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Analysis of public R&D funding in Norway

ERAWATCH R&D Specialisation

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Preface

I 2006 ledet NIFU STEP ERAWATCH-prosjektet "R&D Specialisation in EU", finansiert av EUs JCR IPTS i Seville. Hovedproblemstilling i dette prosjektet var å undersøke mønstre av FoU-spesialisering i den offentlige og den private sektoren i EUs medlemsland basert på internasjonal og nasjonal statistikk. Prosjektet produserte bl.a. en hovedrapport, en sluttrapport, 10 case studier og spesialiseringsrapporter for alle de 33 land som inngikk i analysen.

En del av ERAWATCH-prosjektet (work package 3) hadde som formål å samle statistikk som ikke er lett tilgjengelig gjennom OECD og EUROSTATs databaser for å analysere i større detalj offentlig finansieringsmønstre av forskning i fem EU-land. Disse var: Tyskland, Storbritannia, Østerrike, Slovenia og Norge. Resultatene fra denne analysen er blitt publisert i fem landrapporter på nettsidene av ERAWATCH-prosjektet (se http://cordis.europa.eu/erawatch/index). Den foreliggende rapporten viser analysen for Norge.

Takk til Alex Grablowitz (EU JCR IPTS, Seville), Michael Dinges og Martin Berg (Joanneum Research, Østerrike) samt Kirsten Wille Maus, Susanne Sundnes, Stig Slipersæter and Bo Sarpebakken (alle ansatte i NIFU STEP) for mange nyttige kommentarer.

Oslo, desember 2006

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1 Introduction

The availability of data on R&D and economic specialisation (public R&D funding, BERD etc.) for Norway is excellent both in OECD and EUROSTAT databases. In this study we explore the availability and applicability of more disaggregated national data in order to investigate whether it is possible to establish more 'finer nuances' of specialisation patterns in the Norwegian public R&D system compared to the information obtained from OECD and EUROSTAT statistics.

This report is therefore concerned with exploring the disaggregated use of wider classifications of public R&D funding based on national data sources in order to improve the understanding of the priorities and specialisation of the Norwegian R&D system. Here, the focus will be on the nexus of public R&D funding of business enterprise intramural R&D expenditures (BERD), public R&D funding of HERD and GOVERD and private R&D funding of HERD and GOVERD as well as certain other issues related to the performance of Norwegian R&D systems a whole.

1.1 Definitions

We distinguish between general and non-targeted funding of R&D on the one hand – that is, core or general institutional funding used for the payment of general running expenditures in higher education sector and in the research institute sector and on the other hand, targeted or project funding. In this study we investigate:

- the thematic and socio-economic orientation of the general, non-targeted R&D funding in Norway and
- the thematic and socio-economic orientation of the targeted/strategic R&D funding in Norway.

There is a general need for a more rigorous discussion of what we mean by targeted or project funding and how this may be measured since it is this type of funding which *de facto* is mission-oriented and, therefore, more closely linked to articulated needs of the paying actors commissioning the research.

In general, targeted funding is organised as selected projects under R&D programs or as separate and independent R&D projects involving direct funding flows from the client to the R&D performer. Hence, we define *project funding* as money attributed to a group or an individual in order to perform a research, development or innovative activity – an activity which will be limited in scope, budget and time. Normally, funding of a project is preceded by the submission of a project proposal. Whether the process of allocation is competitive or not, is not decisive in our context. For instance, several Ministries buy R&D-services, organised in larger or shorter R&D projects, from research institutions often without any

open call. Thus, the main criterion used to identify and classify project funding instruments is the aim of the instrument from the point of view of the funding authority, rather than the use of money by the beneficiaries.

This report considers funding from the following sources:

- National funding: funding provided by ministries or other governmental organizations Research Councils. National funding agencies financed by the government, but essentially managed by representatives of the scientific community and enjoying a large decisional and organizational autonomy from the state
- International funding: funding provided by international organisations or supranational bodies, such as the European Union.
- Regional funding. Project funding managed directly by regional authorities. In the case of Norway, this kind of funding is of lesser importance and therefore it is not included in this report.

Scientific fields
A classification of funds, in particular project funding according to scientific domains, is difficult to perform since it should be made at the level of the performer rather than at the level of the funding instrument. Thus we confine this classification to research council funds, which are clearly allocated in accordance with scientific disciplines.
The basic classification is derived from the Frascati manual and comprises five fields:
- humanities
- social sciences
- natural sciences
- engineering and technology, including also agricultural sciences
- medical sciences.

Types of funding instruments
This is one of the core issues to which ERAWATCH should possibly pay more attention in the future, that is, to understand in greater detail not only R&D funding flows in general, but also the throughput, that is, how the funding is structured and divided according to different types of instruments with different thematic orientation and with a different scope as to their effects and the types of participation.

Project R&D funding could be classified into three groups according to main objective of the instruments:

- *Research instruments* are instruments whose main aim is to promote basic research and scientific production (for example scientific publications and PhDs).These are often funded through government appropriations.

- *Mission-oriented* instruments are instruments oriented towards the solution of political, social or economic urgent problems; innovation and economic development might be an aim, but not in such a direct way as the next category.

- *Innovation promoting* instruments, that is, instruments directly oriented towards economic innovation. These fund either targeted collaboration between business and public R&D institutions, or directly support R&D activities in the business sector with or without collaboration with the public R&D institutions.

Although we do not proceed with a deeper analysis of the targeted/project funding in Norway by types of funding instrument, it is important to bear in mind that the division of labour and the respective distribution of funding according to funding instrument is relevant when the task is to acquire a better understanding of the thematic and socio-economic specialisation of national R&D public bases.

In the analysis which follows, we attempt to retain the distinction between general and non-targeted funding on the one hand, and targeted project funding on the other. In particular, we provide more information on the socio-economic and thematic orientation of targeted as well as non-targeted research performed by the higher education sector and by the research institute sector.

1.2 The Norwegian Research Institute Sector

In Norwegian national R&D statistics, resources are classified according to three performing sectors deviating somewhat from the Frascati manual: The industrial sector, the higher education sector, and the institute sector.

The reason for this classification is the relatively large sector of research institutes and laboratories that actually account for 23 per cent of total gross expenditure on R&D in Norway (2005). For use in R&D international statistics and comparisons by OECD and Eurostat, the national figures are reclassified to correspond with Frascati Manual definitions.

The institutes serving industry (both private and non-profit) are reclassified into the Business enterprise sector; OECD's Higher Education sector corresponds to that of the Norwegian classification; thee Government sector and Private Non-Profit sector (PNP) together cover the rest of the Institute sector is as defined in the national statistics. The PNP sector is insignificant in Norway, and is therefore included in the Government sector of the OECD statistics. In this report we will use statistics abased on national definitions although for reasons stated, the data presented below are not always directly comparable with those from OECD and EUROSTAT. It is nevertheless possible to construct data complying with the sector definitions of the Frascati Manual.

1.3 Assessment of data availability at the national level

Comprehensive and disaggregated national statistics are available which are fully compatible with OECD and EUROSTAT databases. The statistical system for collecting data on Norway's R&D activities is well established and has been employed on a regular basis since the 1960s. NIFU STEP and Statistics Norway (SSB) carry out a statistical survey of Norwegian R&D every second year. NIFU STEP is responsible for collecting and processing data regarding the institute and higher education sectors, while Statistics Norway is responsible for the industrial sector. NIFU STEP is also responsible for assembling information included in an overall statistical survey of R&D in Norway. The statistics are prepared in accordance with OECDs "Frascati manual".

Data on R&D funding is available for research on the departmental level for universities and other higher education institutions. For research institutes outside higher education (private and government) data are available on institutional level. Samples from the business enterprise sector are available at the level of the firm. However, for reasons of confidentiality, data is normally not available at the level of the basic unit.

Data on research personnel is assembled by NIFU STEP for the Higher Education sector, public research laboratories/institutes and the non-profit institutions. NIFU STEP maintains a "Research Personnel Register" with data at the individual level. Human resources data for the register is collected through a full survey of headcount every second year (odd years) as a part of the national R&D statistics. Among others things data include perosnal identification number (comprising date of birth and gender), name, position, department and educational background. Data is stored in a national database. No individual level data are published.

Data for the Industry sector is collected biannually by Statistics Norway and is available on aggregate level. Data on researchers in industry sector is also collected through labour force surveys carried out by Statistics Norway. Data is stored in a national database. No individual level data are published.

Due to restructuring of the Higher Education sector, data on headcounts changes between 1993 and 1995 when the former regional colleges were merged into 26 university colleges. The merger resulted in inclusion of several new units in the R&D statistics, and a subsequent increase in the headcount variables for university colleges. Universities were not affected by the restructuring.

