital depreciations and statistical breakdowns by field of science. In this study, main features of the methodology are presented along with characteristics on the funding system and the institutional system of the Nordic HES.

R&D data are also influenced by technical issues regarding methodology, conversion to purchasing power parity and fixed prices, different interpretations and policy views. Kim stated in 2002 (p. 78) that it was unfortunate that first attempts to develop Nordic R&D statistics and common indicators had not been supported. This is still the case in 2015. The Nordic producers of R&D statistics are highly aware of the issue of comparability. In 2012, Nordic cooperation on methodology issues initiated by the producers of R&D statistics started. There are now alternating annual meetings of the group and increased contact. The lack of comparability in parts of the statistics deserves attention, as data comparability is often taken for granted in indicator development, scoreboards, and studies on science and technology.[6] The Nordic countries are relatively small and transparent with good registers and administrative data; these should be a good starting point, acting as forerunners in the development of high quality statistics also within the field of R&D.

[6] Wendt et al. (2012).

## 1.1 Background on the role of R&D in the global knowledge economy

Education and research are at the heart of knowledge economies and are drivers of long-term growth. In the Nordic countries, investments in higher education as well as research are among the highest in the world (OECD, 2013: 86). The level of these countries' investments in education and research are influenced by, for example, industrial structures, natural resources, historical factors, age structure of the population, enrolment rates in higher education, and teacher and researcher salaries. It is also a result of political priorities to secure economic growth, the Nordic welfare model and answers to the environmental, demographical, medical global challenges and stability of our time. Denmark, Finland, Norway and Sweden share similarities in language and culture, long tradition in political collaboration and the common Nordic societal model. But there are also differences among the countries, and in this working paper we look at R&D profiles of the four countries' higher education sector (HES).

**R&D and economic crisis**

The economic situation is increasingly precarious throughout the world since the economic recession of 2008. After a time when public investments in R&D were used as a buffer to prevent overall reductions in R&D expenditure, the OECD Science, Technology and Industry Outlook 2014 reveals that public R&D budgets have started to level off or even decline in many OECD countries.[7] Some countries have tried to protect government knowledge investments, while others have had cutbacks of central government finances that have affected universities and research funding agencies.[8] Higher education institutions are characterised by great complexity, but securing alternative (i.e. private) revenue sources will probably be necessary to sustain current capacity in the HES. For the Nordic states, funding is a major steering mechanism of the higher education systems, and governments remain the primary funding source for higher education institutions.[9]

**Pressure on public funding**

The changing role of the state in enhancing autonomy and stressing quality assurance and accountability are well-known themes of the HES in recent decades, as well as the influence of processes like globalisation, internationalisation and privatisation (Jongbloed, 2008). The composition of funds is likely to influence the degree of autonomy. Public expenditure is under pressure from a continuously expanding higher education system.

**Growing importance of indicators**

There is a growing interest in indicator-based public steering and for university rankings, and indicators on higher education institutions' (HEI) ability to attract the best students and researchers, and external funding. However, there is a need for high quality data which are crucial to make reliable indicators and analysis, not least for comparative studies.

[7] OECD 2014: p. 24.
[8] Treudhards (2012): p. 14.
[9] Jongbloed (2008): p. 4: on the difficult justification of introduction/increase of student fees. The Ministry of Education and Research: Kunnskapsdepartementet (2015), p. 167 Reflections on performance agreements in higher education by Jongbloed and de Boer.

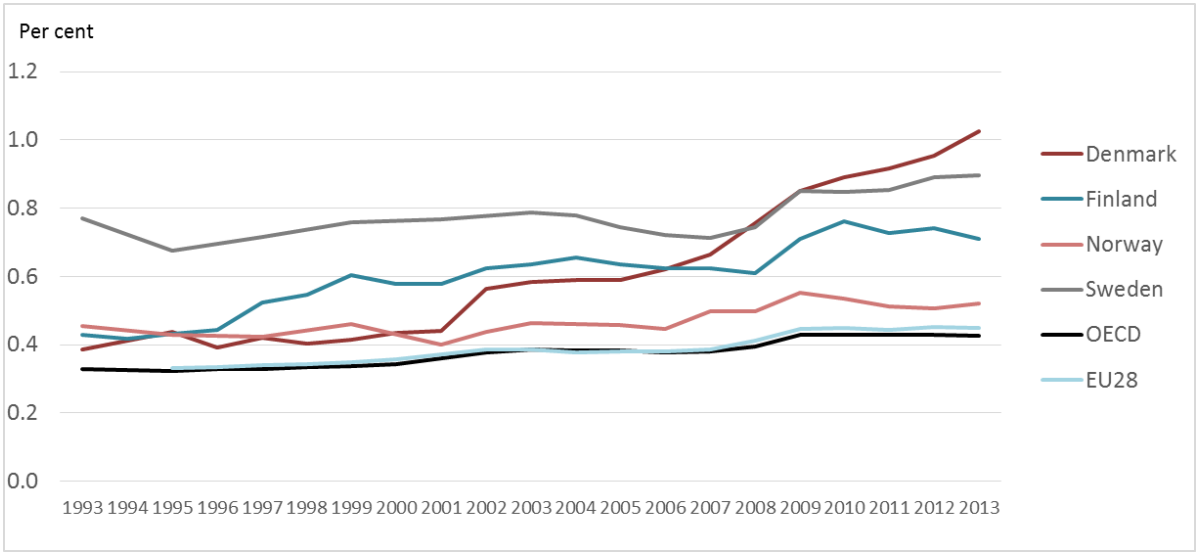
# 2 Higher education R&D (HERD) in the Nordic countries

## 2.1 HERD expenditure in Denmark, Finland, Norway and Sweden

### 2.1.1 HERD expenditure as a share of GDP

From a global perspective, the Nordic countries are among the most R&D intensive regions in the world, when R&D intensity is expressed as R&D expenditure as a share of GDP. When the Nordic countries are counted together, they rank ninth in the world with 2.9 per cent of GDP spent on total R&D.[10] Norway is an exception with a ratio of less than 1.7 per cent. It is foremost the low R&D intensity of the Norwegian business enterprise sector that contributes to this. This is partly due to an industrial structure with a large degree of exploitation of natural resources, few enterprises in R&D intensive industry sectors and a large share of small and medium sized enterprises (SMEs).

***Figure 1*** ***Higher education R&D expenditure (HERD) in the Nordic countries as a percentage of GDP: 1993–2013.***




*Source: OECD MSTI 2014:2 and Nordic R&D statistics*

[10] Norwegian S&T report 2013: p. 15.

R&D expenditure in the HES accounts for a higher share of GDP in all Nordic countries than in the OECD and EU 28 totals as shown in Figure 1. In 2013, the level was highest in Denmark (with more than 1% of GDP), followed by Sweden (0.9%), Finland (0.7%) and Norway (0.5%).

**Danish higher education sector has the highest R&D intensity**

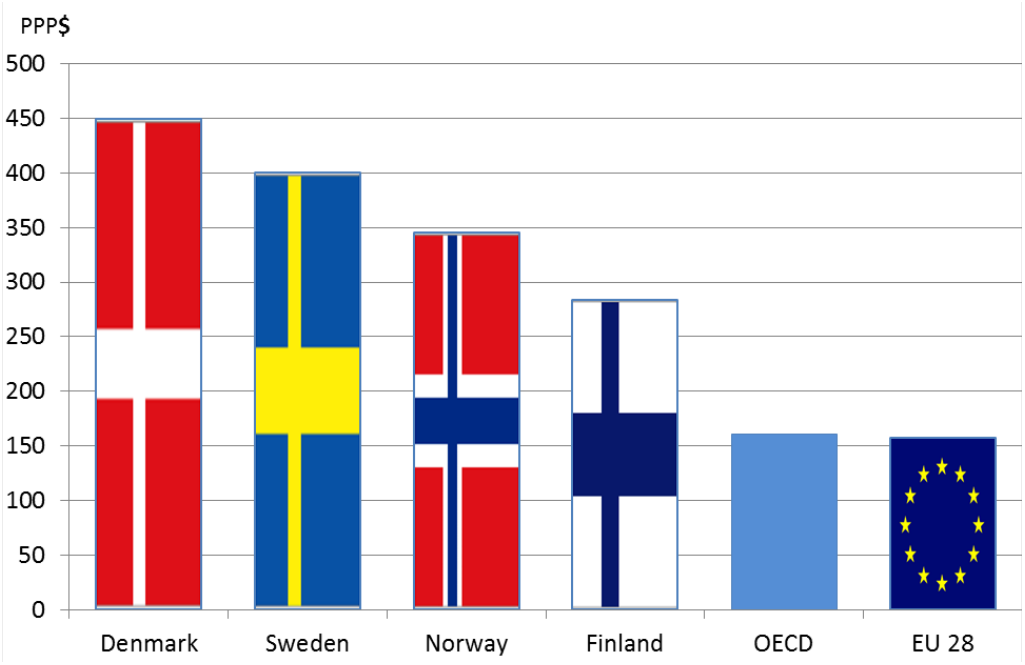
The growth of R&D among the four Nordic countries, expressed as a share of GDP, was highest in Denmark during the period 1993–2013. This is mainly due to the institutional restructuring as explained below (section 2.2.1 and 3.1). In Finland, there was stable growth until 2010, followed by a decrease. In Sweden, the level was higher than in the other Nordic countries until 2010, when Denmark took over the highest position. R&D expenditure in the Norwegian HES was at a lower level of GDP than the other countries over the whole 1993–2013 period. For the OECD total, there was a stronger growth of R&D as a share of GDP in the HES during the years after 2000. See also the time series in Table A.1 in the appendix of the working paper.

After the financial crisis of 2008, there was still growth in Finnish HERD in 2009 and 2010, then a decrease of the R&D/GDP share in the HES from 2010 to 2013. The economic downturn with a clear fall of GDP and hence public spending are central explanations here. After 2008 only Denmark experienced an increased R&D/GDP ratio, while the levels in Sweden and Norway were rather stable; Sweden with a peak in 2013 and Norway in 2009.

### 2.1.2 HERD expenditure per capita

The R&D effort can also be expressed in relation to number of inhabitants. Figure 2 shows that Denmark has the highest HERD expenditure/capita ratio followed by Sweden, Norway and Finland. All the Nordic countries are at a substantially higher level than the EU 28 and the OECD.

***Figure 2 Higher education R&D expenditure (HERD) in the Nordic countries per capita: 2013. PPP$.***




*Source: OECD MSTI 2014:2 and Nordic R&D statistics*

### 2.1.3 Growth in HERD expenditure

**Slowdown in Nordic growth during 1993–2013, but higher level than OECD**

The average annual growth measured in fixed prices is shown in Table 1. Over time the R&D statistics show that the overall annual real growth of R&D expenditure in the higher education sector (HES) was highest in the years1993–2003, then the growth slowed down from 2003 to 2013 with a noticeable reduction of for the last few years (2010–2013) of this period.

The growth was at about the same level for the Nordic countries and in the EU 28 and the OECD total from 1993 to 2003; around 5 per cent. During the last ten years (2003–2013) we see that the Nordic real growth has been stronger than in the OECD and EU 28.

If we look at the development during the last three years, the total Nordic real growth is above the OECD and EU 28 level, but at a lower level than previous years. The EU 28 level at 0.4 per cent is much lower than the total Nordic level at 2.4 per cent.

**Strong increase in Danish HERD**

The strong growth in Denmark is partly due to the merging of government institutes into the universities in Denmark in 2007. In the 1993–2003 period, the growth is also affected by the inclusion of the university hospitals in HES in 2002. Prior to 2002 university hospitals were included in the government sector in the context of R&D statistics. The growth was a bit lower from 2010 to 2013, at almost 5 per cent annually. This is, however, a far stronger growth than the development in the other Nordic countries and the OECD and EU 28.

**Recent decrease in Finnish HES**

There are some striking differences among the Nordic countries regarding when the strongest growth took place. In Finland, the strongest growth was in the first period 1993–2003, and more than three times as high as in the years 2003–2013. Finland experienced an annual real decrease of HERD expenditure of 2.2 per cent from 2010 to 2013.

**Stability in Norway and Sweden**

In the whole 1993–2013 period, the average annual growth in Norway was about the same level, around 4 per cent annually, but with a weaker growth during the last three years. The real growth of R&D expenditure in Swedish HES was at the same level over the 20-year period at 3 per cent annually. The annual growth in Norway and Sweden has been at 2 and 3 per cent respectively over the last three years.

**Table 1 Average annual change in higher education R&D expenditure (HERD) in the Nordic countries, OECD and EU 28. Fixed PPP$ 2010-prices: 1993–2013. (%).**

| Country | Change % in fixed 2010-priced annual growth 1993-2003 | Change % in fixed 2010-priced annual growth 2003-2013 | Change % in fixed 2010-priced annual growth 2010-2013 |
|---|---|---|---|
| Denmark | 6.8 | 6.4 | 4.8 |
| Finland | 8.1 | 2.3 | -2.2 |
| Norway | 4.2 | 4.4 | 2.0 |
| Sweden | 3.4 | 3.2 | 3.1 |
| Total Nordic | 5.0 | 4.0 | 2.4 |
| OECD | 4.8 | 2.8 | 1.3 |
| EU 28* | 4.6 | 2.7 | 0.4 |

Source: OECD MSTI 2014:2 and national sources

*Calculation by OECD. 1995.

### 2.1.4 Distribution of HERD among the Nordic countries

Sweden is, due to its size, the largest country when it comes to S&T resources in the Nordic countries total and, more specifically, HERD. However, during the last decade the Swedish share of HERD expenditure among the Nordic countries decreased from 45 per cent to less than 40 per cent. In Finland, there has also been a decline from 19 to 16 per cent. Denmark has had the strongest increase from 20 to 26 per cent, and the Norwegian share increased from 16 to 18 per cent from 2003 to 2013.

