

## **Appendix II**

### **Norwegian R&D cooperation with the U.S. and Canada**

- trends and status**

# Norwegian R&D cooperation with the U.S. and Canada – trends and status

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## **Introduction**

The goal of this memorandum is to take tentative stock of Norway's R&D collaboration with North America, that is, with the U.S. and Canada. The document presents the main features of Norway's R&D cooperation and orientation relative to North America, and discusses recent trends.

The survey is divided into five main segments: 1) studies and students, 2) researcher training, 3) mobility and research cooperation, 4) industrial R&D collaboration, and 5) conclusions.

## **1 Studies and students**

### **Degree students**

Higher education is becoming increasingly internationalized. The number of Norwegian students enrolled in higher education abroad totaled roughly 4 500 in 1980, swelling to 8 000 ten years later. Internationalization subsequently picked up consideration momentum in the 1990s. Since 2000, there have been about 15 000 Norwegian students studying abroad at any given time. Figure 1 shows the trend in the number of Norwegian students abroad, based on figures provided by the *State Educational Loan Fund*.<sup>1</sup> The figures refer to degree students, i.e. individuals studying to earn a bachelor's (BA), master's (MA) or doctoral degree (PhD) at a place of study in one of the countries in question. Exchange students and part-time students earning part of a Norwegian degree abroad are not included in these figures.

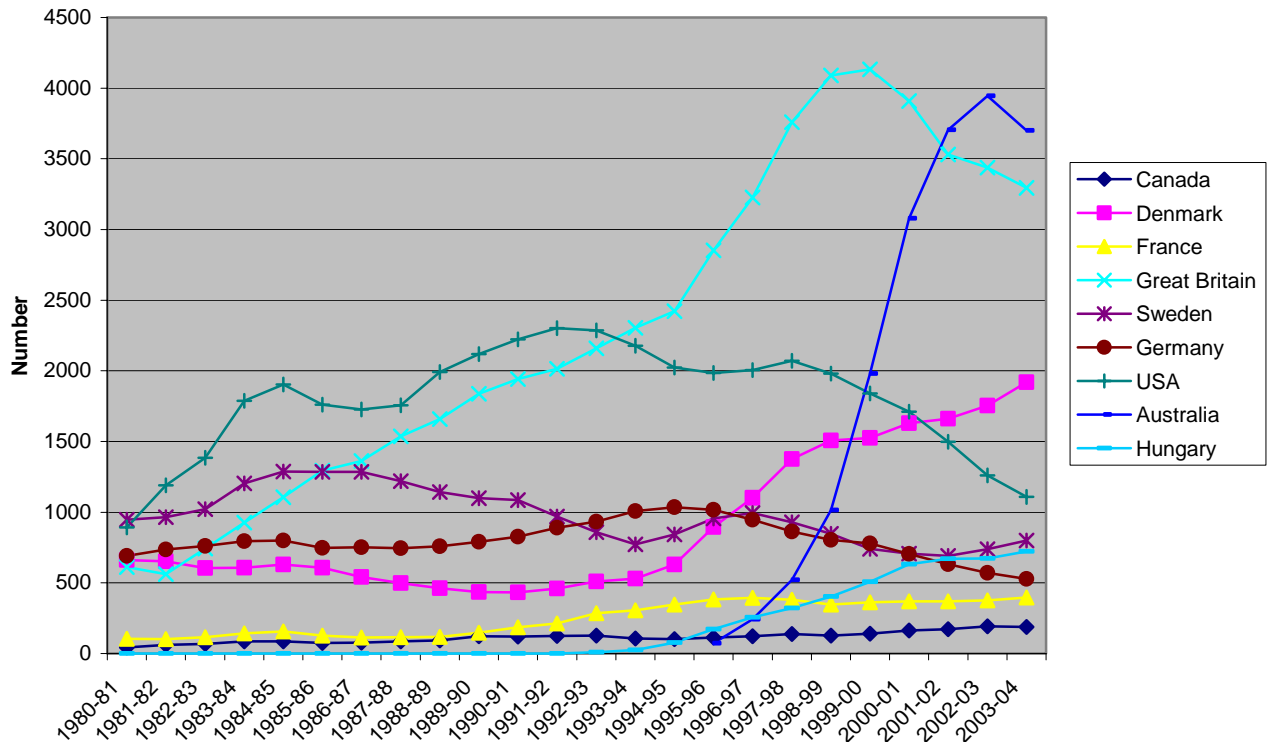
At the peak in 1991/92, there were 2300 students from Norway studying at institutions of higher learning in the U.S. with the intention of earning an American degree. Since then, the number of Norwegian degree students has diminished, slowly at first, until 1998/99 when the figure dropped below 2000, then at a more rapid pace. By 2003/04, the number of Norwegian degree students had dropped to about 1100. In other words, during the interval in which the number of Norwegian foreign students doubled, the number choosing to study in the U.S. dropped by half. The trend for Canada has been more stable, showing steady growth. In recent years, there have been about 200 Norwegian degree students in Canada.