Every second year, a complete overview (input and output) of the Science and Technology (S&T) situation in Norway is published by The Research Council of Norway. This national report on S&T indicators describes developments in the S&T system, and also makes comparisons with the European countries and other countries. The first edition was published in 1997, and the fourth in 2004.

The report is also available in an abridged English version and on the internet (http://forskningsradet.ravn.no/bibliotek/statistikk/indikator_2003_engelsk/)

Data on *research and innovation* system is generally good. Long and continuous time series is established within most domains. Information is basically available from two institutions (the NIFU STEP and SSB) which cooperate closely.

Strong points:

- Strong position in register data at the individual level for researchers in higher education and government sector
- Work force data is also available at the individual level. This enables a detailed analysis of mobility, educational demands etc.
- Detailed data on higher education and public sector R&D finances and expenses
- A wide range of indicators for research institutions
- Detailed publication data (ISI) where institutional addresses are harmonised. So far not fully connected to expenditure data.

Weaker points:

- Indicators on results are so far basically limited to publications, impacts and patents. For research institutes there are some additional indicators on results. New indicators for other results e.g. spin offs, commercialisation etc, thus have to be developed.
- Data on financing higher education institutions have not continuous time series due to changes in organisational structure and budgetary categories reported.
- Data on *project funding* by the Research Council are available, but are not coherent and suitable for analysis. Detailed data on project funding for the Higher Education sector are lacking.

2 Lessons learned from R&D specialisation project – comparisons of specialisation patterns based on international statistics

In very general terms, Norway exhibits a consistent specialisation in terms of public R&D funding, business R&D expenditure, and economic specialisation. Technological specialisation (patents) follow a distinct but quite different pattern of specialisation compared to all other indicators we examined.

In terms of value added (see Annex for Norway in WP1), the country appears to be highly specialised in mining (mainly petroleum and gas, NACE 11), ship building (in particular, building and repairing oil-platforms and modules, NACE 35.114) and transport (both transport via pipelines – NACE 60.30 and general water transport, NACE 61). Obviously, this is the footprint of the petroleum cluster in the Norwegian economic system. Norway also exhibits an increasing specialisation in electricity, gas and water supply.

In terms of employment, the specialisation profile exhibits some differences compared to that of value added. Mining now shows a distinct negative specialisation compared to value added. One explanation for this is the fact that there is an efficient production in the petroleum extraction fields. Ship building and transport exhibit both high positive specialisation indexes as is the case with value added. But in contrast to value added, Norway appears to be specialised also in Printing and publishing (NACE 21), Basic metals (NACE 27), gas and water supply (NACE 40-41), Community Services (NACE 75-99), R&D services (NACE 73) and telecom-services (NACE 64). The employment specialisation in Community services should be seen in light of prominent welfare state activities, education and health care.

As to R&D services, one should note that the majority of non-profit industry-oriented research institutes in Norway are classified in this sector (see also the discussion in the definitions above). The number of employees in the Research Institute sector is high compared to many EU-countries. This may explain why Norway exhibits a specialisation in employment but not in value added in this sector.

2.1 Public R&D funding

Throughout the reference period (1993–2003) R&D intensity in Norway remained relatively constant. During 2003 GERD amounted to 1.8% of GDP. BERD, GOVERD and HERD remained also relatively constant measured as a proportion of GDP over the same period. HEIs perform an increasing share of publicly funded research while that performed by public research institutions has declined slightly. Moreover, it appears that the share of government funds as a source of finance for research has been reduced, while that of the

private sector and funding from abroad have increased correspondingly. In 2003 BERD accounted for 57.5% of GERD.

When we examine GERD by type of research we observe a decrease in the share of applied research by almost 7 percentage points over the ten-year time frame (1993–2003), while at the same time the share of experimental development increased substantially from 42.3% in 1993 to 47.9% of GERD in 2003. This trend may be a result of a structural shift between the R&D performing sectors in Norway, with a decline of R&D expenditure in the research institutes (which mostly conduct applied research), and an increase of R&D expenditures by the Universities and Colleges (where basic research constitutes a large share of total research), and an increase of business R&D expenditure.

This trend suggests a polarisation of R&D activities in Norway with increasing emphasis on basic research and development and less focus on applied R&D. We shall explore this with the use of more disaggregated data.

Looking at the government budget appropriations or outlays of R&D (GBOARD), Norway exhibits high specialisation in social science research (as a result of knowledge based welfare state policy orientation), and agriculture (especially marine research). There is also much specialisation in the mining and extraction industries (particularly in the oil and gas sector), land use (for the same reason), human health and, to a minor extent, general university funds.

An interesting feature is that, based on OECD Basic Science and Technology statistics data for the period 1993–2003, the Norwegian government seems to have changed its priorities relative to those of the EU15 countries - *in industry-oriented R&D funding*. Norway shifted from a clearly specialised funding in 1993 to clearly non-specialised financing in 2003. We have no direct explanation for this finding, but we present disaggregated data which provides further information on this development.

Concerning expenditure on R&D in Higher Education (HERD) by scientific field, the medical sciences, natural sciences and social sciences received 72.1% of total funding during 2003. However, the share of natural sciences over the period declined from 29.1% in 1993 to 21.4% in 2003. The opposite trend holds in GOVERD, where the share of natural sciences increased from 19.1% in 1999 to 24.9% in 2003. This implies that, relatively speaking, the Norwegian research system universities and colleges placed more emphasis, intentionally or otherwise, on medical science, while research institutes exhibited a clear and increasing specialisation in natural sciences and engineering.

Note that these shifts serve to explain some of the observed scientific specialisation trends (e.g. number of publications by scientific field).Consistent with the R&D funding trends, Norway shows high specialisation in social sciences, in the environment and certain medical fields, while by comparison it underperforms in all natural sciences. This

specialisation profile is validated also by the citation statistics. Some aspects of this underperformance in the natural sciences could be explained by the fact that the majority of scientist and engineers in Norway, measured in R&D man years, work in research institutes, not the universities. *The propensity to publish research results in Norwegian research institutes is far lower than universities*.

In terms of technological specialisation, Norway is specialised in pharmaceuticals, chemicals, machinery and furniture/other manufacturing. In these sectors Norway exhibits no economic specialisation. It is also pertinent to mention that in these same sectors Norway increased its technological specialisation between 1993 and 2003. In addition, Norway exhibits high technological specialisation in petroleum, other transport as well as the basic metals sector in accordance with its economic specialisation. In this report we provide some new information as to how the Norwegian public R&D base contributes to the production of patents leading to the above-mentioned specialisation profile.

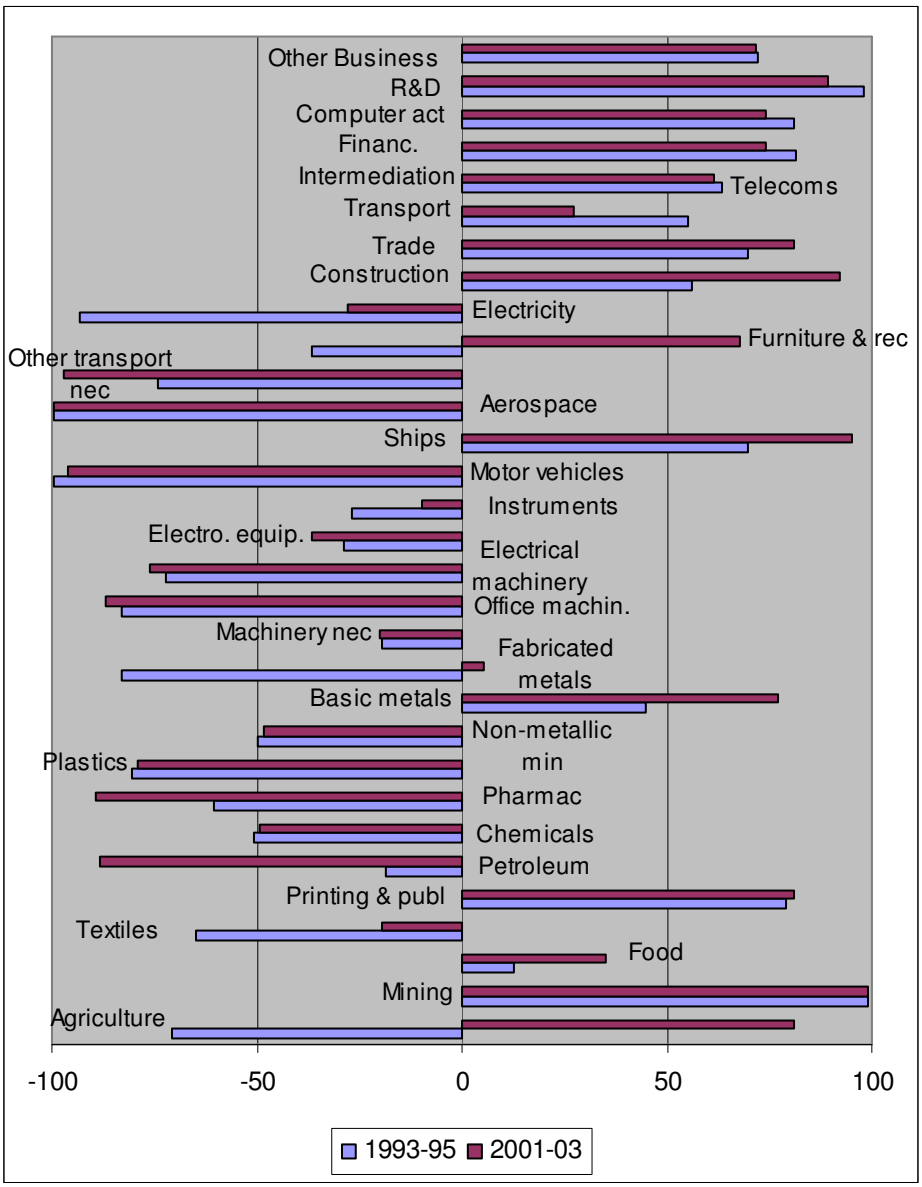
2.2 Specialisation of government funding of BERD