### 2.1.5 Other indicators of HERD resources

**Large Nordic differences in level of FTE and R&D expenditure in the higher education sector**

Table 2 gives an overview of different academic S&T resource measures among the four Nordic countries: publications in 2013 and resources influencing this result; expenditure, full-time equivalents and headcounts in the HES in 2011. Some findings are striking; the different distribution of R&D expenditure and R&D FTE in HES among the countries, especially the share of FTE seems high in Finland and low in Sweden. This is also reflected in the price of an R&D FTE, which seems to be very high in Sweden and rather low in Finland. Finland is just above the EU 28 level. There is no simple explanation for why the price level of an HES FTE should differ that much between the countries. There are many topics to look into: wages, purchasing power parities, and which personnel groups are included in FTE.

**Table 2 Division of S&T resources in Denmark, Finland, Norway and Sweden 2011. Scientific publications 2013. % and PPP$.**

| Land | Inhabitants | Publications in international journals | R&D expenditure HES | R&D FTE HES | R&D head count HES | Expenditure FTE/HES PPP$ |
|---|---|---|---|---|---|---|
| Denmark | 22.0 | 24.5 | 24.6 | 26.6 | 23.7 | 156 |
| Finland | 21.2 | 18.4 | 17.7 | 22.6 | 20.5 | 132 |
| Norway | 19.5 | 18.5 | 17.9 | 18.5 | 19.4 | 163 |
| Sweden | 37.3 | 38.6 | 39.8 | 32.3 | 36.4 | 207 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 168 |

Source: OECD MSTI, Thomson Reuters/CWTS Web of Science. Calculations: CWTS/NIFU.

In 2008, a study at Statistics Sweden[11] compared HERD statistics in Sweden and Finland and found, among other differences, when it came to the inclusion of university hospitals, professional colleges, different methods in production of R&D expenditures, the level of R&D expenditure and FTE, as well as internal and external funding. One conclusion was that there were many factors that contributed to differences in the statistics. A closer follow-up on this work than has been possible in the present working paper would be interesting as the methodology has been further developed in both countries. Still the differences in prices for R&D FTE exist.

There seems to be a high correlation regarding scientific publications and R&D expenditures. Sweden has a higher share of expenditure than publications, but many factors influence this macro picture. In scientific publications all national articles are included (also from the government sector), but when it comes to R&D expenditures only HES is included. International comparisons of the relation between R&D expenditure and scientific publications (input and output) have revealed that there are larger fluctuations in R&D expenditure than in publications (Wendt, 2012). Appendix Table A.2 includes more details and it becomes clear that the role of the government sector varies; more R&D resources are related to this sector in Norway and Finland, than in Denmark and Sweden.

[11] Petterson (2008).

## 2.2 Higher education sector (HES) in relation to other R&D performing sectors

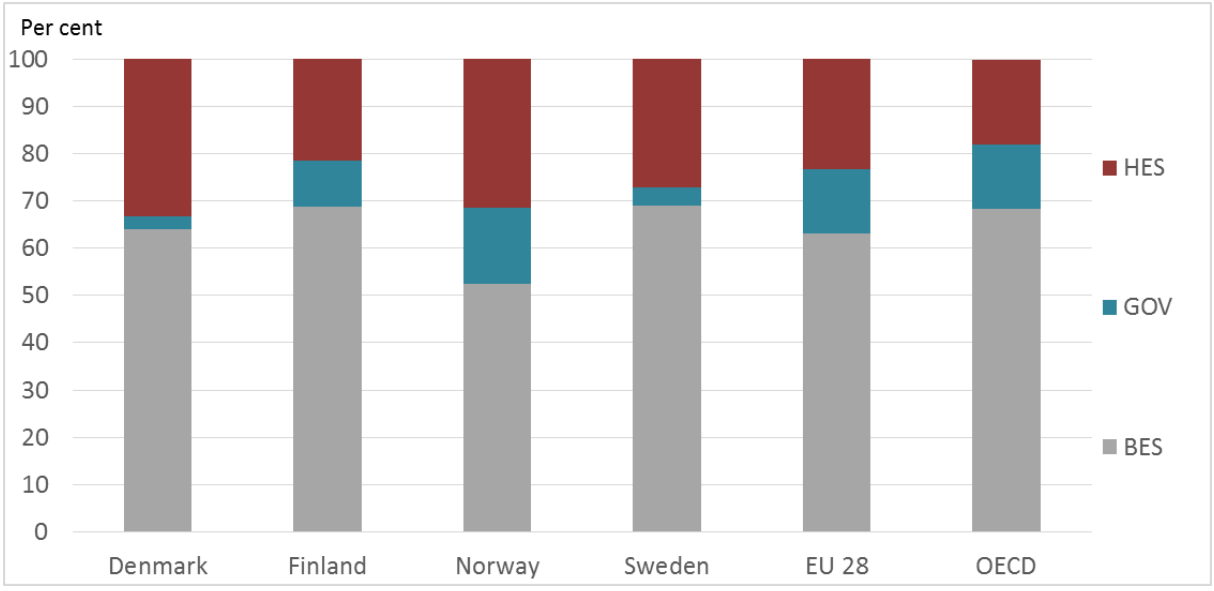
### 2.2.1 Relative size of R&D performing sectors within the Nordic countries

**Finland more similar to EU 28 and OECD compared with the other countries**

In the Nordic countries, as shown in Figure 3, the size of the R&D performing sectors varies. The business enterprise sector (BES) is the largest R&D performing sector in all countries. Especially in Finland and Sweden this sector dominates with close to 70 per cent of total R&D, while in Norway, the business enterprise sector accounts for just over half of R&D expenditure. A common explanation for this modest share is the industrial structure in Norway. Compared with the other Nordic countries, Norway has few enterprises within industries that are R&D intensive (like electronics and high-tech industries) as well as a large proportion of small and medium sized companies.

The private non-profit (PNP) sector is a small R&D performing sector and stands for less than one per cent in the Nordic countries. In Figure 3 the PNP sector is included in the government sector. In Norway, the PNP sector is only included in the R&D statistics as a funder of R&D, not as an R&D performing sector.

***Figure 3 Share of R&D expenditure by sector of performance[1] in the Nordic countries, OECD and EU 28: 2013. (%).***




[1] Private non-profit sector (PNP) is in this table included in government sector (GOV).
*Source: OECD MSTI 2014:2 and national sources*

### 2.2.2 HES share of total R&D expenditure over time

**HES growing more than other sectors**

Over the last 20 years, the overall trend is that HERD expenditure has had a stronger increase than other R&D performing sectors. Norway has during the last 10 or even 20 years had the highest share of its total R&D expenditure in HES among the Nordic countries, as shown in Table 3. In the last few years, R&D conducted in the HES comprised almost a third of total R&D expenditure in Norway, while only a fifth was conducted in the Finnish HES. However, since 2012 Denmark has had an even higher share of R&D expenditure in HES than Norway.

**Table 3 Higher education R&D expenditure (HERD) in the Nordic countries as a percentage of the total R&D expenditures: 1993–2013.**

| Country | 1993 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Denmark | 22.8 | 23.2 | 24.4 | 24.6 | 25.9 | 26.4 | 27.2 | 27.7 | 30.3 | 30.9 | 31.6 | 33.2 |
| Finland | 20.5 | 19.2 | 19.8 | 19.0 | 18.7 | 18.7 | 17.2 | 18.9 | 20.4 | 20.0 | 21.6 | 21.5 |
| Norway | 27.3 | 27.5 | 29.9 | 30.8 | 30.7 | 31.9 | 32.0 | 32.0 | 32.3 | 31.4 | 31.3 | 31.4 |
| Sweden | 25.7 | 21.8 | 22.9 | 22.0 | 20.6 | 21.9 | 21.3 | 24.9 | 26.3 | 26.5 | 27.1 | 27.1 |
| *OECD* | *16.2* | *17.9* | *18.0* | *17.7* | *17.3* | *17.2* | *17.2* | *18.4* | *18.7* | *18.4* | *18.1* | *17.7* |
| *EU28* | *..* | *22.8* | *22.6* | *22.7* | *22.5* | *22.6* | *23.2* | *24.2* | *24.4* | *23.6* | *23.6* | *23.3* |

Source: OECD MSTI 2014:2 and Nordic R&D statistics

**Structural reforms in Denmark**

In Denmark, the HES share of total R&D has risen distinctly from 23 per cent in 2003, to 33 per cent in 2013. In 2000, institutions of medium length vocational training were merged into 22 multidisciplinary colleges; they are however not much involved in R&D. In 2013, these colleges for the first time gained independent R&D funding, and this year the parliament established by law the right and obligation to perform practice- and application-oriented R&D activities to introduce new knowledge.

A major reason for the growth in the Danish HES is structural change, as sectorial research institutes have been merged into the universities, and larger universities have been created. In Denmark, this is part of a general centralisation of public structures implemented over the last 6/7 years including a number of municipalities, police districts, and higher education institutions. The latest data reveal that the HES share of total R&D is still increasing.

**Small institute sector in Sweden**

Since the 1990s, Sweden has systematically strengthened the role of research institutes in order to build a bridge between industry and academia to overcome what has been called the Swedish paradox of high scientific quality and low value creation.[12] RISE Research Institutes of Sweden is the state's company for ownership of research and technology organisations, and consists today of 16 research institutes. But still it is important to bear in mind that the Swedish research institute sector is small compared with the institute sector in Finland, Norway, and until 2007 in Denmark. This implies that part of the R&D conducted at Swedish universities takes place in the institute sector in the other Nordic countries. The share of HERD in Sweden accounted for 27 per cent of total R&D in the Nordic countries in 2013, approximately the same level as in 1993, while around the year 2000, the sector experienced a drop to 20 per cent.

**Finland has the relatively smallest, but very stable higher education sector**

In a long perspective the Finnish share of R&D expenditure performed in the HES has remained stable at around 20 per cent of national R&D from 1993 to 2012, with a dip down to 17 per cent in 2008. The Finnish level is the lowest among the Nordic countries and the only Nordic country below the level of the EU 28.

The OECD total level has had a small increase in the period, from 16 to around 18 per cent, and in the EU 28 from 21 (1995) to 23/24 per cent. From 2003 to 2013 all Nordic countries have strengthened the HES share of R&D more than in the OECD and EU 28, with Denmark having the highest growth during this period.

[12] Solberg et al. (2012): 25–27.

## 2.3 Institutional types of R&D performers in the HES

**Binary HES in the Nordic countries**

All the Nordic countries' HES can be characterised as so-called binary systems with an own sector of vocationally oriented education for such professions and semi-professions as nurses, social workers, engineers and teachers, in addition to the larger university sector. This sector shares the same structure of grades as the universities. The vocational institutions are often organised in multidisciplinary centres by geographical criteria.[13] The size of R&D performed in this part of HES differs clearly between the Nordic countries. In Norway, vocational institutions account for a relatively large share of the R&D expenditure.

**Universities are dominating HERD, highest share in Sweden**

The number of universities, and to some extent the criteria for HEIs to achieve university status, vary among the Nordic countries. However, from the national R&D statistical producers, we have collected information on R&D expenditure in HES by type of institution. Table 4 shows that universities are the largest group of R&D performing units in all the four Nordic countries. In Sweden, the share is almost 90 per cent, while the share in Norway is the smallest at 66 per cent. University hospitals perform as much as 20 per cent of HERD in Denmark and only 4 per cent in Finland and Sweden. The group of other HES institutions includes vocational training at state university colleges, polytechnics and other applied institutions within art, sports, music etc. Table 4 shows that the Nordic HES is organised rather differently among, in many other ways, homogeneous countries.

**Table 4 Share of higher education R&D expenditure (HERD) in the Nordic countries by type of institution: 2013. (%).**

| Type of institution | Denmark | Finland | Norway | Sweden |
|---|---|---|---|---|
| Universities | 76.5 | 84.5 | 66.4 | 89.6 |
| University hospitals | 20.3 | 3.7 | 17.3 | 4.2 * |
| All other HES institutions** | 3.1 | 11.7 | 16.3 | 6.2 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

Source: Nordic R&D statistics

* In Sweden only so-called ALF-funding is included to avoid double counting with the GOV sector.

** University colleges, universities of applied sciences.

**Current reform process in Norway will affect future statistics**

Like in the other Nordic countries, there is a regional sector of state university colleges in Norway, and they have become increasingly R&D intensive. Their R&D comprises almost 9 per cent of total Norwegian HERD in 2013. The Norwegian government has prepared a Parliamentary White Paper examining which structure the higher education system should adopt. The government states that resources allocated to research and higher education are spread too widely, with too many small, academic environments offering the same educational programmes. The White Paper was published in March 2015. Merging processes are underway; as a result the Norwegian share of R&D conducted at universities will rise in the coming years, and there will be a reduction in number of higher education institutions.

**University hospitals stand for high shares of HERD in Denmark and Norway**

According to the international recommendations of the OECD Frascati Manual, R&D conducted at university hospitals is to be included in the HES, while R&D at other hospitals is included in the

[13] Kyvik (2006): 7.

government sector. R&D is often carried out in cooperation between the university and university hospital and hence it might be difficult to attribute the R&D expenditure to the right institution.

The large share of R&D conducted at university hospitals in Denmark and Norway partly explains the high HES share of R&D in these countries. In Norway, all hospitals came under governmental responsibility organised in regional health trusts in 2002. Research was then defined as one of four legal obligations, and a new system of reporting the resource allocation (among these expenditures for research) was established. The government gave more attention to the research efforts of the sector, and there was a real increase in the research funding from the Ministry of Health and Care. R&D expenditure at the university hospitals has hence had a strong growth during the last decade.

In Denmark, university hospitals are included in HES, while other hospitals are included in the government sector. This has been the situation since 2002, prior to this the university hospitals were included in the government sector. The hospital sector in Denmark is under the responsibility of the Regions, of which there are five. All major hospitals, with respect to R&D performance, are according to the Regions classified as university hospitals, which may partly explain the high share of R&D.