Parallel to the rapid rise in the number of Norwegian students abroad, major changes have taken place in students' choices of countries and institutions of higher education. As shown in Figure 1, the U.S. is not the only country in which there has been a decline in recent years. The same applies to Sweden and Germany, and lately also to Great Britain. Among the new countries of preference, Australia has topped the statistics for the past few years, along with countries in the former Eastern Europe, represented here by Hungary. It is also worthy of note that Denmark has seen a pronounced increase, in sharp contrast to Sweden.

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<sup>1</sup> The figures from the State Education Loan Fund are believed to cover the vast majority of the Norwegians who study abroad. The number of rejections, i.e. applicants who receive no form of support from the State Education Loan Fund, comprises one to two percent for the years under review. Statistics from the State Education Loan Fund are available on the Internet at <http://www.lanekassen.no> and in "Norske elever og studenter i utlandet" ("Norwegian pupils and students abroad" (in Norwegian only)), which is published annually. The State Education Loan Fund has also provided relevant information about studies in the U.S. and Canada.

Figure 1 Foreign students from Norway at colleges and universities in selected countries, 1980/81 – 2003/04



What is the explanation for the trend seen for North America? The State Educational Loan Fund and the student guidance counselor in New York consider the following elements to be of importance when it comes to the U.S.:<sup>2</sup>

- High tuition fees and the high cost of living in the U.S. compared with other countries, combined with limits on the financial support provided by the State Education Loan Fund.
- No support for freshman year in the U.S., the first year of a four-year bachelor's degree, in contrast to e.g. Australia, New Zealand, Great Britain and Canada.<sup>3</sup> The State Education Loan Fund discontinued financial support for freshman year as from the 1985-86 school year.
- Very cumbersome application processes compared with what Norwegian students and pupils are used to (no 'general admission' procedure; separate applications must be submitted to each institution).
- The American educational system is vast, overly complex and difficult to understand and navigate.
- Persistent marketing on the part of other countries, including Australia. American<sup>4</sup> colleges and universities are not generally present at Norwegian education-related trade fairs or other events where they might be likely to recruit Norwegian students.

<sup>2</sup> Status report dated September 2003, Norway's educational attaché in New York.

<sup>3</sup> The content of freshman year varies from one country to the next. In the British system, which is also practised in Australia, the fourth year of a bachelor's degree involves specialization. In the U.S., freshman year is largely general studies, which was one of the main reasons that support was discontinued. Certain universities in the U.S. offer foreign students a dispensation for freshman year or accept that the year be taken in Norway.

<sup>4</sup> This presentation uses the term 'American' to refer to the U.S., while 'North American' refers to both the U.S. and Canada.

## **Non-degree students**

The internationalization of higher education has also led more students to take part of their degrees abroad. In this area too, the trend in relation to the U.S. is moving in a different direction than that for other countries. The number of non-degree and exchange students from Norway is on the rise, except for in the U.S., where the number is diminishing.

In 2003-04, there were 466 exchange and non-degree students from Norway in the U.S. (with financial support from the State Education Loan Fund), slightly more than the year before (450). There were 111 exchange and non-degree students from Norway in Canada, a significant rise from the year before (80), relatively speaking. Other major recipient countries for this category of Norwegian students are Australia (587), Great Britain (601), Spain (481), Germany (326), France (301) and Denmark (226).

## **Distribution by degree level**

In the U.S., a growing share of the Norwegian degree students are enrolled at graduate level (MA and PhD), e.g. a total of 38 percent in 2002/03. This is because fewer new Norwegian students start undergraduate (BA) studies there.