In terms of business enterprise intramural R&D expenditure (BERD), Norway appears to be highly specialised in:

- Primary sectors, in particular petroleum and gas, but also agriculture (and fisheries)
- Several low-tech. and medium-tech. manufacturing sectors, such as food, printing and publishing, ship building, basic metals and manufacturing nec; recycling.
- Services and other non-manufacturing activities, except electricity and water supply.

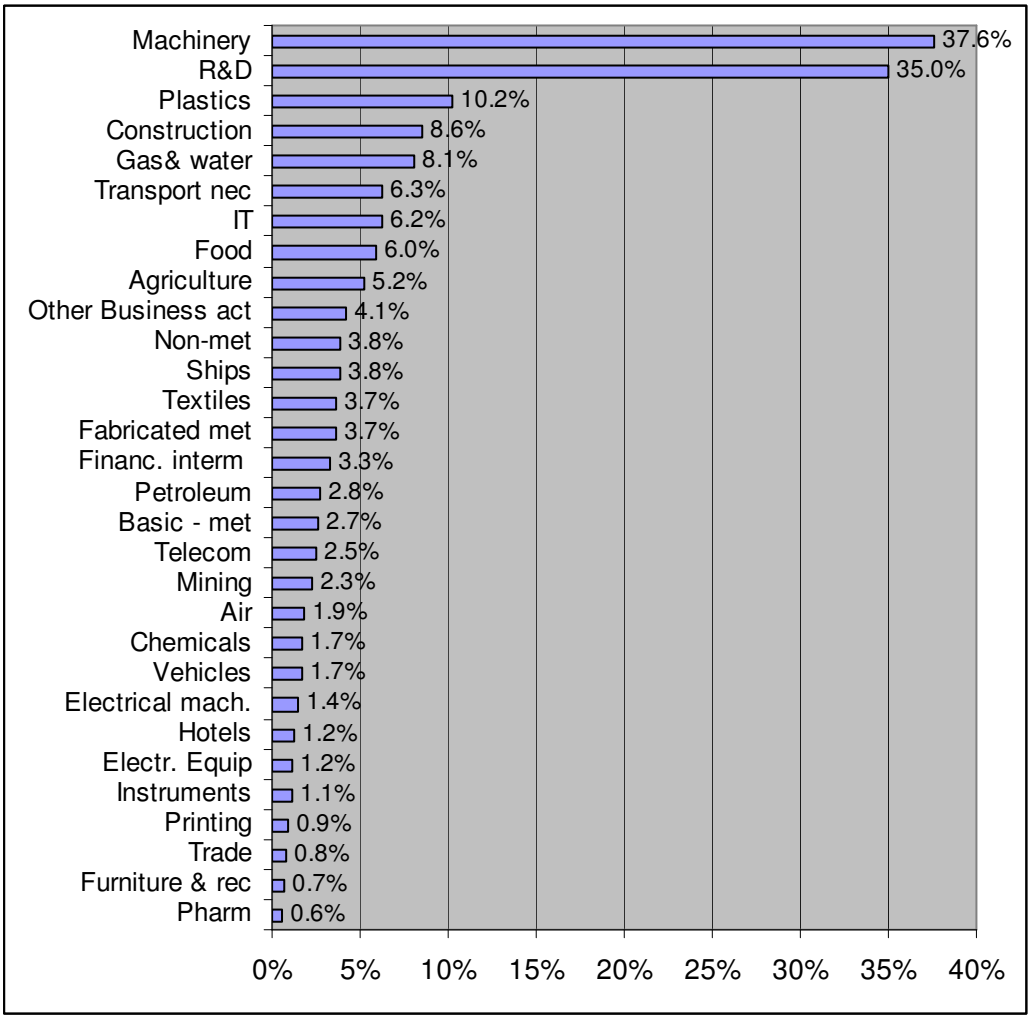
Note that, Norway's BERD specialisation (Figure 1) in services reflects a somewhat unique pattern compared to EU Member States. In 2003 (see Figure 3) two sectors received more than 70 per cent of the total government R&D funding of BERD (GBERD) in Norway; research services (NACE 73), and machinery and equipment (NACE 29). Next to these we find Computer and related services (NACE 72) which received 7.8 per cent of total GBERD. All other sectors received less than 3 per cent each of GBERD.
In general, government support of BERD followed the specialisation patterns of the R&D activities of the business sector in 2003, except for the industries NACE 29 (Manufacture of machinery and equipment) which, relatively speaking, receives more than what it contributes to national BERD specialisation patterns, and NACE 27 (Manufacture of basic metals), NACE 45 (Construction) and NACE 74 (Other business activities – legal, accounting, advertising etc.) all of which, again relatively speaking, receive less than what they contribute to national BERD specialisation patterns.

Figure 1. Business enterprise intramural expenditure on R&D by industrial sector. 31 sectors. Specialisation profile. Norway. Averages 1993–1995 and 2001–2003.



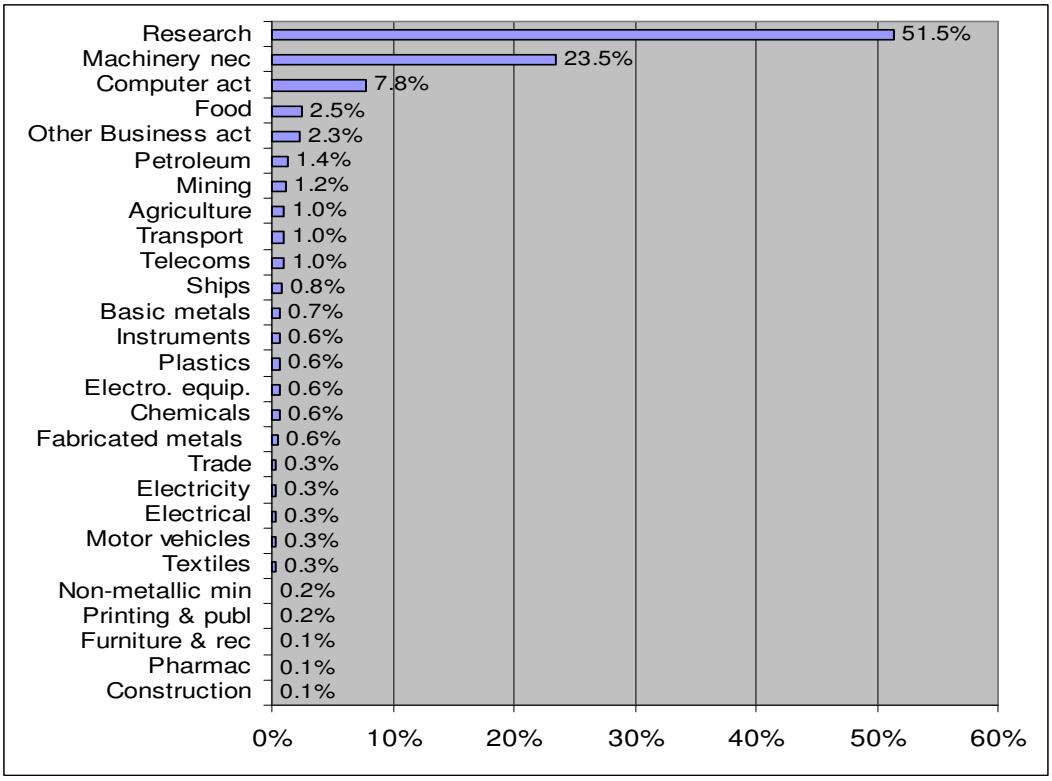
Notes: Specialisation index with EU15 as reference. Maximum specialisation: + 100. Minimum specialisation: –-100.
Source: OECD Basic Science and Technology Statistics 20052005, ANBERD 2005, Logotech calculations

Figure 2. Shares of Business enterprise intramural expenditure on R&D (BERD) in the sector funded by government. 2003.