**In Finland, little R&D is performed at university hospitals**

The Finnish higher education system has gone through major reforms in recent years. Universities have become more autonomous in terms of choosing their legal status, of funding allocation and management of human resources. In order to develop stronger profiles several universities merged into larger entities. Eight universities merged into three large universities; the Helsinki University of Technology, The Helsinki school of Economics and the University of Art and Design Helsinki.[14] These universities perform 85 per cent of Finnish HERD. Also, the Finnish system consists of a university sector and so-called polytechnics that provide more vocational higher education. The latter contribute to almost 12 per cent of total HERD in Finland.

The statistical coverage of Finnish HES expanded in the late 1990s as the university clinics were included in 1997 and polytechnics in 1999. Compared with the other Nordic countries Finnish university hospitals account for a small share of HERD of less than 4 per cent. This is also reflected in the low share of medical and health sciences in the Finnish HES. Within the government sector Finnish R&D expenditure is a bit higher than in Denmark, but only a third of the Norwegian government sector level. Data from the Finnish government budget appropriations or outlays for R&D (GBAORD) show that GOV funding of the university hospitals was reduced from €40m in 2009 to €31m in 2013 and even €21m in 2015; this clearly has affected and will affect R&D at the university hospitals.

**Swedish characteristics of funding classification**

In Sweden, the university hospitals are also included in HES, but not all of their funding. In Swedish, the abbreviation ‘ALF’ stands for Avtal om läkarutbildning och forskning, which translates into Agreement for Medical Education and Research. ALF-funding is compensation that the state provides to cover additional costs such as clinical research and education. ALF-funding is collected both in the GOV and HES. In order for these funds not to be double counted, they are removed from the government sector when total R&D in Sweden is calculated. In addition to ALF-funds, the university hospitals are financed by other funds such as county councils’ own funds and private funds. In the R&D statistics these are not included in the HES, but in GOV sector. Summarising all funds of the university hospitals, they would amount to about 9 per cent of total HERD.

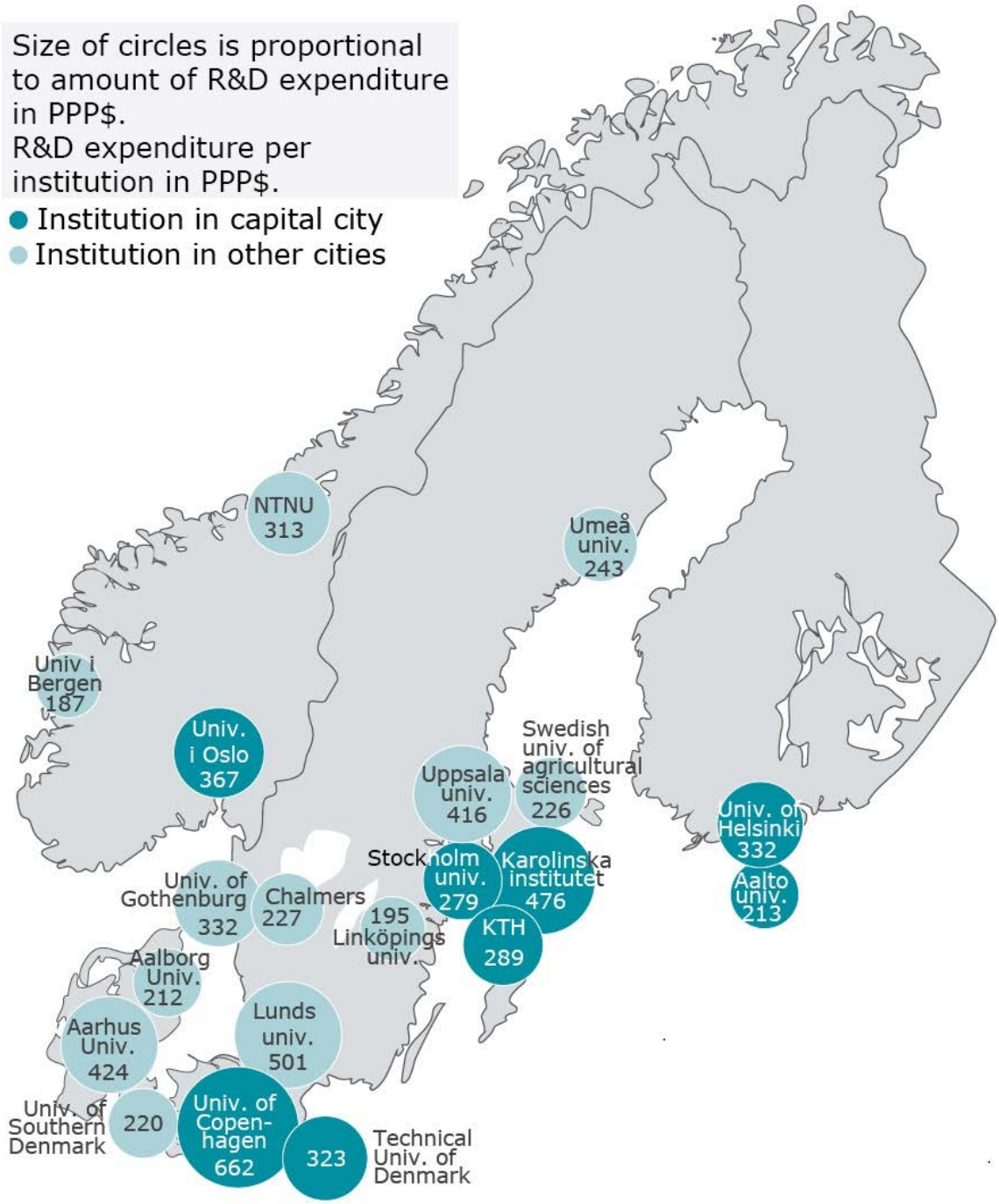
**Size of R&D performing units in Nordic countries HES varies**

The size of the R&D performing units in the Nordic countries HES varies a lot. In Figure 4 the 20 largest institutions are presented. The largest institution is the University of Copenhagen with 660

[14] Solberg et al. (2012): 29.

million PPP$ in R&D expenditure in 2013. Then follow three Swedish higher education institutions: Lund University, Karolinska Institutet and Uppsala University. The largest Norwegian institution is the University of Oslo with almost 370 million PPP$ at place number 6. At place number 8 the largest Finnish institution is found: the University of Helsinki at 330 million PPP$.

**Figure 4** **Higher education R&D expenditure (HERD) in the Nordic countries by 20 largest institutions: 2013. Mill. PPP$.**




*Note that for Sweden university hospitals ALF-funds are excluded at their university institution. In the ordinary R&D statistics for the sector, these funds are included in HERD.*
Source: National R&D statistics

Among the 20 largest R&D performing institutions measured by PPP$ we find 10 Swedish, 5 Danish, 3 Norwegian and 2 Finnish units. See appendix Table A.4 where more details on R&D expenditure among Nordic higher education institutions are presented.

**Largest concentration in Denmark**

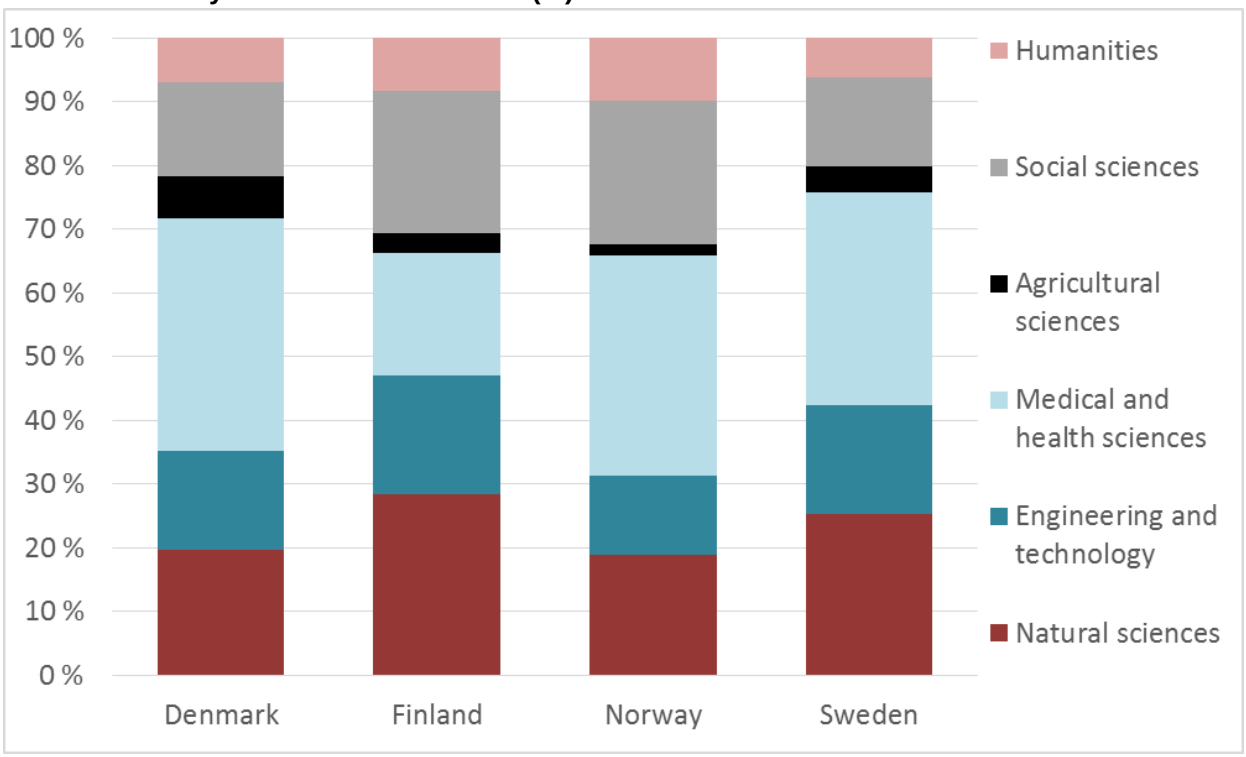
In Denmark, R&D expenditure is more concentrated than in the other countries; the 3 largest R&D performing units stand for 55 per cent of total R&D in HES, the 5 largest institutions for as much as 73 per cent. This large concentration is a result of merging processes where institutions from especially the Government sector have been integrated at the university level.

In Norway, there is also a relatively large concentration. The three largest HEIs represent 50 per cent of total R&D expenditure. With the forthcoming reforms this share will even increase. In Finland and Sweden, the three largest institutions stand for about 40 per cent of HERD expenditure. When it comes to the five largest institutions, the share differs between 56–61 per cent for Sweden, Finland and Norway. See also the blue box in Chapter 4 presenting the higher education institutions of the Nordic countries.

## 2.4 HERD by field of science and technology (FOS)

R&D statistics of the Nordic countries contain information on field of science (FOS) for R&D expenditure in the HES. According to the current FOS classification of the Frascati Manual (2007) there are 6 FOS; Natural sciences, Engineering and technology, Medical and health sciences, Agricultural sciences, Social sciences and Humanities. Below this level the OECD also defines a 2-digit level, but not all countries report on this, and some have also a 3-digit level for national use. As shown in Figure 5, there are some interesting variations in the academic profiles of the countries. At the end of this section, country information on how FOS is calculated is presented.

**Figure 5** **Share of higher education R&D expenditure (HERD) in the Nordic countries, by field of science: 2013. (%).**




*Source: OECD R&D statistics and national R&D statistics*

**R&D within medical and health sciences is strong in Denmark, Norway and Sweden**

All countries have a relatively high share of research within medical and health sciences, a third or more of total R&D expenditure in HES. Here, Finland stands out with a lower share (19%). Denmark has a high share of agricultural sciences at 7 per cent, while the other countries have a share from 2–4 per cent.

When it comes to the natural sciences and technology, Finland had the highest share in 2013 (47%), followed by Sweden, Denmark and Norway. The share of natural sciences is particularly high in Finland at 28 per cent.

Investments in R&D within humanities are between 6–10 per cent. When it comes to the social sciences, Finland and Norway invest most at 23 per cent and 22 per cent respectively, while Denmark and Sweden invest at 14–15 per cent.

**Over time medical and health sciences has increased most**

The changes between 2003 and 2013 are presented in appendix table A.3. Over time the largest changes have been within medical and health sciences. The share of R&D in medical and health sciences has increased in all countries except Finland where there has been a decline from 24 to 19 per cent of total HERD. The growth in medical and health sciences has been especially high in Denmark (9 percentage points), followed by Norway (6 percentage points) and Sweden (4 percentage points).

In Denmark, there has been a reduction in the share of HERD within the natural sciences and humanities from 2003 to 2013. Finland has had low growth within the natural sciences and social sciences. In Norway, the largest decline was in agricultural sciences and natural sciences. In Sweden there has been a shift within the natural sciences and engineering with an increase in the share of natural sciences and a decrease in engineering and technology.

**Differences in the national production of R&D statistics on field of science**

In Denmark, units are classified according to the 6 Frascati fields of science with some divergence: R&D data within the social sciences are collected without ‘psychology’ and ‘educational sciences’. Both are included in the humanities. Until 2002, university hospitals were included in the government sector, since then they are part of the HES, and medical R&D performed at the university hospitals contributed to the growth within this field.

In Norway, the information on field of science is based on answers from the R&D survey at the department level, and all R&D activity is classified to the largest FOS of the unit. Data are collected at 2-digit level with some national adjustments to the OECD codes.[15] FOS that are small within many departments will not be visible because of this. The actual level of agricultural sciences performed in the Norwegian HES would probably be higher with another methodology. The principle of the Norwegian Statistical Law of minimum three units of data for each published category might also influence the exact level of FOS.

In Finland, the FOS structure of a department is defined by fields of science at 2-digit level assigned to each employee based on their main R&D activity. Because each individual has only one science code, some interdisciplinary fields, such as biotechnology, tend to have low figures.