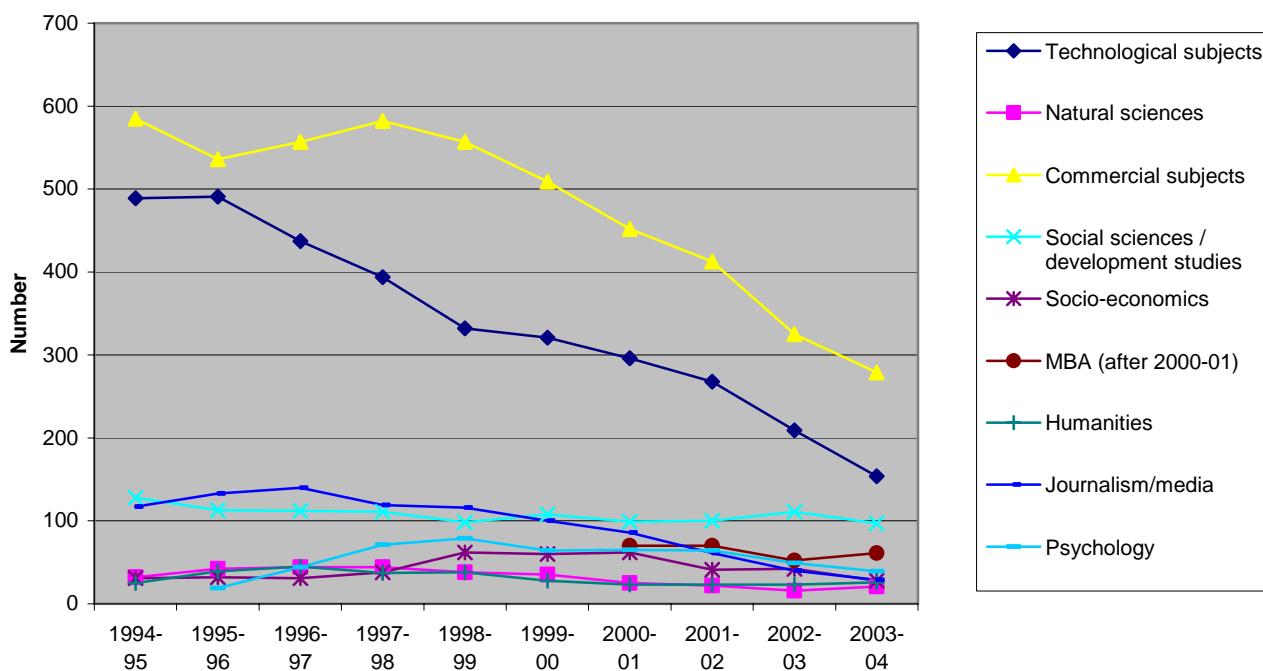
In Canada, the share of Norwegian graduate students is declining, aggregating just 14 percent in 2002-03. There are more new students at the undergraduate level there, however, while the number of graduate students has remained relatively stable.

## **Distribution by subject area**

Figure 2 shows the distribution of students by selected subject areas for degree students in the U.S. (graduate and undergraduate studies). The subject designations are the same as those used by the State Education Loan Fund. Those who receive support for researcher training are not included because they are not registered by subject area.

As the figure indicates, there has been a dramatic decline in the number of Norwegian students in the U.S. studying business administration and technical subjects, the subject areas that traditionally attract the largest contingents of Norwegian students. Large subject areas such as journalism have also declined. The same applies to natural science and economics, although the impact is substantially less. The figures for the social sciences (apart from economics and business management subjects), psychology and the humanities have been more stable.

Figure 2 Degree students in the U.S. 1994/95 – 2003/04, selected subject areas



This figure fails to include many subjects and subject areas. For example, very few Norwegians study medicine in the U.S. since that course of study is particularly time- and cost-intensive compared with corresponding educations in Norway or Europe. In the U.S., the natural sciences have not traditionally attracted large numbers of students from Norway.

The figure does not show distribution by subject area in Canada as the figures are too small to be indicative of significant development trends. Nonetheless, the pattern is somewhat similar to that for the U.S. In addition to commercial and technical subjects, science and social sciences/development studies are important courses of study for Norwegian students in Canada.