Source:OECD Basic Science and Technology Statistics 2005.

Figure 3. Proportion of total government funding of business enterprise intramural expenditure on R&D (BERD) by industrial sectors. 2003 last available year in OECD statistics



Source:OECD Basic Science and Technology Statistics 2005.

3 Issues to address in this report

In the rest of this report we use disaggregated national data in order to test whether these data can provide more detailed and policy-relevant information on the funding structures in Norwegian R&D activities. The main objective is to understand the finer institutional aspects of R&D funding patterns in Norway and to provide more detailed information on the specialisation of the Norwegian R&D research system compared to the specialisation profiles derived from OECD and EUROSTAT data (see the section above). We focus in particular on:

- Government Budget Appropriations or Outlays for R&D (GBOARD) by socio-economic objectives and by funding Ministry.

- The distribution of General University Funds (GUF) by higher education institutions (finer classification of the higher education sector) and by fields of science.

- The size and the distribution of strategic R&D funding in Norway (via the Research Council of Norway) by fields of science and performing sectors.

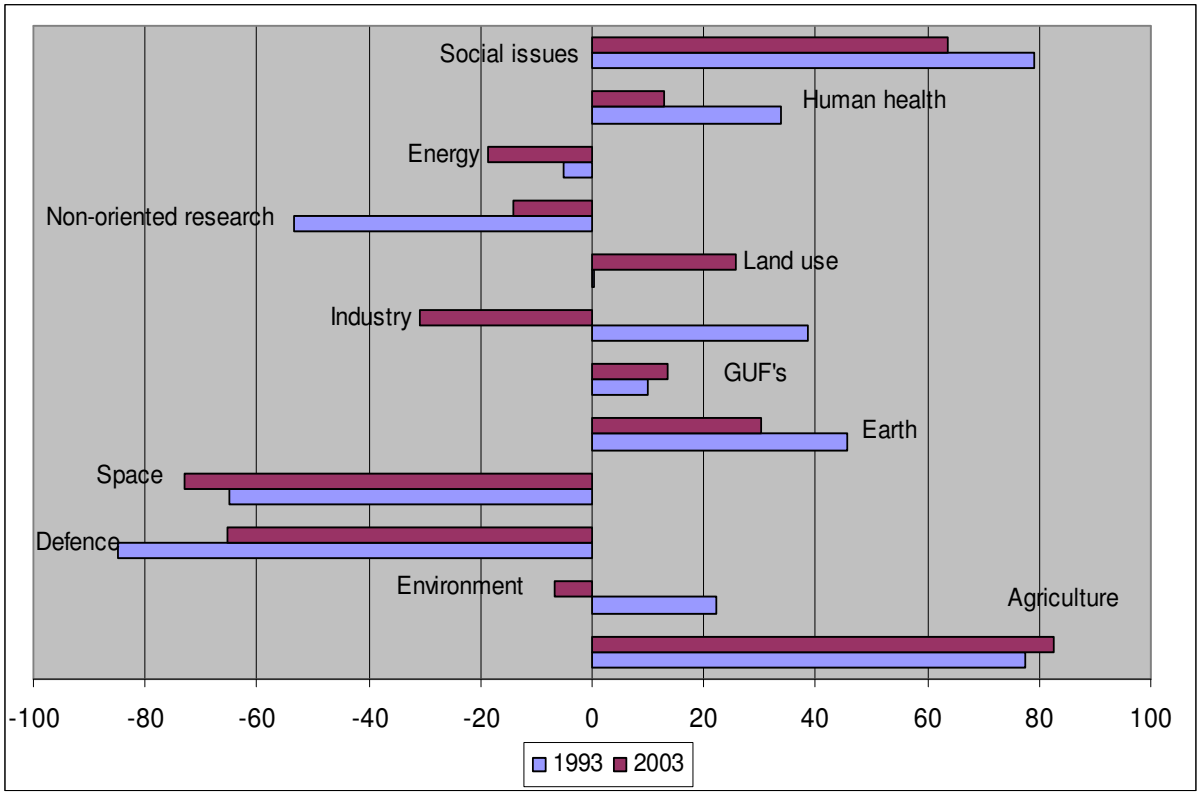
- HERD and GOVERD financed by external sources (excl. GUF and basic allowances). Funding by industry, government, the Research Council of Norway (RCN) and by field of science. This is a key information as to the contract research the public R&D base in Norway is exposed to.

- Government funding of BERD

- Statistics on public–private co-authorship in Norway. This is, perhaps, the only output indicator on public–private R&D collaboration which is possible to standardise.

3.1 GBOARD by socio-economic objective

Figure 4. Government Budget Appropriations or Outlays for R&D (GBAORD) by socio-economic objective. Specialisation profile. Norway. 1993 and 2003.



Notes: Specialisation index with EU15 as reference. Max specialisation: + 100. Min. specialisation: -100.
Source: OECD Basic Science and Technology Statistics 2005, own calculations.

Figure 4, taken from the Norway report in Annex 1 of WP1, shows that compared to the aggregated data for the EU15 countries,–in terms of public R&D funding Norway tends to prioritize social development and services, land use, earth and atmosphere, health and general university funds.

As an attempt to provide explanations for the GBOARD specialisation profile above, Table 1 shows the distribution of Norwegian GBOARD by funding ministries in 2003. The break-down by socio-economic objectives shown in Table 1 is much more detailed than that presented in OECD statistics (see also Figure 4).

Though the interesting information is whether and how ministries are targeting and influencing research in the their policy sectors, Table 1 provides only general indications of this matter. It is nevertheless noteworthy that half of the Norwegian government R&D appropriations in 2003 were dedicated to general university and research institute funds (general advancement of knowledge) from the Ministry of Education and Research.

In general, the majority of the ministries channel most of their mission-oriented R&D budgets to national R&D actors through national R&D programs under the RCN. This renders RCN a key knowledge policy institution in Norway, but is also creates some tensions between the ministries and RCN due to the reduced steering ability the funding ministries have when project research is organised under national R&D programs.

Table 1 shows that environmental research represents only 3 per cent of the total GBOARD. The Ministry of the Environment is a fundamental actor as it funds about 70 per cent of the research activities within this socio-economic objective. These funds are either channelled directly to R&D institutions or to national R&D programs under the aegis of the Research Council of Norway.

Norway is highly specialised in GBOARD funding of agricultural production and technology. Funding of this socio-economic objective (SEO) includes promotion of agriculture, forestry, fisheries and food production (see OECD 2002, Frascati Manual, p. 145). Table 1 below shows clearly that the Norwegian Ministry of Fisheries funds about 60 per cent of this SEO, implying that Norway's specialisation in this objective may be explained by the investment in R&D in fisheries and related activities.

Exploration and exploitation of Earth is also an SEO to which the Norwegian government gives priority. Table 1 shows that this is a SEO funded by several ministries which not always have a coordinated approach in the funding of this particular SEO. Social structures and relationships (after agriculture, social issues is that SEO receiving most investment by the Norwegian government. Table 1 (columns 8–11) shows that at least seven different Ministries contributed about 460 million NOK to R&D in this SEO. In addition, eight ministries funded 367 million NOK for R&D in economic planning and public administration in 2003. Altogether, more than 7 per cent of total GBOARD went to socially-related R&D in 2003. This is an indication of the volume of research-based knowledge generation on social issues in Norway and how seriously the Norwegian government treats knowledge needs on social issues.

Only seven per cent of the total GBOARD is used in R&D on defence. Industrial production and technology (this being an area where Norway's GBOARD showed no signs of specialisation in 2003). Two ministries account for the major part of funding in this area, the Ministry of Trade and Industry (82 per cent), and the Ministry of Local Government and Regional Development (13 per cent). The R&D budgets of the Ministry of Trade and Industry have remained stable in the period 2002-2005 while the total GBOARD increased by 16 per cent in the period 2002–2005. In general, we find the disaggregated data presented in Table 1 useful as they clearly present a more complete picture of the funding sources of GBOARD and their possible motives compared to OECD statistics.

Next we proceed to a classification of R&D activities by socio-economic objectives based on sector of performance rather than the funding source.