In the Swedish data, field of science is based on answers from the survey at the institutional level. Each unit allocates all funds (revenue for research and postgraduate education) among the six fields of sciences at a 3-digit level (2-digit in OECD classification) by source of funding. This level of detail

[15] A list of what is included in the Norwegian FOS can be found here: http://www.nifu.no/statistikk/om-fou/definisjoner-og-klassifiseringer/fagomrader/faggrupper-og-fagdisipliner/

makes it possible to present current costs by field of science and source of funding at the institutional level. In the survey regarding 2011, data were collected both according to the national classification of research fields and according to a new classification (Standard för svensk indelning av forskningsämnen 2011) which corresponds to FOS in the Frascati Manual.

These differences in methodology, especially regarding the level of information gathering, might influence the level of FOS in the Nordic countries even if all countries conduct the R&D statistics according to the broad Frascati guidelines. How much it is influenced is hard to tell as long as the existing background data and level of response rate are not the same in the Nordic countries.

## 2.5 Funding sources for R&D

The HES is an essential part of the knowledge society by educating personnel for all sectors of society. The sector also has an important role when it comes to addressing the grand challenges of our time. There is need for research funding based on specific themes and within specific areas, but on the other hand, there must also be scope for investigator-driven basic research that covers all the various disciplines. Research policy, and accordingly the funding system of a country's HES, is largely about striking a balance between these two principles.[16]

The R&D survey allows an international comparison of the R&D expenditure that comes from the different funding types. The different funding sources are presented in the blue box. High core budget funding, so called General University Funds (GUF), might imply a greater degree of academic freedom, while other funding schemes like funding from national research councils and sectoral funding sources (like ministries, regional sources) are more likely to come with some conditions on direction and strategy. During the last decades all Nordic countries have introduced a result component in their HES funding system.

**Funding sources in the Nordic higher education sector**

International funding sources for R&D collected by OECD and Eurostat are divided into categories based on R&D performing sectors. For the Nordic countries it is possible to disaggregate in Research council funding and sectoral funding as well. Regarding funds from abroad we look at total and EU funding.

Business enterprise: funding from the business enterprise sector units; private firms.

General university funds (GUF): special funding category for HES, incudes block grants, basic funding. In Nordic countries, mainly public funding.

Direct government: (project) funding from ministries, regional and other public authorities (research councils). In this study, direct government funding is split into research council funding and sectoral funding:

- Research council funding: Collected from national statistical sources.
- Sectoral funding: Direct government minus research council funding.

Higher education: funding from other institutions in higher education sector, own funds at the higher education institution, R&D income (revenue). In Norway, private GUF is included here.

Private non-profit (PNP): funding from PNP-sector, covering foundations.

Funds from abroad, subdivision in: Foreign business enterprises, Foreign enterprises within same group, Other business enterprise companies, Other national governments, Higher education, PNP, European Commission, International organisations.

Rest category: Not elsewhere classified

[16] Treuhardt (2012): 14.

**High GUF = high academic freedom?**

Basic funding might allow the institutions freedom of leadership and long-term-planning across different purposes. It secures basic research and scientific infrastructure and is a prerequisite for co-funding which is often required for competitive funding. Competitive research funding often implies major restrictions and is project based; which makes long term planning and prioritising challenging for the HEI.

On the other hand, as shown in a Danish study, competitive funding allowed researchers to use more of their time on research than researchers on basic funding.[17] The pressure on GUF for co-funding external projects also limits the freedom of GUF. Basic funding might also come with different instructions from the government when it comes to priority areas, e.g. the Norwegian consensus to prioritise research and education in the areas of natural sciences, technology, engineering (STEM). To what degree the institutions follow the instructions might be difficult to measure.[18]

There is an international trend among governments to consider knowledge, R&D and higher education as crucial for future growth and prosperity. During the last couple of years, public finances have come under pressure. For R&D expenditure, a long period of growth ended in autumn 2008 with the economic recession.

In Europe, there are currently intense discussions, proposals for change and reports involving higher education and research. Some keywords are resource allocation, career structures, organisational autonomy and internationalisation. This can be considered as an increased importance of higher education and research and more interest in governing knowledge and knowledge production.[19]

R&D statistics provide one way of analysing the effects of the changes on funding structures and whether R&D funding has become more strategic in the HES. Thanks to the data provided by the national R&D producers we also have information on the level of research council and sectoral funding. But the degree of actual (academic) freedom of general university funds and the level of restrictions from the funding ministries is, as mentioned above, a difficult question, which lies outside the scope of this study.

**Table 5 Share of higher education R&D expenditure (HERD) in the Nordic countries, by source of funding: 2013. (%).**

| Funding sources | Denmark | Finland | Norway | Sweden |
|---|---|---|---|---|
| General university funds (GUF) | 57 | 42 | 67 | 45 |
| Higher education sector | - | 1 | 2 | 3 |
| National research councils | 11 | 28 | 15 | 15 |
| Sectoral funds | 12 | 10 | 7 | 16 |
| Business enterprise sector | 3 | 5 | 4 | 4 |
| Private non profit | 11 | 4 | 3 | 10 |
| Funds from abroad | 8 | 10 | 3 | 7 |
| *Of which EU* | *4* | 8 | *2* | *5* |
| Totalt | 100 | 100 | 100 | 100 |

Source: Nordic R&D statistics

**Highest GUF-share in Norway, lowest in Finland**

Table 5 shows distinct variations of the funding structure in the four Nordic countries. Norway stands out with the highest share of core budget funding (GUF). This has been the situation over time. Since 1993 the share of GUF has decreased significantly among all Nordic countries except Norway. In

[17] Finansministeriet (2009): p. 6.
[18] Langfeldt, Liv m.fl. (2014): Satsing på matematikk, naturvitenskap og teknologi (MNT-fag): Hvordan følges de politiske føringene opp ved universiteter og høgskoler? NIFU-rapport 33/2014.
[19] Wedlin, Linda (2011): p. 3.

Norway, GUF and funding from the national research council together amounts to 82 per cent; the share was 68 per cent in Denmark, 70 per cent in Finland and 60 per cent in Sweden.

**Limited funding from business enterprises in Nordic countries, large private funds in Denmark and Sweden**

Funding from the business enterprise sector is low among the Nordic countries; between 5 per cent in Finland and 3 per cent in Denmark. For the OECD total, the share is 6 per cent and for EU 28 6.4 per cent. Private funds amount to 11 per cent in Denmark and 10 per cent in Sweden, while the shares are lower in Finland and Norway with 4 and 3 per cent respectively.

In Sweden, the Wallenberg foundation, Cancerfonden and the Swedish Foundation for Humanities and Social Sciences (Riksbankens Jubileumsfond) are major private contributors for HERD. Also in Denmark, private funds are a major contributor to HERD. The four foundations that have contributed most in recent years are Novo Nordisk Foundation Group, Lundbeck Foundation, the Velux Foundations and the Carlsberg Foundation.[20]

Funding from the HES itself consists of own funds and revenues, and accounts only for a minor share of total HERD – see the blue box on funding sources. Sweden has the highest share of this kind of funding at 3 per cent. In Denmark, this funding is not registered separately, but included in the category of sectoral funding.

**Finnish HERD has the highest share of funding from abroad**

When it comes to funding from abroad, the share is highest in Finland with 10 per cent of national HERD. Funding from the EU amounts to 8 per cent of this funding. Since 1997 Finland had as much as 4 per cent of total HERD from the EU; Denmark about 3 per cent from 1993, and Sweden had an increase from 1 to 2 per cent of total HERD coming from EU funding between 1995 and 1997. In Denmark and Sweden, funding of HERD expenditure from abroad constituted 8 and 7 per cent respectively in 2013, while in Norway only 3 per cent is funded from abroad. Over time, Finland has had a strong increase in funding from abroad. EU funding has been open to Norwegian researchers from 1994 as part of the EEA agreement and was registered in the R&D statistics from 1999. The level has never exceeded 1–2 per cent.

**Sectoral funds most important for R&D funding in Swedish HES**

Norway has the lowest share of HERD financed by sectoral funds with 7 per cent. In the other countries, the level is twice as high, and more in Sweden. In Sweden, sectoral funds consist of public authorities other than GUF and research councils. Included are Vinnova and regional, public funding and public research foundations. Vinnova is the Swedish innovation agency and is classified as part of sectoral funding in the national R&D statistics. Its Finnish sister organisation Tekes, the Finnish Funding Agency for Innovation, is classified as a research council. This clearly influences the numbers. Compared with the other three Nordic countries, Finland has a remarkably high share of HERD stemming from research councils, with 28 per cent. Finland's GUF share of funding is very low at 42 per cent, though in 2009 it was still 46 per cent. This is partly due to changes described in Chapter 2.4.2.

### 2.5.1 General university funds

Back in 1993, the GUF was clearly the most important funding source for R&D among all four Nordic countries, accounting for 67 per cent in Denmark and Norway and about 55 per cent in Finland and Sweden.

**Decreasing share of GUF**

The time series in Table 6 show that the level of GUF has decreased in all countries, except Norway as shown in Table 6. Most of the decrease took place during the first 10 years of the 1993–2013

[20] DEA (2012): Private fonde – En unik aktør i dansk forskning.

period, while the level has been more stable during the last ten years. In Denmark,[21] there was a clear drop from 2001 to 2003 of 9 percentage points. There was an increase of a few percentage points followed by a new minor decrease to 57 per cent in 2011 and 2013. In recent years, the development has been influenced by the restructuring of the research institutes that were merged into the universities in 2007: first some extra funding, then back to 'normal'.

In Finland and Sweden, the level of GUF was lowest among the Nordic countries in 2013, at 42 and 45 per cent respectively. Both countries have experienced a steady decrease in the share of this type of funding over the last 20 years. But while the Finnish level of GUF experienced a clear drop from 2009 to 2011, the GUF level has been more stable in Sweden over the last decade. The Finnish drop of GUF in 2011 can partly be explained by a new methodology of compiling these data as described in section 3.2.

**Table 6 The General University Funding's (GUF) share of higher education R&D expenditure (HERD) in the Nordic countries: 1993–2013 (%).**

| Country | 1993 | 1995 | 1997 | 1999 | 2001 | 2003 | 2005 | 2007 | 2009 | 2011 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Denmark | 67 | 67 | 69 | 68 | 67 | 58 | 60 | 59 | 58 | 57 | 57 |
| Finland | 55 | 57 | 50 | 46 | 44 | 45 | 45 | 44 | 46 | 40* | 42 |
| Norway | 67 | 70 | 68 | 69 | 65 | 64 | 64 | 64 | 66 | 65 | 67 |
| Sweden | 54 | 56 | 51 | 48 | 47 | 45 | 46 | 47 | 44 | 46 | 45 |

* Break in the time-series due to change in the methodology.

Source: Nordic R&D statistics

### 2.5.2 Research council funds

**Increased importance of HERD funded by research councils in Finland**

Finland has the highest level of research council funding among the four Nordic countries, as shown in Table 7. There was a leap in HERD funding by the Finnish Academy and Tekes in 2010 as described in the box below. This led to a higher level of research council funding from 2011. The share of HERD funded by research councils increased from 22 per cent in 2009 to 27 per cent in 2011 and 2013.

**Table 7 The research council share of the higher education R&D expenditure (HERD) in the Nordic countries: 1993–2013. (%).**

| Country | 1993 | 1995 | 1997 | 1999 | 2001 | 2003 | 2005 | 2007 | 2009 | 2011 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Denmark | 14 | 16 | 10 | 12 | 13 | 10 | 8 | 10 | 10 | 11 | 11 |
| Finland | 20 | 21 | 19 | 24 | 24 | 22 | 21 | 21 | 22 | 27* | 28 |
| Norway | 18 | 14 | 14 | 13 | 16 | 18 | 18 | 17 | 18 | 18 | 15 |
| Sweden | 13 | 12 | 10 | 9 | 7 | 8 | 11 | 11 | 12 | 14 | 15 |

* Break in the time-series due to change in the methodology.

Source: Nordic R&D statistics

In Norway, the level of research council funding decreased from 18 to 15 per cent between 2011 and 2013. Some of this is due to the termination of centres of excellence before new centres have started up.

The lowest share of research council funding of HERD among the Nordic countries is found in Denmark at 11 per cent in 2013. This has been the level during the most recent years.

In Sweden, there has been a steady growth in the share of R&D expenditure funded by research councils during the last ten years, from 7 per cent in 2001 to 15 per cent in 2013.

[21] In 2010 there was a methodological improvement in the data from a larger data provider in Denmark. This gives a higher level of externally funded R&D in the HES. With the same method in 2009, external R&D would have been about 200 million DKK higher.

An overview of the research councils' R&D funding in HES can be found in the box below. Vinnova, the Swedish innovation agency, is not included among the councils, but classified as sectoral funds. In contrast, in Finland and Denmark the more applied organisations like Tekes and The Danish National Innovation Foundation are included among the research councils. If Vinnova was treated as a research council in the R&D statistics, the share of research council funding in Sweden would rise from 15 to 18 per cent for 2013. In Norway, Innovation Norway (IN) does not fund R&D in the HES. IN is the Norwegian government instrument for innovation and development of Norwegian enterprises and industry, often with a regional profile.

**Research council funding of R&D**

The landscape of research councils differs among the Nordic countries. Here is an overview of the research councils included in the research council category of funding in the R&D statistics:

**Denmark**

Denmark used to have several applied, strategic and innovation related research councils, responsible for the promotion of strategic as well as applied research and innovation: The Danish Council for Strategic Research (DSF) supported both basic and applied research in fields of political priority. The aim of the Danish National Advanced Technology Foundation (HTF) was to create growth and employment in Denmark by supporting knowledge transfer from research institutions to the business community. The Danish Council for Technology and Innovation (RTI) was both an advisory body to the Minister for Higher Education and Science and an administrative body for initiatives handed to the council by the Minister. There has been a reorganisation of the research council structure in Denmark, which now consists of:

- The Danish National Innovation Foundation – the foundation for strategic research, advanced technology and innovation – established in 2014 by amalgamating the three mentioned research councils. The new foundation is responsible for implementing grants for research technology development and innovation, which are based on societal and commercial challenges and needs. An overview of the present Danish research council system can be found here: http://ufm.dk/forskning-og-innovation/rad-og-udvalg/oversigt-over-radssystemet

- The Danish national research foundation (Danmarks Grundforskningsfond) – an independent organisation established by the Danish Parliament in 1991 to supports the elite within Danish research within all scientific fields. The Center of Excellence (CoE) program is the main funding mechanism.

- The Danish Council for Independent Research (Det Frie Forskningsråd) – funds specific research activities based on researchers' own initiatives. Moreover, the Council provides advice in all scientific areas for the Danish Minister for Higher Education and Science, the Danish Parliament and the Government. It consists of five scientific research councils; Natural sciences, Social sciences, Technology and production sciences, Humanities, and Medical sciences.

**Finland**

There are two major research councils in Finland:

- Academy of Finland – with the mission to fund high-quality scientific research, provide expertise in science and science policy, support international scientific cooperation, grant funding for scientific research, researcher training and the development of framework conditions for research. This is an agency within the administrative branch of the Finnish Ministry of Education, Science and Culture.

- Tekes – the Finnish Funding Agency for Innovation – which finances both business research and development projects, and public research projects at universities, research institutes and universities of applied sciences. Focus areas are natural resources and resource efficiency, digitalism renewing business and industry, wellbeing and health, new business ecosystems and market access. Tekes allocates about a third of its funding to the HES.

Since the large university reform of 2010, all Finnish Academy researchers and professors became university employees, but they are still paid by the Finnish Academy. Earlier they were employed by Academy. Now all their labour costs are reported under Finnish Academy funding. This is an important reason for the leap between 2009 and 2010 figures. These labour costs were included in the statistics also earlier, but it is possible that they were not fully reported with all side costs.

**Norway**

- The Research Council of Norway (Norges forskningsråd) – since a merging process back in 1993 there has only been one research council in Norway, covering all fields of science and basic research as well as applied research and innovation. The Ministry of Education and Research and the Ministry of Trade, Industry and Fisheries are the most important contributors to the budget of the Research Council of Norway, but many ministries contribute to its funding.

**Sweden**

- The Swedish Research Council (Vetenskapsrådet) – by far the largest among the Swedish research councils with a leading role in funding basic research within artistic research, clinical therapy research, development research, educational sciences, humanities, social sciences, medicine and health, natural and engineering sciences. The Swedish Research Council also advises the government on research-related issues. Government agency under the Swedish Ministry of Education and Research.

- Forte – The Swedish Research Council for Health, Working Life and Welfare, funding basic and needs-driven research. Government agency under the Swedish Ministry of Health and Social Affairs.

- The Swedish Research Council Formas – a national research council with a mission to promote and support high quality basic research and need-driven research in the areas Environment, Agricultural Sciences and Spatial Planning. Government agency under the Swedish Ministry of Environment.

### 2.5.3 Sectoral funds

Sectoral funds are public funding other than GUF and funding from the research councils. Regional research funding is included in this funding source. To a large degree sectoral funding is targeted funding from the ministries. Also, the GUF funding may contain guidelines on thematic priorities, fields of subject or personnel groups that the government wants to promote, but sectoral funding is oriented towards more applied research than GUF funding.

**Table 8 The sectoral funds' share of the higher education sector R&D expenditure (HERD) in the Nordic countries: 1993–2013 (%).**

| Country | 1993 | 1995 | 1997 | 1999 | 2001 | 2003 | 2005 | 2007 | 2009 | 2011 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Denmark | 7 | 7 | 11 | 8 | 7 | 10 | 9 | 12 | 13 | 13 | 12 |
| Finland | 9 | 8 | 17 | 17 | 16 | 16 | 15 | 15 | 12 | 14 | 10 |
| Norway | 4 | 6 | 6 | 5 | 5 | 5 | 6 | 8 | 6 | 7 | 7 |
| Sweden* | 17 | 15 | 17 | 21 | 22 | 22 | 17 | 17 | 20 | 16 | 16 |

Sectoral funds= Total Government incl. regional funding minus GUF and Research Council.

*Funds from HES are included for the years 1993-2003.

Source: Nordic R&D statistics

In 2013, the sectoral funding share of HERD is lowest in Norway at 7 per cent, while Sweden has the highest share at 16 per cent, followed by Finland and Denmark. Over the years, the shares of Danish and Finnish sectoral HERD have increased most as they rose from 7 to 12 per cent and 9 to 14 per cent respectively. In Sweden, the 2013 level was lower than in 1993 while the level was higher in 2001 and 2003 at 22 per cent. As noted above, funding from Vinnova is included in the Swedish figures. Without funding from Vinnova the level would have been two percentage points lower.

**Funding structure in Norway less dependent on external funding?**

When we look at total private funding (business enterprise sector and private funds), Sweden and Denmark are at the top with 13–14 per cent, while Norway is found at the bottom at 7 per cent. When research council and sectoral funding is put in the same category (as they are both public funding), the level is highest in Finland and lowest in Norway. Funding from abroad is highest in Finland (10%) and lowest in Norway (3%).

Finland and Norway are in many ways the extremes: the R&D statistics indicate that the Finnish HES is more dependent on external funding, including funding from abroad, while the Norwegian HES still has a very high level of basic funding and is not obliged to seek external funding to such a degree.

Whether a high share of external funding gives more or less freedom of research is not clear. GUF funding often comes with signals of prioritising, while for some departments extra external funding can provide freedom to follow their own research interests.

# 3 Methodology of R&D statistics in the higher education sector (HES)

In this section, we present information on how HERD is compiled for the four Nordic countries.

R&D statistics measure retrospectively past activities based on the units' assessment of their conducted activities and available accounting data.[22] The 2013 data were published at the end of 2014/start of 2015.

The higher education sector is the most heterogeneous of the R&D performing sectors. While the BES, GOV and the PNP sectors have corresponding units in the Systems of National Accounts (SNA) this does not go for the HES. The sector has been separately identified because of the important role it plays in the performance of R&D. According to the OECD Frascati Manual, the HES consists of all tertiary level education units; from universities to small specialised, private colleges providing post-secondary education (OECD 2002, p. 68).

**Basic methodological questions**

The higher education institutions have tasks other than performing R&D – education, dissemination, administration, supervision etc. To isolate the R&D share is challenging and there are different ways to proceed depending on existing data and resources. All the statistical producers of R&D statistics must consider the following: should the statistics be based on survey data or public registers and administrative data, or a combination? How often should the data be produced? How is the share of R&D determined for full-time-equivalents and expenditure? How is GUF calculated? How is FOS breakdown calculated?

Generally speaking, all the Nordic countries' HERD statistics follow Frascati recommendations, but as a consequence of the heterogeneity of the sector the manual allows for several methods to produce R&D statistics of good quality; several ways may lead to this goal. There are some differences in how the Nordic countries produce the data that we will try to highlight in this section.

**Frequency and level of data production**

Finland and Denmark conduct a total R&D survey of the HES every year, while Sweden and Norway have a biannual survey. In the Nordic countries, some data are collected at individual level, some at

[22] Unlike GBAORD data that are available earlier as they measures the government intentions or objectives when committing money to R&D.

departmental level and some at institutional level. This varies from country to country and type of variables.

**Time-use survey**

The calculations of R&D coefficients to estimate the R&D share of the accounting data and personnel are crucial. The Frascati Manual recommends time-use surveys, but there are different methods for calculating this. In Norway, a time-use survey is conducted about every tenth year. In Sweden, the time-use survey covers R&D personnel employed in higher education institutions and conducted as part of the biannual R&D survey. In Denmark, the information stems from the R&D survey, and the information is based on very detailed employment categories depending on whether it is a university or university hospital. In both cases, the information is required for about 10 specific categories. In Finland, a new best-practice system based on university employer's time-registration is used since 2011. Prior to this, a time-use survey was used. A closer description follows below.

**R&D Survey and response rate**

As recommended in the Frascati Manual, all Nordic countries base their R&D statistics on a survey, but frequency, coverage and content of the questionnaires vary. The response rate of the survey is generally high in all Nordic countries; 100 per cent in Finland, mandatory and very high also in Denmark. In Sweden, the expenditure part of the survey has a 100 per cent response rate, while the time use/personnel survey has a response rate of about 60 per cent. In Norway, the response rate is about 80 per cent for the R&D survey.

**Variables**

For all countries, both R&D expenditure, R&D personnel (head-count) and full-time equivalents (FTE) are collected. Current costs are considered the best way of giving information on FOS, type of R&D and other generic technologies. This is because expenditures on land and buildings (and scientific equipment) tend to vary a lot from year to year. Denmark and Norway collect data on the share of basic research, applied research and experimental development, while Sweden and Finland do not collect this information.

In Sweden, income data and capital expenditures are collected and used as an approximation for R&D expenditure. Over years this probably gives a correct overall picture of resources for R&D, while for one funding source it may differ if a large project has been postponed and money transferred to the next year.

Table 9 sums up some of the main elements of each country's R&D methodology for HES in the four Nordic countries.

**Table 9 Overview of data and methods for producing R&D statistics in the HES in Denmark, Finland, Norway and Sweden: 2013.**

| Data and datasources | Denmark | Finland | Norway | Sweden |
|---|---|---|---|---|
| R&D survey | Every year at department level (about 600). Not prefilled with administrative data. | Annual survey (institutional level). In the universities external funding, own funding and investments are collected by a direct survey. The rest of the data are derived from the registers. Direct survey of all data from university clinics and polytechnics. | Every two years at department level (about 400). Prefilled with expenditure and personnel data from HEI administration. University hospitals surveyed every year as part of result-based-measurement-system | R&D survey consist of two parts: R&D expenditure survey (institution level, about 40) and time use survey (individual level). Both are conducted every two years. |
| Time use survey | Time use as part of annual R&D survey at department level | Coefficients from the time-use surveys until 2010. After that coefficients calculated from the time-monitoring or work-plan data of the universities. | Dedicated survey appr. every ten year at individual level (last from 2010). Some information only at institute level. | A time use survey is conducted every second year at individual level. The results are used to calculate FTEs. |
| R&D coefficient for a professor | No | 38 | 37 | 44, according to the time-use survey. However, no coefficients derived from the time-use survey are used to calculate R&D expenditure. |
| Administrative data | No use of administrative data | Extensive use of administrative data provided by The Ministry of Education and Culture, The Confederation of the Finnish Industries and Statistics Finland. | From HEI central administration. Expenditure data on type of cost and funding source. For prefilling R&D survey for large institutions, for control and completion of R&D survey data. | The Swedish higher education authority provides accounting data of revenues, depreciations and rents for research and postgraduate education. |
| R&D expenditure | R&D survey | R&D expenditure is calculated by using the R&D coefficients from the wage and accounting data. These are combined with the R&D survey data. | Based on administrative data on expenditure and results of time use survey R&D expenditure are calulated on FOS and type of expenditure (wages, other current costs, equipment and buildings). | Figures of revenues of research and postgraduate education by source of funds from Swedish higher education authority are prefilled in the questionnaire. R&D expenditures are derived by subtracting the cost of coursework in postgraduate education (non-R&D). R&D expenditure is calculated on FOS and type of expenditure (current costs and capital expenditure). |
| R&D personnel | R&D survey | Register of university personnel contains all the key information such as age, gender, title of the post, total work-time and FOS. | Key information on all personnel in HES is collected in a individual register of research personel, covers HES and GOV. | Derived from register of persons employed in HES. |
| R&D Full-Time Equivalents (FT | R&D survey | Calculated by appying the R&D coefficients into register data containing information on the total work time of the university personnel. | From time-use survey all HEI within all FOS has a unique R&D coefficient for groups of personnel. | Derived from register of persons employed in HES combined with the results of the time use survey. |

Source: National producers of R&D statistics

In this section we have also collected information on national characteristics in the data production. The information is based on information from the national R&D producers and on information extracted from the OECD metadata.

## 3.1 Denmark – production of higher education R&D statistics

Since 2007, Danish R&D statistics for all sectors have been carried out by Statistics Denmark (DST). Prior to this, The Danish Institute for Studies in Research and Research Policies (Analyseinstitutet for forskning)[23] was responsible for producing Danish R&D statistics. The change in statistical producer also implied that the response rate increased, as answering the questionnaire now became mandatory. There were also minor changes in accounting principles at this time. It is difficult to tell in what way the results were influenced by methodological changes. In publications from Statistics

[23] Now: Danish Centre for Studies in Research and Research Policy (CFA), part of School of Business and Social Sciences at Aarhus University.

Denmark it is stated that comparisons in time series before 2007 are difficult and should be done carefully.

In general terms, from 2007 HERD expenditure increased at the expense of the government sector. This is mainly due to large institutional changes and mergers between units in the government and higher education sector as part of large reforms in the Danish public sector. In other countries similar units will be counted as Government sector institutions, while in Denmark they belong organisationally to the universities after 2007.

When it comes to Danish HERD, it is also important to bear in mind that prior to 2003, university hospitals were included in the Government sector. This is important for time series on R&D expenditure and FOS data.

Salaries and social costs for personnel directly involved in R&D and personnel at the unit providing services for R&D are usually based on survey responses from the individual units asked as part of the survey. Salary costs for people indirectly involved in R&D at a higher organisational level are included as an 'overhead' in 'other current costs'. This is in line with the Frascati manual.

Ph.D. students who receive salaries or grants are recorded as a separate category and included in the data.

Capital expenditure data are reported in the survey and, when necessary, have been completed with information from annual reports, finance accounts, the Law of Finance, etc. The data are divided between buildings and other capital costs. Survey levels are institutes, departments and centers, totalling around 600.