Table 1: Government Budget Appropriations of Outlays for R&D by sosio-economic objectives by source of funding. 2003. Mill NOK

Ministry	Agriculture, forestry and fishery	Industrial development	Energy	Transport and telecommunication	Living coditions and physical planning	Environment	Health	Social conditions	Culture	Education	Working conditions	Economic planning and public administration	Exploration and exploitation of the earth and atmosphere	General advancement of knowledge	Space research	Defence	EU Framework Progrrams	Total	%
Ministry of foreign affairs	84		4			43	49	3	9			78	8	124				401	3 %
Ministry of Education and Research	17	7	1	1		0	65	51	17	81	0	86	78	5877				6281	50 %
Ministry of Culture and Church Affairs									75					1				76	1 %
Ministry of Justice and the Police												25						25	0 %
Ministry of Local Government and Regional Development		121			5			16				22						163	1 %
Ministry of Social issues								80										80	1 %
Ministry of Health							799											799	6 %
Ministry of Children and Equality							1	26				22						49	0 %
Ministry of Trade and Industry		778		51								32	48	13	240		310	1472	12 %
Ministry of Fisheries	611													10				620	5 %
Ministry of Agriculture	392	14				5							9	34				454	4 %
Ministry of Transport and Communications				198														198	2 %
Ministry of the Environment	24				13	251			25				65					378	3 %
Ministry of Labour and Administration	23						8		3		82	30	4	193				342	3 %
Ministry of Finance												72						72	1 %
Ministry of Defence									1							848		850	7 %
Ministry of Petroleum and Energy		2	276						0				31					310	2 %
The National banks		22																22	0 %
Total	1150	944	282	249	18	300	921	176	130	81	82	367	243	6252	240	848	310	12592	100 %

About 23 per cent of total R&D expenditure in Norway was performed by research institutes in 2003. Table 2 shows how total R&D expenditures in the Norwegian research institutes are distributed according to 20 socio-economic objectives in 2003.

There are three main points to be made here. First, the research institute sector is undertaking more research oriented towards fisheries, industry, the environment, energy and social issues compared with the distribution of GBOARD by socio-economic

objectives as shown in Table 1. Table 2 shows total R&D operating costs in the research institute sector (national classification of the institute sector). This information clearly provides a better understanding of the orientation of R&D as performed (actual orientation), not as funded (intentional orientation).

Table 2: Expenditure on R&D by socio-economic objectives in the institute sector in 2003. Mill NOK. Operating costs.

Socio-economic objectives	Mill. NOK	Per cent
Agriculture, forestry	391.0	6 %
Fishery	626.6	10 %
Production and distribution of oil and gas	445.8	7 %
Industry	834.3	14 %
Other business related activities	325.3	5 %
Energy	341.1	6 %
Transport and telecommunications	305.2	5 %
Living conditions and physical planning	77.4	1 %
Environment	598.1	10 %
Health	444.3	7 %
Social conditions	204.6	3 %
Culture	147.1	2 %
Education	76.9	1 %
Working conditions	158.4	3 %
Economic planning and public administration	359.4	6 %
Exploration and exploitation of the earth and atmosphere	43.2	1 %
Other civil research	87.6	1 %
Non-oriented research	132.2	2 %
Space research	45.7	1 %
Defence	431.0	7 %
Total	6075.3	100 %

Source: NIFU STEP

To complete our understanding of the socio-economic orientation of the entire Norwegian public R&D base (at the level of performing sector) we also need information on the R&D activities in the higher education sector. Table 3 shows the clear division of labour, in terms of socio-economic objectives, between higher education and research institutes in Norway.

Research institutes specialising in R&D on fisheries, production and distribution of oil and gas, industry-oriented research, energy, transport and telecommunications, environment and defence. The higher education sector specialises in R&D on health, education and non-oriented research.

Table 3: R&D Expenditure by socio-economic objectives in the higher education and institute sectors. 2003. Mill NOK. Operating costs.

Socio-economic objectives	All	Higher Education	Institutes
Agriculture, forestry	594	203	391
Fishery	708	82	627
Production and distribution of oil and gas	570	125	446
Industry	1090	256	834
Other business related activities	498	172	325
Energy	473	132	341
Transport and telecommunications	461	156	305
Living conditions and physical planning	102	24	77
Environment	803	205	598
Health	1924	1480	444
Social conditions	399	194	205
Culture	454	306	147
Education	693	616	77
Working conditions	233	74	158
Economic planning and public administration	563	204	359
Exploration and exploitation of the earth	95	52	43
Other civil research	218	131	88
Non-oriented research	2316	2184	132
Space research	100	54	46
Defence	444	13	431
Total	12736	6661	6075

3.2 General University Funds

Research funded through general university funds constitute 50 per cent of total GBOARD in 2003 in Norway. Hence, it is important to investigate what type of research is funded through this SEO.

Table 4 shows the thematic R&D orientations of the higher education institutions in Norway. The University of Oslo is by far the most important actor in research in medical sciences and dominates research in the natural sciences. The state university colleges dominate research in the social sciences while the Norwegian University of Life Sciences and The Norwegian School of Veterinary Science are the key actors in agricultural sciences.

Table 4: Expenditure on R&D from General University Funds by field of science and institution in the higher education sector. 2003. Mill NOK. Operating costs and capital costs.

Institution	Humanities	Social sciences.	Natural sciences.	Engineering	Medical sciences	Agricultural sciences.	Total
University of Bergen	100.9	136.8	213.2		314.4		765.3
University of Oslo	197.2	271.3	317.1		618.6		1404.3
University of Tromsø	68.1	105	121.1		147.9	32.8	474.9
Norwegian University of Science and Technology	93.4	111.5	117.5	354.4	296.3		973.2
Norwegian University of Life sciences		19.5	45.5	27.6		79.5	172.1
Norwegian School of Econ. and Business Adm.		78.9					78.9
Norwegian School of Veterinary Science						80.9	80.9
Other specialised university institutions	64.6	118.3	15	2.3	33.2		233.5
State university colleges	102.3	326.4	61	105.7	86.4	17.5	699.1
Total	627	1168	890	490	1497	211	4882.0

In other words, it is possible to identify both key actors receiving GUF and the thematic profile of the GUF-funding by R&D performing institution.

3.3 External funding – universities and research institutes

The previous sections analysed government R&D funding according to socio-economic objectives, by scientific fields and by sector of performance (higher education sector, research institutes and business enterprise sector).

In this section we focus analysis on external funding of public R&D institutions, that is, funding other than GUF for the higher education sector, and funding other than basic allowances for the research institute sector. This information provides an indication of the degree to which the public R&D base serves the concrete needs of industry and public administration.

Total R&D expenditure in the higher education sector in 2003 was 7.5 billion NOK (about 1 billion EURO). This includes operating costs and capital costs (mainly instruments and buildings). About 35 per cent of the 7.5 billion NOK was funded by external sources. Table 5 shows that national R&D programmes funded by the Research Council of Norway (RCN) were the most important external funding source for universities and colleges in 2003 (43 per cent of all external funds).

Direct project government funding is mostly oriented towards the social sciences; about one third of total external government R&D funding in higher education institutions was directed to this field in 2003. Non-profit organizations are an important source of funding of research in medical science alongside the RCN.

One could expect a larger share of the external funds to be provided by the business sector; only 13 per cent of total external funding comes from this sector. Another noteworthy feature is that universities and colleges receive considerable R&D funding from abroad for research in agricultural sciences.

Table 5: Externally funded R&D expenditure in higher education sector by financial source and by field of science. 2003. Mill NOK. Operating costs.

Field of science	Industry	RCN	Other government	Other national	Abroad	Total
Humanities	44.2	89.9	36.5	12.5	22.7	205.8
Social sciences	49.4	210.4	131.1	46	51.6	488.5
Natural sciences	30.6	296	31	8.8	107.3	473.7
Engineering and technology	130.1	227.2	37.3	23.7	69.9	488.2
Medical sciences	35.9	235	84.2	186.6	65	606.7
Agricultural sciences	58.9	97.1	51	15.2	143.5	365.7
Total	349	1156	371	293	460	2629.0

Table 6 shows that industry and direct government funding is the predominant external funding sources for the research institutes.

Table 6: Externally funded R&D expenditure in the institute sector by financial source and by field of science. 2003. Mill NOK. Operating costs.

Field of science	Industry	RCN	Other government	Other national	Abroad	Total
Humanities	26.9	19.6	112.5	0.9	4.5	164.3
Social sciences	106.1	425.4	468.0	30.1	89.6	1 119.2
Natural sciences	186.7	366.2	568.4	1.9	144.5	1 267.8
Engineering and technology	882.3	431.7	397.8	11.7	423.2	2 146.7
Medical sciences	13.4	40.3	303.4	16.1	27.2	400.3
Agricultural sciences	159.4	268.2	497.4	14.7	37.4	977.0
Total	1 374.8	1 551.4	2 347.4	75.3	726.5	6 075.3

Information from Tables 5 and 6 is consistent with the information provided in Tables 2, 3 and 4. All these tables together describe the socio-economic and thematic orientation of the public R&D base in Norway as well as all R&D financial sources.