Danish R&D statistics primary source of information is the R&D survey, which also contains elements of a time-use survey. Administrative data are not used in producing HERD.

## 3.2 Finland – production of higher education R&D statistics

The production of R&D statistics for the HES by Statistics Finland has several components. The methodology for polytechnics and university clinics is quite straightforward, as all the data are gathered by a direct online survey. As for the universities there are several data sources:

A direct survey conducted by Statistics Finland: external R&D funding, own funds used for R&D, R&D investments and the id-codes of the university personnel at the end of October of the reference year.

- The register of the university employees maintained by the Ministry of Education and Culture
- The register of wages obtained from the Confederation of the Finnish industries
- R&D coefficients based on the time-use monitoring data of the universities
- Accounting data of the universities compiled by the Ministry of Education and Culture

The register of the university employees includes the total person-years (annual work-time) at the individual level; OECD 2-digit field of science code assigned to all the employees involved in the R&D; the code of the post (e.g. professor, lecturer etc.); the code of the educational degree; and the department and its location.

Up to 2010, R&D share was based on the time-use survey of the university teachers and researchers. The extensive survey was repeated approximately at 10-year intervals. Coefficients were applied only to the personnel funded by the GUF. R&D FTEs of the external funding were estimated by the average wage.

The methodology of the coefficients was changed in order to better measure R&D in the new context after the university reform of 2010. As time-use surveys were deemed too expensive, new solutions were sought. It appeared that time-monitoring records of the universities could be a data source. The

quality of the new data was verified by comparing it to the old time-use data. The main difference with the new coefficients was that the proportion of the GUF is lower (a drop from 46% in 2009 to 40% in 2010). One reason for this might be that in the 'old' system the starting point was the proportion of research by a person funded by GUF (a civil servant), and that was 100 per cent allocated to GUF, while a part of the research might have actually been due to the external funding. In the 'new' system the starting point is total work time, out of which total R&D expenditure is calculated by the coefficients. Then, external R&D funding and university's own funds (survey data) are subtracted and what remains is GUF.

The R&D FTEs are calculated by applying the R&D coefficient matrix (main employment category x main field of science, e.g. professor x natural sciences) into the register of total annual person-years. By combining R&D share data into economic data (accounting and wages) the HERD is obtained. Breakdown by the field of science is calculated by allocating the funds at the department level and dividing this by field of science distribution of the employees. Uniform coding system of the individuals facilitates the linking of the different data sources.

For post-graduate students, calculations of FTE on R&D have been made to include only the person-years which have been paid with grants corresponding to a normal salary.

## 3.3 Norway – production of higher education R&D statistics

In Norway, the Nordic Institute for Studies in Innovation, Research and Education (NIFU), carries out R&D statistics in the higher education and government sectors, while Statistics Norway is responsible for the business enterprise sector. This has been the situation since 1991, prior to which the research councils were involved in the production of R&D statistics. NIFU (earlier as part of one of the research councils) has been involved in the production of R&D statistics since its start in 1963 with large stability in personnel resources.

NIFU also carries out R&D statistics for health trusts and, among these, university hospitals. From 2006 university hospitals are surveyed as part of the health trust resource measurement system; before 2006 as part of the HES survey. The new system gives a higher response rate as it is part of the institution's own system, but the information on FOS is less detailed. Because of the new methodology and because of targeted efforts from the ministry, medical and health sciences have increased rather strongly in the Norwegian HES over the last years. The Norwegian data in this presentation of Nordic R&D statistics comply with international standards for compilation and classification.

All departments/institutes in the HES receive a 4/5 page web-questionnaire every two years. Questions regarding professional activities are included (FOS at 2-digit level, share of basic research, generic technologies), as well as questions on R&D share of external funding and GUF current expenditures as well as funding of scientific equipment investments. Respondents are also asked to add/control prefilled data provided by administrative data of the HEI regarding R&D personnel; researchers and support staff as well as accounting data.

NIFU updates its register on research personnel annually by the end of October with information from the HEI administrations. The register contains all HERD personnel and includes individual information on age, gender, position, department and field of science. This register is central to the calculations of R&D personnel, and GUF.

A time-use survey is conducted about every ten years. Tenured staff are asked to provide their average working time on different tasks: R&D, education, administration, supervision, external activities.

NIFU has contact with the administration at all HE institutions (about 50). They provide the data on personnel and accounting every year, i.e. expenditure by type of cost and funding source for each

department/institute from their central registers. Depreciations are, according to the Frascati Manual, not included in statistics. NIFU receives information on where these expenditures occur in the accounting data, or they are already excluded by the HEI administration.

Data on new building projects in the HES are received from the agency responsible for this in Norway (Statsbygg), and the budget propositions of the ministries. FOS and R&D coefficients of these investments are calculated by NIFU based on future use of the building (library, laboratory, education, research etc.). In Norway, the four 'old' universities mainly own their own buildings, while the new universities and the state university colleges pay rent. This makes comparison of R&D expenditure at institutional level challenging.[24]

The quality control of R&D questionnaires is an important part of the work on the statistics. In total about 400 units (institutes/departments/centres/university hospitals) are surveyed and included in total HERD statistics.

Every second year (the year that is not surveyed) main figures are calculated based on information from the register of personnel, wage inflation and information on new building projects.

## 3.4 Sweden – production of higher education R&D statistics

The Swedish Higher Education Authority provides Statistics Sweden with accounting data from all HEIs in Sweden. These data include, for each HEI (about 40), revenues for research and Ph.D. training for different sources of funding. Where a HEI has no such revenue, that institution will not be included in the R&D survey. The accounting data also includes depreciations and rents for research and Ph.D. training.

A questionnaire is sent to each HEI where the figures from the Swedish Higher Education Authority are prefilled for each source of funding. Also, depreciations and rents for research and Ph.D. training are prefilled. The HEIs are asked to distribute the revenues on the field of science (3-digit, 2-digit in OECD classification), prior to 2013 for each faculty. They are also asked to report capital expenditure for research and Ph.D. training, prior to 2013 by faculty and from 2013 by fields of science (1-digit). Depreciations and rents (information about rents is not used since it is a part of the revenue) should also be distributed, prior to 2013 among the faculties and from 2013 by FOS (1-digit). The depreciations for research and Ph.D. training are subtracted from the revenues for research and Ph.D. training for each field of science and prior to 2013 by faculty, from 2013 by institution.

In the next step the cost of Ph.D. training (courses) is excluded from the revenues, since this is not R&D according to the Frascati Manual. The cost of Ph.D. training is estimated with information from the register of Ph.D. students in Sweden. The register contains information on Ph.D. students for each HEI, including field of science and type of employment (scholarship etc.). The course work is assumed to be 37.5 per cent of the total Ph.D. education. This cost is excluded from the revenues of research and Ph.D. training.

The revenues of research are assumed to correspond to the current costs of R&D. The cost of Ph.D. training is also excluded from the capital expenditure to get capital expenditure for R&D. To estimate the R&D expenditure the current costs of R&D are added to the capital expenditure of R&D.

The county funds large parts of its R&D activities in the university hospitals under the Agreement on Medical Training and Research (ALF). ALF-funding is compensation that the state pays out to cover additional costs such as clinical research and education. ALF-funding is collected both in the government and the higher education sector. In order to ensure that these funds are not double counted, they are removed from the GOV in international figures.

[24] Possible differences between cost at institutions that own their buildings and those that pay rent is a topic that receives international attention in the Frascati revision process.

Sweden has nationally often reported current costs as R&D expenditure; but as capital expenditures are included proportionally in international reporting, this does not influence the figures in this working paper. From 2013 this can also be calculated for national numbers.

# 4 Funding systems of Nordic higher education sectors (HES)

There have been several major changes to the European HES over the last two decades. Many of them are connected to the autonomy (organisational, academic, financial, control/reporting) of the sector (Kunnskapsdepartementet 2015: 76). The autonomy is influenced by the increased possibility to decide on internal distribution of external and internal funding. However, the autonomy has often been followed by increasing accountability measures as the institutions must report on results along different criteria. It is hard to measure the real impact of these mechanisms (Langfeldt et al. 2014).

**Higher education institutions (HEI) performing R&D in Denmark, Finland, Norway and Sweden**

There is today no internationally recognised definition of the different types of institutions that belong to the HES, and the definition of a university differs from country to country. Here is a short presentation of the institutional landscape of the HES in each of the Nordic countries.*

Denmark: 37 HEI – 8 universities, 7 professional colleges, 9 business academies, 5 university hospitals and some small institutions within the marine and artistic areas. Universities shall perform research and offer education at bachelor-, master-, Ph.D.-level. Colleges offer profession oriented-bachelor and foundation courses.

Finland: 45 HEI – including 14 universities, 5 university clinics, 26 polytechnics (universities of applied sciences) as of 2013.

Norway: Close to 60 HEI – 8 universities, 18 state university colleges, 5 specialised university institutions, 2 artistic colleges, about 20 private colleges and 6 university hospitals. The universities offer a broad range of education. The specialised university institutions offer education and research within specific areas; music, archeology, sports. The state university colleges provide mainly professional bachelor, but increasingly also master degrees and some also Ph.D.

Sweden: Almost 50 HEIs – In 2014, there were 16 universities (2 private), 14 university colleges (1 private), and 5 specialised university colleges in fine arts (1 private). There are also 13 private specialised educational providers. Of all HEIs, about 40 have revenues for research and postgraduate education. Due to the Frascati definition of HES, one government research institute is also included in the sector.

* Partly based on Kunnskapsdepartementet (2015): p. 160.

Results-based funding systems have been introduced in most western countries during the last 15-20 years and all of the Nordic countries have adopted elements of this in their current system of funding. The Nordic countries are among the few in the world that do not have tuition fees, which could have increased their autonomy, but this has so far been regarded as noncompliant with the Nordic welfare model. In Denmark (2006) and Sweden (2011), students with citizenship of countries not within the EU/EEA, or Switzerland, are required to pay application and tuition fees for university studies. This new system has led to a large reduction in applications from international students.This section gives a short presentation of the HES funding system of each country.

## 4.1 Denmark – HES funding system

In Denmark, a number of significant changes in recent years have been influencing the funding system and other aspects of HES. In 1993, the funding system was transformed in two important ways: 1) No more detailed steering of the universities' budgets, the institutions were given full sovereignty of their budgets and no split in funding for education and research. 2) Funding of education was based on student production.[25] From 2003 to 2007 there were small changes in this funding system, based on three components: 1) The taximeter principle, linked to number of students. A number of stakeholders wanted improvements. In particular there was a problem with actual taximeter-rates (total cut, balance and rationale). 2) Basic grants are the second component, of great importance in ensuring long-term planning and important for quality and outcome of basic research, but lack of performance parameters and large share for co-funding external projects, actual free funds more limited. 3) External research grants are the third component, with problems with competition and areas that are too narrow.[26]

Relatively many research councils and foundations were funding Danish research up until 2013/2014. The high number of research councils and foundations have been established over many years to support specific political and academic priorities. This made unified and flexible prioritising difficult. The Government wanted to develop a more simple and flexible system.[27] As a result of merging processes also at research council level, there are today only 3 research councils – see also the blue box on Research council funding in this working paper.

Today there is still a taximeter principle based on education activities, basic funding from the government and based on a distribution model of 4 parameters with weights: educational activities (45%), research funded by external sources (20%), scientific publishing (25%), Ph.D. production (10%). This is meant to support the universities' abilities to employ scientific personnel in line with student growth. They receive the taximeter funding for education and basic research funding as a block grant and can freely use them within applicable rules. Two per cent of university funding is kept for redistribution, inspired by the so-called Norwegian Model. As discussed earlier in this study, there has in recent years been a shift in the size of the HES and GOV sector. The HES has increased due to mergers between units in the two sectors. The funding system has become a management tool for the government and is actively used to achieve three goals: quality, concentration and synergy.

From 2006 to 2010, Aagaard (2011) describes three changes in the HES funding; the shift from basic to external funding, from free research to strategic research, and from smaller to larger grants. An overhead reform on public money was also introduced to try to compensate for increased external funding. Basic funding has increased, but is at the same time met with more demands regarding priorities, among them co-funding, third mission activities, fusion expenses, indirect costs of external funding, local strategic claims, claims in development contracts and of course administration, research and education.[28] As seen in the study by Langfeldt (2014), the exact amount or share of conditions on

[25] Finansministeriet (2009): p. 32.
[26] OECD (2006): p. 2.
[27] Regjeringen (2012): p. 12.
[28] Aagard (2011): p. 403.

basic funding are hard to measure. R&D statistics can only follow the money at aggregated or starting point level.

## 4.2 Finland – HES funding system

The Finnish HES has gone through major changes over recent decades and has gained more independence. There are some historical reasons for the changes. The strong level of natural sciences and technology goes back to a political decision at the time of the 1990s crises. The Finnish Government planned the development of the country's economy after the collapse of the Soviet Union and chose to follow the Nordic welfare state model. The key to this policy was to determine national strengths of the economy. The government invested in the knowledge economy through an extensive funding programme in the fields of technology and knowledge-based industries. In line with these decisions, the importance of higher education increased.[29] Information and communication technologies (ICT) and innovation became increasingly important. The development is also reflected in the strong growth of R&D expenditure. From the end of the 1980s and onwards, the autonomy of the Finnish HES increased – an OECD report with criticism of the relationship between the Government and the HES contributed to this process. The system that was developed was also recognised by increased accountability around outputs, results, quality and evaluation.

The second half of the decade brought in exceptionally rapid growth of R&D along with the economic recovery. The proportion of R&D expenditure in GDP rose from 2.2 per cent in 1993 to 3.4 per cent in 2000, reflecting the change in the economic structure led by the electronics industry. The growth of R&D investments was not driven only by industry. The level of central university resources was guaranteed by means of the specific act up to 2000 (Science and Technology Policy Council of Finland (1996)). The role of competitive funding (mainly Tekes and The Academy of Finland) increased. Also new programmes, such as centres of excellence and graduate schools were launched.