3.4 The role of the Research Council of Norway – targeted research

The Research Council of Norway is the main research policy institution in Norway. RCN designs, organises and administers almost all national R&D programs in Norway. Furthermore, the RCN finances the basic operating costs for the majority of the research institutes in Norway. In total RCN funded R&D activities of a value of 3.1 billion NOK in 2003. This is only 11 per cent of total GERD, but constitutes 27 per cent of total GBOARD and represented fifty per cent of general university funds in 2003.

These figures indicate that about half of government R&D funding in Norway is allocated to non-targeted research in the higher education sector; one quarter is allocated to targeted research through the RCN; the remaining quarter is also *project research* channelled directly through the ministries to the R&D performing sectors.

The more GBOARD funds are channeled though RCN, the less direct influence is able to be exerted by the ministries on R&D research institutions. Conversely, the more funds are channeled to contract/project research directly to the R&D institutions from the ministries,

the more likely it is that the ministries have a detailed and hands-on steering of project research.

As a general principle, it is agreed in Norway that most of the targeted research funding should go to the research performing sectors through the RCN. Some ministries follow this principle, others do not, a situation which creates some tension in Norwegian research policy. As a direct consequence, the ministries vary their tactics in this matter and the RCN is obliged to shape its national R&D programs in close collaboration and in agreement with all relevant ministries in order to fund its R&D program activities. This dependence of RCN on funds from the ministries may provide some explanation of the relatively large number of small national R&D programs in Norway today.

On the other hand, it becomes increasingly more difficult for ministries to directly fund project research without a competitive process (call for tender etc.) – both research institutes, universities and, when relevant, consultancies. This makes direct project funding more time-consuming and less flexible. In the long run, one of the consequences of this open-market practice related to project mission-oriented R&D activities may be that funds channeled though RCN will increase, provided that RCN is capable to foresee needs and to execute R&D programs of high relevance for the ministries and of high quality.

Be that as it may, we previously mentioned that funding by the RCN is the predominant external source of funding for universities. Figure 5 shows the distribution of RCN funds to performing sectors in 2003. About 1.4 billion NOK went to the higher education sector and included 1.2 billion NOK in operating costs and 214 million NOK for instruments, equipment etc.

The surprising feature in Figure 5 is that the business sector receives a very small portion of RCN funds; only 156 million NOK went to this sector while 1.6 billion NOK was distributed to the research institute sector. We discuss the implications of this finding in the section below.

Figure 6 shows that the higher education sector increased its share of RCN funding while the share of business and research institutes decreased its share of RCN funding in the period 1995–2003. In other words, RCN funding has been increasingly oriented towards research performed by universities over the last ten years, and not to research carried out by research institutes or businesses.

Figure 7 shows that natural sciences and engineering receive fifty per cent of total funding, with only 18 per cent going to medical research and 10 per cent to agricultural sciences. Social sciences and the humanities receive a large part of RCN funding (about 30 per cent), an unusual pattern compared with the proportion granted to social sciences in targeted research in other countries and in the EU Framework programs. This distribution pattern

has remained stable throughout the period. However, social science research received a marginally lower share of RCN funding in 2003, compared to 1995.

In conclusion, RCN funding is an important institution, especially in targeting research in the higher education sector. As expected, the thematic structure of RCN funding is similar to the thematic orientation of GBOARD. The business sector receives only a small fraction of RCN funds, but from other sources we know that these funds generate a considerable additional business which, according to several surveys, would not have been triggered without RCN funding (high input additionality). From the perspective of ERAWATCH input and output additionality should be important issues to address and more standardised indicators are needed for a comparison of the impact of national project funding of business R&D.

Figure 5: R&D funding from Research Council of Norway by sector of performance. 2003. Mill NOK.

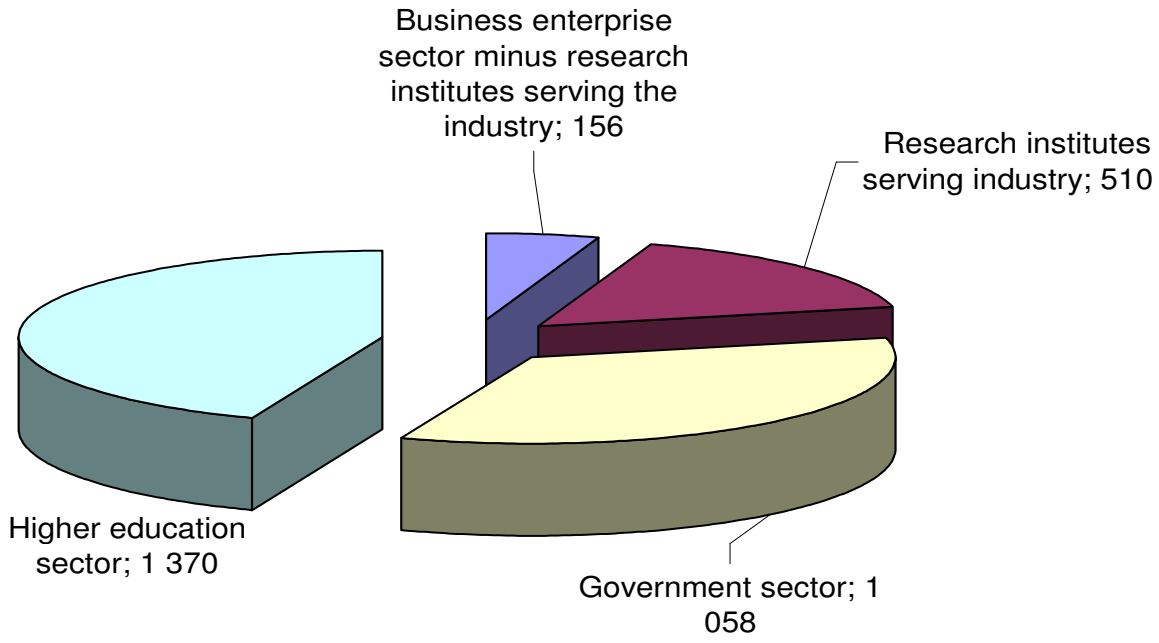


Figure 6: R&D funding from Research Council of Norway (RCN) by sector of performance. 1995–2003. Per cent of total RCN funding.

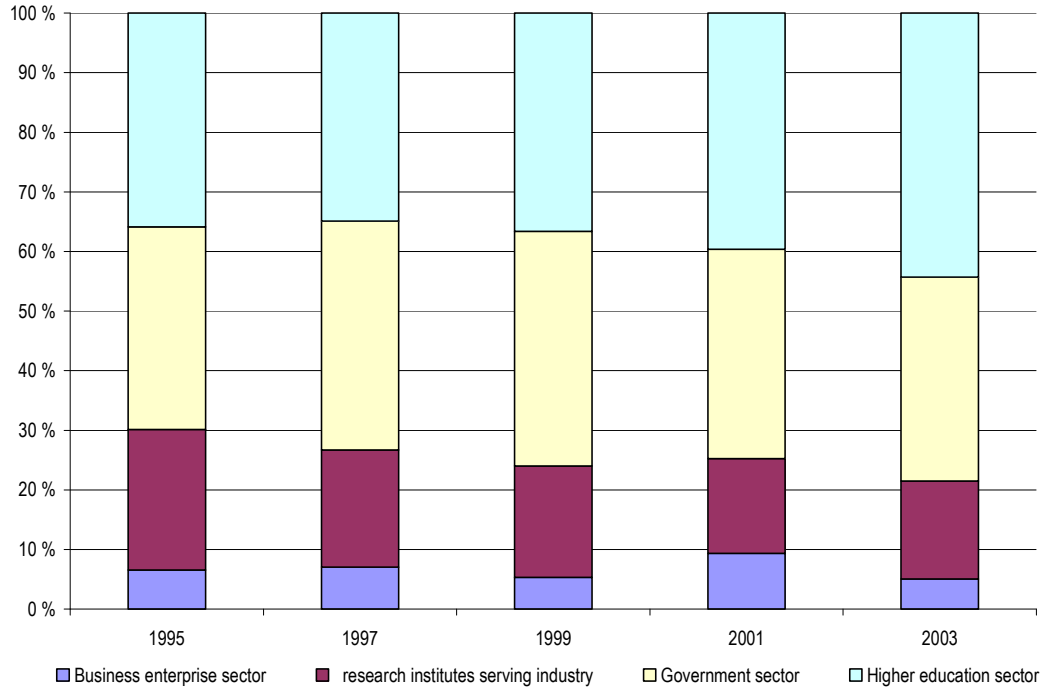
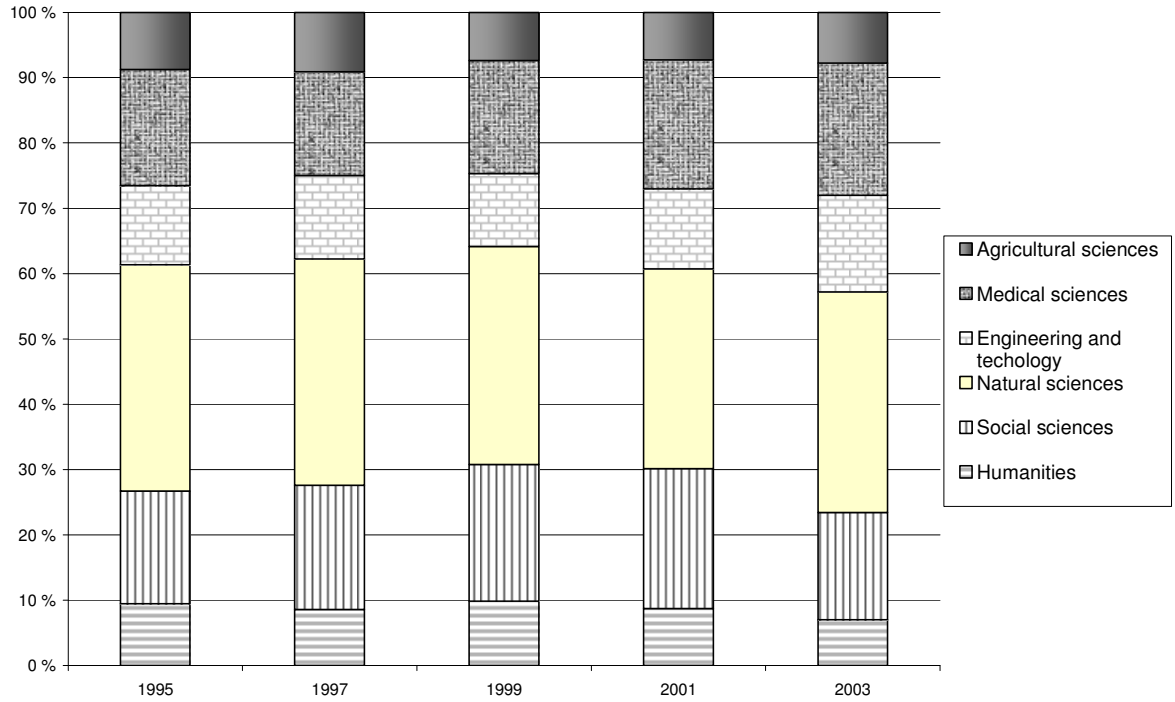


Figure 7: R&D funding from Research Council of Norway (RCN) by field of science. 1995–2003. Per cent of total RCN funding. Only operating costs.



3.5 Government funding of BERD

While government funding of BERD by sector is shown in Figure 3, we will not present further detailed data on government funding here. Rather, it is more important to focus on the types of flows of R&D funding from government to businesses.
In 2003, the business sector received 800 million NOK as R&D support by the Norwegian government of which 156 million NOK was through the Research Council of Norway. In addition, the business sector received 531 million NOK as tax deduction through the new tax credit scheme, SkatteFUNN, introduced in 2002. The entire government funding of R&D in 2003 amounted 12.6 billion NOK, indicating that the business sector received about ten per cent of total GBOARD in 2003.

More than half of this is allocated to the manufacture of weapons and ammunition (NACE 29.6). This leaves us with an almost negligible volume of funds supporting civil R&D activities in Norway. As mentioned, only 160 million NOK (1.5 per cent of total government R&D funding) was channeled through targeted research activities organised by the Research Council of Norway. In fact, business R&D funding from abroad was in 2003 about the same level (1.1 billion NOK) as the business R&D funding from national government sources.

Research institutes serving enterprises, which in OECD statistics are classified as private companies in NACE 73 (R&D sector) received 843 million NOK from government funds of which 510 million NOK was through the RCN. These institutes received additional 100 million NOK though the national tax credit scheme as a result of cooperation with an R&D performing firm.

The main conclusion to be drawn here is that government funding of civil R&D expenditure is negligible in Norway, especially when compared with the volume of business enterprise intramural R&D expenditure in 2003 (12.8 billion NOK). This is, however, not the same as saying that the effects of government funding are negligible, as complex issues of input and output additionality has to be taken into account for an assessment of this matter.

Since this issue seems to be of very high policy importance in the EU, we need disaggregated information and new indicators on the effects and impacts of government funding of BERD.

In particular, there is a need for more information on:

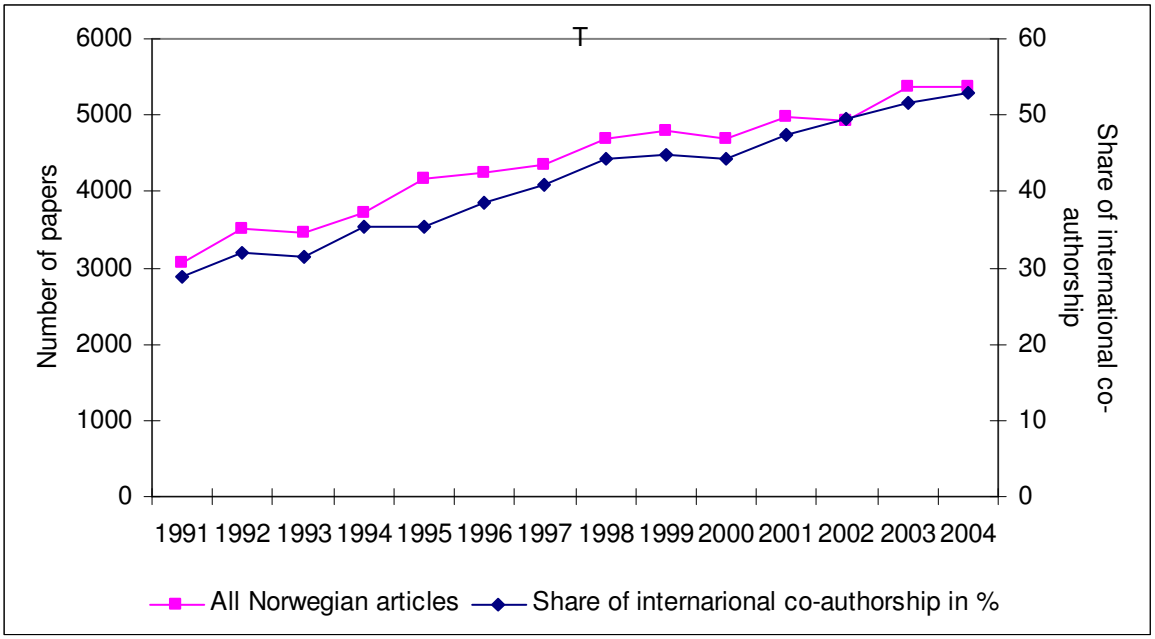
- The degree of input additionality of government R&D support by type of instruments. One fundamental distinction as regards the type of instruments is the targeted R&D funding (national R&D-programs) vs. general R&D support (tax credit schemes).

- The number and the volume of funds dedicated to policy instruments supporting general R&D needs of the business sector (networking, meeting arenas, mediating, financial advice, etc.).

- The number and volume of other non-R&D support measures (in particular, innovation policy instruments), where possible by industrial sector.

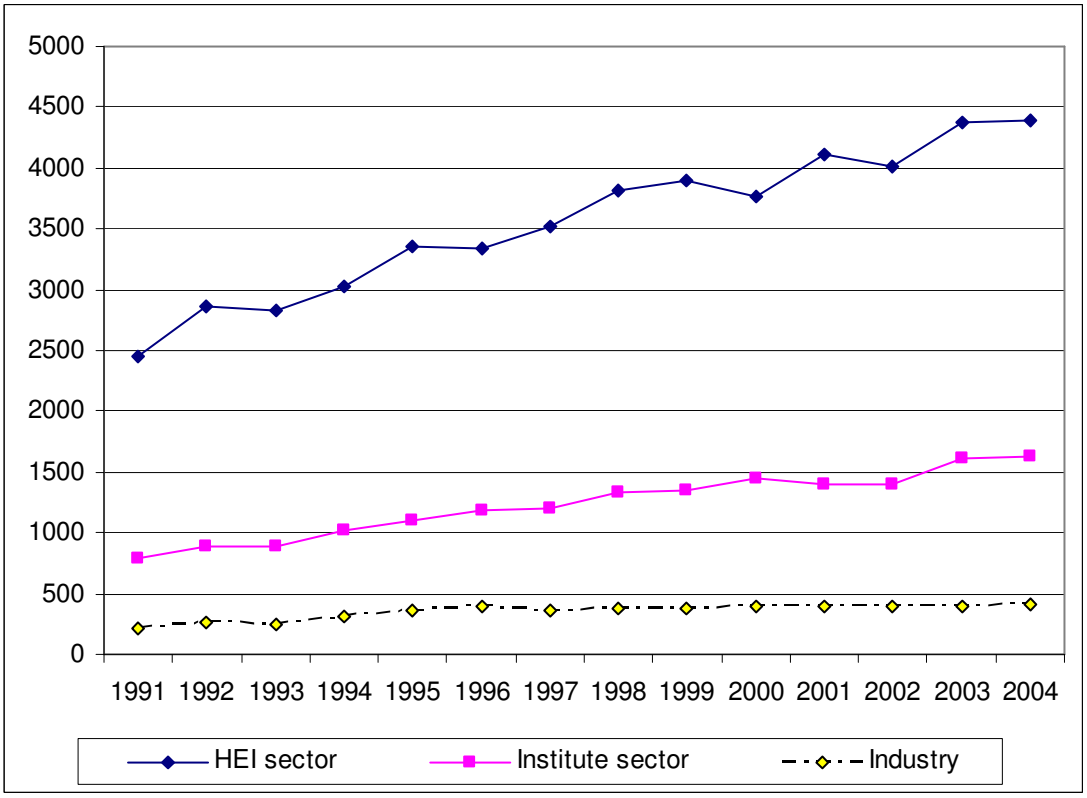
4 Relevant output indicators

Figure 8: Trend of Norwegian publications 1991–2004 (N=61315) and the shares of international co-authorship.