The next decade witnessed a fairly steady growth in R&D expenditures. The themes were globalisation, innovation and linkages between academic research and enterprises (Science and Technology Policy Council of Finland (2003)). One concern in the STI policy was that in the international comparison the high level of the R&D investments in Finland did not produce a correspondingly high level of commercial applications. At the same time, the scientific output as measured by articles and citations was at the average OECD level, but lagged behind the other Nordic countries (The Academy of Finland (2009)).

In recent years, Finnish universities have been reformed to meet competition at international level. The legal status of the universities changed with the Universities Act of 1 January 2010, and the Government has made significant additional investments in the universities which provide opportunities to expand their funding base and develop their own policy regarding human resources (The research and innovation council of Finland 2010: 36). The university reform of 2010 made the universities independent legal entities. The government is still the main funder, but the universities have full financial liability. However, the government funding is more and more based on performance (Ministry of Education and Culture (2011)).

The Finnish Research and Innovation Policy Guidelines of 2011 stated that the number of universities in Finland was too high, giving the education and research sector a fragmented nature. By reducing the number of units, eliminating duplication, adjusting intake to size of decreasing age cohorts, it hoped to release large resources. There was also focus on the time needed to complete studies, strengthening priority areas and profiles of HE institutions, conditions for research careers, research environment; and new models for financing universities and polytechnics were announced. The Finnish HES consists of a dual model; universities and polytechnics. There was a need to clarify and

[29] Pillay (2010): p. 33.

strengthen status of polytechnics to meet regional needs and support strong cooperation between them.

From a situation where Finland had one of the world's highest R&D-GDP ratios the most recent development has been a sharp decrease of R&D expenditure after 2011. This goes along with a very modest increase in GDP. The HES continued in the growth path by increasing R&D expenditures by more than 40 million euro in 2012, but in 2013 there was a 36 million euro decrease in HERD.

## 4.3 Norway– HES funding system

The present funding system for the Norwegian HES was introduced in 2002. One part of the funding system involves a component of research incentive developed by the Norwegian Association of Higher Education Institutions (UHR) and the Ministry of Education and Research. The research component is based on different indicators of results: publications, production of Ph.D.s., and funding from the EU and the Research Council of Norway. The system of publications is rather unique as the institutions themselves participate in the process of choosing scientific journals. This information is presented at CRIStin (Current Research Information System in Norway). The redistribution of funds includes less than 2 per cent of total basic funding. The HE institutions are free to make internal resource allocation of these funds.

Funding is allocated as an annual block grant to each institution and is neither divided into cost categories nor in research or education. How much is spent on research activities can vary widely between institutions, but is mainly a consequence of the payoff from the funding model. Funding is considered an important management tool and is composed of a combination of criteria such as historical allocations, priorities in the state budget, and performance-based payoff on selected indicators.

Today's block grant includes both long-term and strategic elements and is based on specific priorities over time for the various institutions and the performance-based payoff for research and educational components. The aim of the scheme is to stimulate better results, and the payoff is supposed to be neutral between institutions and disciplines. The criteria should be objective and measurable. It is a challenge that the indicators measure quantitative sizes, while it is aimed at achieving quality. Another challenge is to apply one system to all disciplines and institutions.

The research incentives are calculated on the basis of the institutions' performance. Today it is a closed budget, i.e. high return for one institution will be 'taken' from another institution. Education incentives have an open budget. The educational incentives intend to reward institutions that provide quality education, i.e. getting students to complete within the prescribed time, and international student exchanges.

In Norway, there are two important political processes going on that will both have significant consequences for the HEI; a structural reform and suggestions for a new funding system. In 2014 the Government ordered a review by NIFU/Deloitte on how the higher education institutions (HEI) distribute their resources to different core activities and specific educational tracks (Reiling et. al, 2014). The review of accounting data found that there are differences in how much funding the HEI receive, and what they receive seems to control what they spend. The review found no evidence of economies of scale. Large institutions are hence not necessarily more cost-effective with increasing numbers of students. The expenditures are linked to roles and types of institutions, budgetary limits due to historically grants, and political priorities.

In connection with the new White Paper on structural changes in the Norwegian HES, published in March 2015, the government also ordered an expert review of the HES funding system within the existing budgetary limits (Kunnskapsdepartementet, 2015). The Norwegian HES has many small institutions that have become more alike, partly because of more standardised funding incentives. The government called for more differentiation, division of labour and clearer institutional profiles. The

government mandate for a new funding system regarding research was that it should increase quality at all levels including world-leading groups, and strengthen international cooperation, innovation and breakthrough research. The expert committee review of the Norwegian funding system for HES did not recommend a completely new system, but some adjustments to the present one. It recommended a rather generous block funding at about 70 per cent where the institutions themselves still can make priorities on education and research, results-based funding linked to publishing (greater emphasis on top level journals), assessment on whether citation can be used as an indicator, stronger incentives on EU and ERC funding, and international mobility of staff. The budget frame for research will be open (except for publishing). The feedback[30] from the HES is rather positive about the new suggestions as they imply stability of a system that has been considered rather well-functioning. The state university colleges and new universities are more interested in opening up the block-funding part for reallocation than are the old universities. External views are positive about the suggestion of linking a small part (5%) of block-funding to agreements between the Ministry of Education and Research and the HEIs on development, quality, and profiling to meet business and societal needs.

As shown in chapter 2.4, Norway is prominent with much higher public funding than the other Nordic countries. This has probably several explanations. The Ministry of Education and Research (Kunnskapsdepartementet, 2015) highlights the lack of large commercial funding sources and the large industrial-technical institute sector that perform a larger part of the research funded by the BES. The R&D statistics show that none of the Nordic countries have more than 3–4 per cent of their R&D funded from the BES, so the difference between Norway and the other Nordic countries are stronger regarding private sources like foundations and private donations than for enterprises.

The relatively generous block funding is probably not stimulating engagement in the search for external funding sources. HES involvement in applications to the EU framework programme shows (for 2008 and 2010) that in Norway the HES was involved to a much lesser degree than Denmark and Sweden, while the research institutes had a larger share of applications in both Norway and Finland (NIFU, 2012: 73).

## 4.4 Sweden – HES funding system

The Swedish GUF is split into two different funding streams: one for undergraduate and graduate levels and one for research and postgraduate education. The institutions also have to report back to the government based on these two categories of funds. Between the late 1990s and the beginning of the 2000s the HES in Sweden experienced an expansive phase where revenues for both research and postgraduate education and undergraduate and graduate levels increased. Revenues during the years 2002 and 2008 remained relatively stable, but with some variation between a few years. For example, since 2009 revenues for research and Ph.D. training have increased while revenues for undergraduate and graduate levels have been quite stable, except for a temporary increase 2010–2011. This means that the Swedish HES has become more research-intensive during recent years.[31]

Higher education institutions receive the grant for education at the undergraduate and graduate levels based on the number of students and their university credits. The grant is paid per full-time student and full-year performance. Full-time student is defined as the total number of students in terms of the number of full-time students, i.e. 40 weeks of study per year. The number of annual performance is the students' overall academic performance, expressed as the number of completed 40-week studies. The Government decides on a cap that sets the maximum compensation a university or college can receive each year. The compensation for full-time students and annual performance differs between different educational areas, such as social sciences, medicine or theatre.

[30] Kallerud has analysed the submissions on the new funding system (2015: p. 10–11).
[31] Higher education in Sweden – 2013 status report, p.48. http://www.uk-ambetet.se/download/18.1c251de913ecebc40e780003405/annual-report-2013-ny.pdf. And 2014: http://english.uk-ambetet.se/download/18.7ff11ece146297d1aa65b4/higher-education-in-Sweden-2014-status-report.pdf

Funding for research and postgraduate education was previously allocated to institutions based only on historical allocations and political decisions. For example, in the late 1990s, some colleges were awarded the entitlement to award doctoral degrees and received extra state funding. Nowadays, there is no such connection between the entitlement to award doctoral degrees and funding.

As a result of the two last research bills, state funding for research has risen considerably and will continue to rise. The Swedish government decided upon a new system in 2009, where a part of the government grants for research and Ph.D. training should be distributed according to quality indicators.[32] The new system affects both new and existing funds. New funds were allocated according to the model, and 10 per cent of the existing grants are distributed according to the indicators. Since 2014, 20 per cent of existing funds are reallocated according to the new model. The quality indicators consist of two parts: publications and citations and external funds.[33] Art colleges and the National Defence College are not included in this system. About 1.5 billion SEK has been distributed according to this model, between 2009 and 2012.[34] In 2013, the Swedish Research Council was assigned the task of developing a new model for resource allocation to the HES that involves peer review regarding the quality and relevance of research.[35]

The Government and Parliament have linked the quality-based resource allocation to the Swedish higher education authority (Universitetskanslersämbetet, UKÄ) evaluation system. It is, in other words, outside the actual evaluation system. The quality-based resource allocation includes training organised by state universities and colleges, and also Chalmers University of Technology and University of Jönköping which are private. But this system was only in use from 2009–2012 and consisted of only 1.5 per cent of the total grant. From 2016, there will be a new quality assurance system.[36]

[32] Regeringens proposition: Ett lyft för forskning och innovation (2008/09:1, bet. 2008/09:NU1, rskr. 2008/09:98)
[33] The indicator for publications is measured as a HEI's total number of publications as a share of the total number of publications by Swedish HEIs. The citation indicator is the total average citation for a HEI. The average number of citations is measured as the number of citations of an article divided by the average number of citations for articles in the field of science. See also Flodstrøm, Anders (2011): p. 77.
[34] Regeringens proposition, Forskning och innovation (prop. 2012/13:30, bet. 2012/13:UbU3, rskr. 2012/13:151).
[35] Regeringens proposition, Forskning och innovation (prop. 2012/13:30) p. 61.
[36] Utbildningsdepartementet (2015): *Kvalitetssäkring av högre utbildning*, Promemoria U2015/162/UH.

# 5 Concluding remarks

Like most European countries the Nordic countries now have a funding system of R&D in HES, based on a combination of basic funding and competitive funding. The trend has turned from input-oriented management and funding towards result orientation, autonomy and market dynamics.

**How has R&D funding developed in the Nordic countries' HES?**

Among the Nordic countries, public funding and especially basic block grant funding – GUF – plays a major role. Over the last 10–20 years, external funding has gained increased importance in funding HERD. In Norway however, the relative share of external funding is lower than in the other Nordic countries. Relatively generous Norwegian GUF funding is not stimulating attempts to seek external funding from the EU. Changes in the funding system that reward EU/ERC-funding are underway. At the same time basic funding is more result-based. In general, funding comes with more conditions, and these trends are affecting a larger part of R&D today compared to the situation twenty years ago.

**Size of university hospital R&D**

The university hospitals are according to Frascati guidelines a part of HES. Their share of R&D expenditure is much higher in Denmark and Norway than in Finland and Sweden. Their share of HERD is also influenced by national characteristics. In Denmark, the hospital sector is under the responsibility of the five regions, and all major hospitals, with respect to R&D performance, are according to the regions classified as university hospitals, which may partly explain the high share of R&D. In Norway, reforms in the hospital system led to more focus on R&D in the new so-called health trusts and also to more funding of research from the Ministry of Health and Care. The system of reporting R&D also changed from 2006. In Sweden, the share of university hospitals almost doubles when total funding is attributed to the R&D performing institutions, but still the share is half of the level of Denmark and Norway. In Finland, government budgets for the R&D at university hospitals have experienced large cuts in recent years; this is reflected in a relatively small share of R&D at Finnish university hospitals and in medical and health sciences.

**Research council funding – Innovation agencies**

There are differences in the national research council structures in the Nordic countries and in what the national producers of R&D statistics classify as a research agency. In Norway, there is only one research council that also includes funding for innovation, while the Norwegian Innovation agency is not involved in HERD funding. Denmark, Finland and Sweden all have several public institutions funding R&D in HES; research councils and innovation agencies as well. In Sweden, Vinnova is classified as providing sectoral funding, while its Finnish counterpart Tekes is classified as a research council. This influences the statistics and can be indicated in this working paper, but in studies using international data from OECD MSTI and Eurostat they are both included in the category 'direct

government'. In Finland, the Research council funding increased clearly from 2010. This is partly due to organisational changes, but also based on the policy to promote competitive funding.

**Private funding**

Business enterprises contribute to a small share of HERD in all Nordic countries. But when it comes to private foundations, Denmark and Sweden have a much higher share of this funding than you find in Finland and Norway. In Denmark and Sweden, the Lundbeck Foundation, the Carlsberg Foundation, Wallenberg Foundation, and Riksbankens Jubileumsfond, might be considered strategic research actors, with similarities to public research councils.

**Methodology matters**

The cooperation among the Nordic R&D statistical producers is important to ensure real comparability of the R&D statistics and indicators used for policy management. The cooperation has made it clear that all countries put efforts in producing high standard R&D statistics and in meeting the international recommendations of the OECD Frascati Manual. The data produced are probably the best possible statistics based on existing data and resources. To a large degree national characteristics are eliminated in international reporting of the statistical data.

**Policy recommendations**

The recent years of cooperation between the Nordic producers of R&D statistics on statistical methodology has increased mutual understanding on how R&D statistics are compiled. However, these methods are constantly revised and developed in each country and according to international developments. In order to decrease divergence, continuing cooperation within the field is necessary. A permanent Nordic funding of this cooperation to ensure that all statistical offices can participate at annual meetings and joint developmental work is highly important.

Discrepancies in the HERD statistics are more visual when aggregated data are broken down by funding source, field of science and type of institution. These discrepancies also emerge when different statistical numbers are combined: publications, full-time-equivalents and R&D expenditure. Detailed statistics are the most challenging to produce, but they are also the most interesting data and central to the development of S&T indicators. As politics is more indicator-based, the importance of their quality increases.

One example that needs a closer look is the high level of R&D expenditure per FTE in Sweden, compared with low figures in Finland. The level in Denmark or Norway is not necessarily more correct. Investigating this more thoroughly requires a closer study of accessible data, resources and methods to produce both the numerator and denominator.

Other fields to look into in the future are characteristics regarding type of expenditure in the HES; labour costs, other current costs, land and buildings, instruments and equipment.

The Nordic work on the revision of the Frascati Manual has revealed that the Nordic HERD is comprehensive and based on dedicated surveys. This compared to other statistics based on desk work only or data collected only among top HEI administration with no contact to academic research level. It is possible to think that the Nordic countries could take an even more active role in international statistical work and cooperate on common positions to contribute to high quality R&D statistics.

First, a closer Nordic cooperation on the production of R&D statistics may pave the way for further improvement of R&D-statistics production within the Eurostat and OECD countries, especially given the high quality and credibility of Nordic statistics. Second, the Nordic region constitutes in many ways an ideal framework for pilot studies and comparisons based on more sophisticated use of R&D-data. Such pilot studies are both directly relevant for Nordic R&D-policies, and indirectly for the international community as cases of comparative studies and examples of feasible development, use and refinement of comparative R&D-data.

To be able to act as forerunners in these areas, a permanent system of cooperation is essential. In addition to the already established informal cooperation between Nordic R&D statistics producers, a number of concrete initiatives could contribute to the further development of the cooperation, for instance:

- A common Nordic report on R&D statistics, issued (in English) for instance every second year
- A set of coordinated pilot studies, with the aim of exploring issues with high policy relevance and where existing data is insufficient for comparative studies
- Improvements of common web-page for communication and dissemination of Nordic R&D statistics, possibly also including news on R&D policy developments in Nordic countries
- An annual Nordic conference on trends and developments in Nordic R&D (and innovation)

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# Appendix

Table A.1 Shares of S&T resources in Denmark, Finland, Norway and Sweden 2011. Scientific publications 2013.

| Total | 2011 | 2013 | 2011 | 2011 | 2011 | 2011 | 2011 | 2011 | 2011 | 2011 | 2011 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | Inhabitants | Publications | R&D expenditure HES | R&D expenditure GOV | R&D expenditure HES + GOV | R&D FTE HES | R&D FTE GOV | R&D FTE HES+GOV | R&D head count HES | R&D head count GOV | R&D head count HES+GOV | PPP$ Expenditure FTE HES |
| Denmark | 5 569 | 15 795 | 2 188 | 151 | 2 339 | 14 065 | 1 220 | 15 285 | 26 580 | 20 628 | 47 208 | 156 |
| Finland | 5 388 | 11 811 | 1 579 | 699 | 2 277 | 11 964 | 4 630 | 16 594 | 22 993 | 18 538 | 41 531 | 132 |
| Norway | 4 953 | 11 931 | 1 589 | 833 | 2 422 | 9 760 | 4 601 | 14 361 | 21 812 | 12 601 | 34 413 | 163 |
| Sweden | 9 450 | 24 826 | 3 543 | 580 | 4 123 | 17 101 | 2 097 | 19 198 | 40 855 | 6 396 | 47 251 | 207 |
| Total | 25 360 | 64 363 | 8 899 | 2 263 | 11 162 | 52 890 | 12 548 | 65 438 | 112 240 | 58 163 | 170 403 | 168 |

Source: OECD MSTI 2014:1 and Thomson Reuters/CWTS Web of Science. Calculations: CWTS/NIFU.

Table A.2 R&D expenditure in the HES in the Nordic countries as a percentage of the GDP, 1993–2013.

| Country | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Denmark | 0.39 | .. | 0.44 | 0.39 | 0.42 | 0.40 | 0.41 | 0.43 | 0.44 | 0.56 | 0.58 | 0.59 | 0.59 | 0.62 | 0.66 | 0.76 | 0.85 | 0.89 | 0.92 | 0.95 | 0.97 |
| Finland | 0.43 | 0.42 | 0.43 | 0.44 | 0.52 | 0.55 | 0.60 | 0.58 | 0.58 | 0.62 | 0.63 | 0.66 | 0.63 | 0.63 | 0.62 | 0.61 | 0.71 | 0.76 | 0.73 | 0.74 | 0.71 |
| Norway | 0.45 | .. | 0.43 | .. | 0.42 | .. | 0.46 | .. | 0.40 | 0.44 | 0.46 | 0.46 | 0.46 | 0.45 | 0.50 | 0.50 | 0.55 | 0.53 | 0.51 | 0.51 | 0.53 |
| Sweden | 0.77 | .. | 0.68 | .. | 0.72 | .. | 0.76 | .. | 0.77 | .. | 0.79 | 0.78 | 0.74 | 0.72 | 0.71 | 0.74 | 0.85 | 0.85 | 0.85 | 0.89 | 0.90 |
| *OECD* | *0.33* | *0.33* | *0.32* | *0.33* | *0.33* | *0.33* | *0.34* | *0.34* | *0.36* | *0.38* | *0.39* | *0.38* | *0.38* | *0.38* | *0.38* | *0.40* | *0.43* | *0.43* | *0.43* | *0.43* | *0.43* |
| *EU 28* | .. | .. | *0.33* | *0.33* | *0.34* | *0.34* | *0.35* | *0.36* | *0.37* | *0.39* | *0.39* | *0.38* | *0.38* | *0.38* | *0.39* | *0.41* | *0.45* | *0.45* | *0.44* | *0.45* | *0.45* |

Source: OECD MSTI 2014:2

Table A.3 R&D expenditure in the HES in the Nordic countries in 2003 and 2013, by field of science (%).

| | Denmark | | Finland | | Norway | | Sweden | |
|---|---|---|---|---|---|---|---|---|
| Field of science | 2003 | 2013 | 2003 | 2013 | 2003 | 2013 | 2003 | 2013 |
| Natural sciences | 26.5 | 19.7 | 26.1 | 28.4 | 21.4 | 18.9 | 20.4 | 25.4 |
| Engineering and technology | 11.9 | 15.5 | 19.1 | 18.7 | 11.9 | 12.4 | 23.0 | 16.9 |
| Medical and health sciences | 27.1 | 36.5 | 24.1 | 19.2 | 28.9 | 34.6 | 29.8 | 33.4 |
| Agricultural sciences | 4.6 | 6.6 | 2.4 | 3.0 | 5.0 | 1.7 | 5.0 | 3.9 |
| Social sciences | 13.9 | 14.8 | 19.9 | 22.5 | 21.8 | 22.5 | 12.9 | 14.4 |
| Humanities | 15.9 | 6.9 | 8.3 | 8.2 | 11.0 | 9.9 | 6.8 | 6.0 |
| Not elsewhere classified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.1 | 0.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: OECD R&D statistics, national R&D statistics

Table A.4 R&D expenditure in the HES by R&D performing units by country. 2013. Million national currency and PPP$.*

| Denmark | DKK | PPP$ |
|---|---|---|
| Københavns Universitet | 5 081 | 662 |
| Aarhus Universitet | 3 251 | 424 |
| Danmarks tekniske universitet | 2 481 | 323 |
| Syddansk Universitet | 1 687 | 220 |
| Aalborg Universitet | 1 624 | 212 |
| CBS (Handelshøjskolen i København) | 335 | 44 |
| Roskilde Universitetscenter | 251 | 33 |
| IT-Universitetet | 99 | 13 |
| ***University hospitals*** | ***3 936*** | ***513*** |
| ***Other institutions*** | ***601*** | ***78*** |
| **HES Total** | **19 346** | **2 521** |

| Finland | Euro | PPP$ |
|---|---|---|
| Helsinki University | 309 | 332 |
| Aalto University | 198 | 213 |
| Turun University | 116 | 125 |
| Oulun University | 114 | 123 |
| Itä-Suomen University | 103 | 111 |
| Jyväskylän University | 95 | 102 |
| Tampereen teknillinen University | 73 | 78 |
| Tampereen University | 71 | 76 |
| Åbo Akademi University | 45 | 49 |
| Lappeenranta University of Technology | 45 | 48 |
| Vaasan University | 16 | 17 |
| Lapin University | 14 | 15 |
| University of the arts | 9 | 9 |
| Svenska handelshögskolan/Hanken | 8 | 8 |
| ***University clinics*** | ***54*** | ***58*** |
| ***Polytechnics*** | ***169*** | ***181*** |
| **HES Total** | **1 438** | ***1 544*** |

| Norway | NOK | PPP$ |
|---|---|---|
| Universitetet i Oslo | 3 380 | 367 |
| Norges teknisk-naturvitenskapelige univ. | 2 876 | 312 |
| Universitetet i Bergen | 1 721 | 187 |
| Universitetet i Tromsø | 1 222 | 133 |
| Universitetet for miljø- og biovitenskap | 559 | 61 |
| Universitetet i Stavanger | 381 | 41 |
| Universitetet i Agder | 307 | 33 |
| Høgskolen i Oslo og Akershus | 302 | 33 |
| Universitetet i Nordland | 173 | 19 |
| Norges Handelshøyskole | 168 | 18 |
| Norges veterinærhøgskole | 161 | 17 |
| Høgskolen i Hedmark | 115 | 13 |
| Høgskolen i Sør-Trøndelag | 96 | 10 |
| Høgskolen i Telemark | 95 | 10 |
| Høgskolen i Bergen | 95 | 10 |
| Høgksolen i Vestfold | 90 | 10 |
| Høgskolen i Lillehammer | 73 | 8 |
| Høgskolen i Buskerud | 67 | 7 |
| Høgskolen i Østfold | 66 | 7 |
| Høgskolen i Nord-Trøndelag | 57 | 6 |
| Høgskolen i Sogn og Fjordane | 55 | 6 |
| Høgskolen Stord/Haugesund | 51 | 6 |
| Høgskolen i Gjøvik | 46 | 5 |
| Høgskolen i Volda | 41 | 4 |
| Høgskolen i Molde | 41 | 4 |
| Høgskolen i Ålesund | 36 | 4 |
| Høgskolen i Finnmark | 33 | 4 |
| Høgskolen i Narvik | 28 | 3 |
| Samisk høgskole | 26 | 3 |
| Høgskolen i Harstad | 22 | 2 |
| Høgskolen i Nesna | 18 | 2 |
| ***Other institutions*** | ***829*** | ***90*** |
| ***University hospitals*** | ***2 772*** | ***301*** |
| **HES Total** | **16 001** | **1 739** |

| Sweden | SEK | PPP$ |
|---|---|---|
| Lunds universitet | 4 408 | 501 |
| Karolinska institutet | 4 188 | 476 |
| Uppsala universitet | 3 665 | 416 |
| Göteborgs universitet | 2 877 | 327 |
| Kungliga tekniska högskolan | 2 546 | 289 |
| Stockholms universitet | 2 454 | 279 |
| Chalmers tekniska högskola | 2 142 | 243 |
| Sveriges lantbruksuniversitet | 2 002 | 227 |
| Umeå universitet | 1 990 | 226 |
| Linköpings universitet | 1 615 | 183 |
| Luleå tekniska universitet | 802 | 91 |
| Linnéuniversitetet | 416 | 47 |
| Mittuniversitetet | 342 | 39 |
| Örebro universitet | 323 | 37 |
| Karlstads universitet | 311 | 35 |
| Södertörns högskola | 262 | 30 |
| Malmö högskola | 237 | 27 |
| Mälardalens högskola | 200 | 23 |
| Högskolan i Jönköping | 193 | 22 |
| Blekinge tekniska högskola | 142 | 16 |
| Handelshögskolan i Stockholm | 134 | 15 |
| Försvarshögskolan | 122 | 14 |
| Högskolan i Gävle | 119 | 14 |
| Högskolan Dalarna | 111 | 13 |
| Högskolan i Halmstad | 111 | 13 |
| Högskolan i Borås | 107 | 12 |
| Högskolan Väst | 97 | 11 |
| Högskolan i Skövde | 95 | 11 |
| Institutet för rymdfysik | 89 | 10 |
| Högskolan Kristianstad | 59 | 7 |
| Gymnastik- och idrottshögskolan | 36 | 4 |
| Stockholms dramatiska högskola | 24 | 3 |
| Ersta Sköndal Högskola | 22 | 2 |
| Högskolan på Gotland | 21 | 2 |
| Sophiahemmet Högskola | 17 | 2 |
| Konstfack | 10 | 1 |
| Dans- och Cirkushögskolan | 8 | 1 |
| Kungliga Musikhögskolan | 8 | 1 |
| Operahögskolan i Stockholm | 7 | 1 |
| Kungliga Konsthögskolan | 6 | 1 |
| Teologiska högskolan Stockholm | 1 | 0 |
| **HES Total** | **32 320** | **3 670** |

* *PPP$ (purchasing power parity), a price-level indicator adjusting for currency and purchasing powers (Denmark 7.67, Finland 0.93, Norway 9.20 and Sweden 8.80).*
*Note that for Sweden university hospitals ALF-funds are excluded at their university institution. In the ordinary R&D statistics fort the sector, these funds are included in HERD. HERD total is 33 831 SEK.*
*Source: National R&D statistics*

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## Acronyms

| | |
|---|---|
| BES | Business enterprise sector |
| EEA | European economic area |
| EU | European Union |
| FOS | Field of science and technology |
| FTE | Full-time equivalence on R&D |
| GBAORD | Government budget appropriations or outlays for R&D |
| GDP | Gross domestic product |
| GOV | Government sector |
| GUF | General university funds |
| HEI | Higher education institution |
| HERD | Higher education R&D |
| HES | Higher education sector |
| MSTI | Main Science and Technology Indicators |
| OECD | Organisation for Economic Co-operation and Development |
| PNP | Private non-profit |
| PPP | Purchasing power parity |
| R&D | Research and experimental development |
| STI | Science, technology and innovation |

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