Data: NCR Norway 2004 / NSI Deluxe 2004 / NIFU STEP

Figure 9: Number of Norwegian publications produced by the higher education sector (including hospitals), the research institute sector and the business sector. 1991–2004.



Data: NCR Norway 2004 / NSI Deluxe 2004 / NIFU STEP

Figure 10: Number of articles in the Norwegian higher education sector (including hospitals), the institute sector and Industry. 1991-2004.

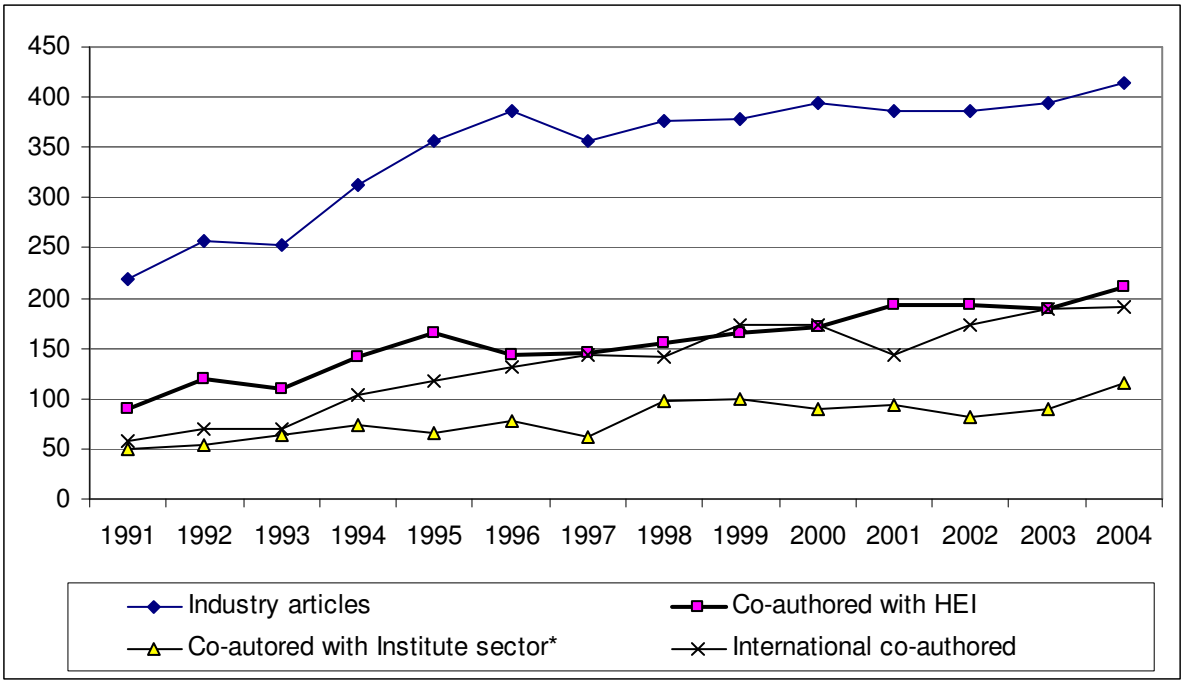


Table 7: Number of patents from the public R&D base. Patent applications to the Norwegian Patent Office, 1998–2003.

Year	Colleges	Research institutes	Universities	Public R&D base (A)	Total number of patents (B)	Per cent A/ B
1998	14	38	58	110	1291	9 %
1999	9	34	82	125	1338	9 %
2000	10	54	69	133	1406	9 %
2001	13	59	80	152	1275	12 %
2002	10	71	86	167	1267	13 %
2003	9	54	48	111	1161	10 %

Source: NIFU STEP and Norwegian Patent Office.

Table 7 provides new information on the technological output of the Norwegian public R&D base. About 10 per cent of all patent applications in Norway involve at least one researcher from a Norwegian R&D institution. This is information is difficult to find for other countries. A more detailed analysis of the distribution of patents from public R&D institutions to technical fields could indicate whether the public R&D base follows the same specialisation patterns as that of the business sector. Figures 9 and 10 show the volume of publications (research output) involving researchers from the business enterprise sector. Half of publications from industry are co-authored with researchers from the higher education sector and with researchers from foreign research institutions. This information shows that universities may be more important actors for business R&D output than indicated in Tables 3 and 4. A relevant question is whether business publications exhibit the same scientific specialisation profile as the specialisation profile of the country as a whole.

5 Conclusions

In this brief survey of public R&D funding with disaggregated national R&D data we attempted primarily to provide information on three issues which we believe are important for the future of ERAWATCH project. These issues are:

1. The share of targeted (project) research funding in the Norwegian research system compared to GERD, GBOARD and non-targeted funding of R&D

2. The distribution of both targeted and non-targeted research by sector of performance, socio-economic objective and fields of science

3. The type of instruments which are most important in government funding of BERD.

The analysis based on disaggregated data went deeper than what is possible with OECD and EUROSTAT data, and provides – we believe – new insights into the structure and inner organisation of the Norwegian research funding regime. Hence, we were able to provide some background information explaining specialisation profiles of the public R&D in Norway.

Main findings:

1. We present the distribution of Norwegian GBOARD by funding ministries in 2003 and by socio-economic objectives which are much more detailed classified than that in OECD statistics (see Figure 4, cf. Table 1).

2. In general, the majority of the ministries channel most of their mission-oriented R&D budgets to national R&D actors through national R&D programs under the RCN. This renders RCN a key knowledge policy institution in Norway, but also creates some tension between ministries and RCN due to the reduced steering ability of the funding ministries when project research is organised under national R&D programs.

3. The research institute sector is undertaking more research oriented towards fisheries, industry, environment, energy and social issues compared with the distribution of GBOARD by socio-economic objectives (see Table 2)

4. OECD and EUROSTAT data do not provide further information on how this large share of government appropriations is thematically related to national research activities. In the report we show how GUF-funding in Norway in 2003 is distributed to various fields of science (Frascati-classification) and by individual higher education institutions. The latter permits a better understanding of the regional distribution of GUF funds as well as the distribution of GUF funds by fields of science at the regional level. GUF funds represent fifty per cent of total government R&D funding in Norway in 2003.

5. In total, RCN funded R&D activities amounted to 3.1 billion NOK in 2003. This is only 11 per cent of total GERD but constitutes 27 per cent of total GBOARD, corresponding to fifty per cent of general university funds in 2003.

6. Direct project government funding is mostly oriented towards the social sciences; about one third of total external government R&D funding in higher education institutions was directed to this field in 2003. Non-profit organisations are an important source of funding of research in medical science together with the RCN.

7. Government funding of civil R&D expenditure is negligible in Norway, especially if when compared with the volume of business enterprise intramural R&D expenditure in 2003 (12.8 billion NOK). This is, however, not the same as saying that the effects of government funding are negligible, as complex issues of input and output additionality have to be taken into account for an assessment of this matter.

8. We provide data on the number of publications produced by the higher education sector, research institutes and business sector based on the ISI-Thomson database. These data provide more detailed information on the scientific output from the R&D performing sectors in Norway. As in the WP3 report for UK, linking publications to the individual institutes at the universities, colleges and research institutes enables a measure of publication productivity in the various segments of the Norwegian research system. This is, however, a labour-intensive and costly undertaking.

9. Statistics on public-private co-authorships in Norway are also presented in the report. This is, perhaps, the only output indicator on public-private R&D collaboration which could be standardised and compared across countries. The production of this indicator is, however, costly and it only covers a limited range of output from public-private R&D collaborations.