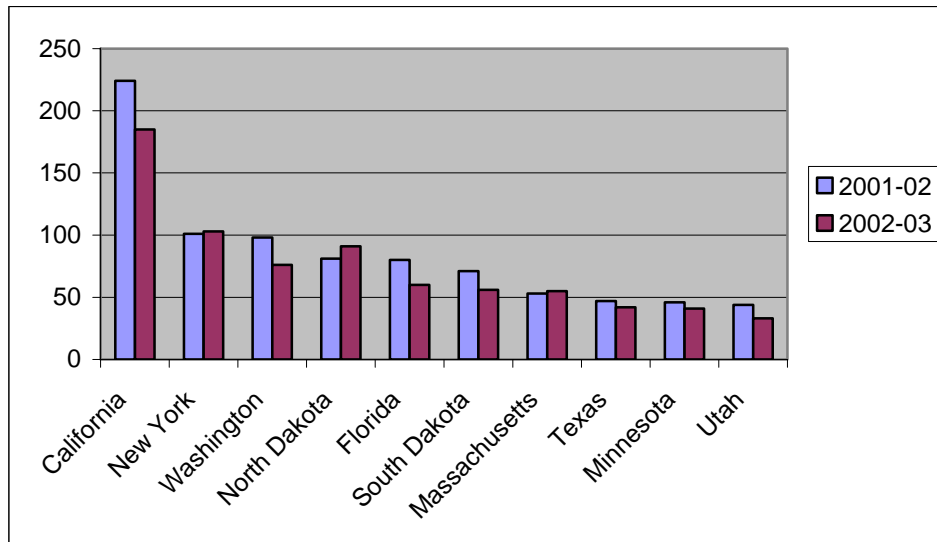
### Who and where

The majority, 55 percent, of foreign students from Norway in higher education are women. In the U.S. and Canada, however, the percentages of women are lower, i.e. 43 and 49 percent, respectively. This can to some extent be explained by which subjects attract the largest number of Norwegian students; technological and commercial subjects are traditionally male-dominated.

When it comes to the choice of places to study, the list shows a concentration of Norwegian students along the east and west coasts of the U.S., with high density spots in the traditional Norwegian areas of the Midwest. The states with the highest density of Norwegian students are shown in Figure 3 below:<sup>5</sup>

<sup>5</sup> The figure is based on figures provided by the Norwegian educational attaché in New York and the State Education Loan Fund.

**Figure 3 U.S. states with the highest densities of Norwegian degree students**



There are Norwegian students at nearly 400 institutions of higher education in the U.S., i.e. the students are distributed among a larger number of institutions than before. The vast majority of the institutions are well-known, reputable colleges and universities. However, there are very few Norwegian students at the most prestigious universities that rank highest by international standards. This is probably related to the level of tuition fees and limited opportunities for admission.

### **U.S. and Canadian students in Norway?**

It is not known how many U.S. and Canadian students apply to Norwegian institutions with the intention of earning a Norwegian degree.

When it comes to non-degree studies, there are a number of North American students in Norway, among other things as a result of exchange agreements between Norwegian and U.S. and Canadian universities and colleges. These students spend a limited time studying in Norway, for example, they may attend summer school.<sup>6</sup>

### **The impact on research**

Those who complete a course of study, particularly advanced degrees and researcher training (PhDs), make up the recruitment base for the future researcher population. It is important that the recruitment base for Norwegian research is broad, and that it includes applicants with different subjects and institutional backgrounds. It is also important for Norwegian research institutions to have contact with a number of good research communities in Norway and abroad. This will contribute to future network building, providing impetus for mobility and breadth in the recruitment of researchers. Accordingly, such contact is of significance for the qualitative development of Norwegian research communities.

This contact has a considerable impact on the research-intensive subject areas, and the importance is greater for higher rather than for lower degrees. It is especially important in relation to PhD studies.

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<sup>6</sup> Reference is made to a separate memorandum on cooperation agreements between universities in Norway and the U.S. and/or Canada compiled by Sonja Mykletun on commission for the Norwegian embassy in Washington, D.C. (Appendix III).

## **2 Researcher training**

### **Norwegians engaged in researcher training**

There are several funding opportunities available to Norwegians who study in the U.S. or Canada to earn a doctorate (PhD). First of all, the *State Educational Loan Fund* offers loans and grants to PhD students (in the U.S., Canada and many other countries, PhD students are considered students rather than academic staff as in Norway).<sup>7</sup> However, the State Education Loan Fund provides only partial funding.<sup>8</sup> Second, it is possible to apply to *the Research Council of Norway*, which can, in principle, finance an entire course of study.<sup>9</sup> Third, it is possible to apply for support to study in the U.S. through the *Fulbright Foundation* or *the Norway-America Association*, both of which offer lump sum scholarships to recipients. Those who receive grants from the Fulbright Foundation or the Norway-America Association are also eligible for support from other quarters, e.g. travel grants from the State Education Loan Fund. In addition, many receive support from their employers and respective host institutions during their stays. Data from the State Education Loan Fund cover the vast majority of these sources.

U.S. colleges and universities have different regulations for studies, depending to some extent on subject area. At some institutions, it is common to start on a PhD immediately after completing an undergraduate degree (BA), that is, without going through a master's program (MA). This is more common in the natural sciences and technological subjects than in the social sciences and commercial subjects. In many cases, however, a master's degree is a prerequisite for applying to a doctoral program. PhD students can also choose to take a master's degree during the course of their doctoral studies. For example, if a student fails to complete his/her PhD program for other reasons, e.g. financial problems, the State Education Loan Fund will provide a grant for tuition fees for MA studies, while PhD students qualify only for loans (and not for grants) for this purpose. The following conditions may have had an impact on the registered enrollment figures for PhD and MA students in the State Education Loan Fund statistics. Figure 4 shows trends in the number of people taking researcher training in different countries, based on figures from the State Education Loan Fund (degree students).

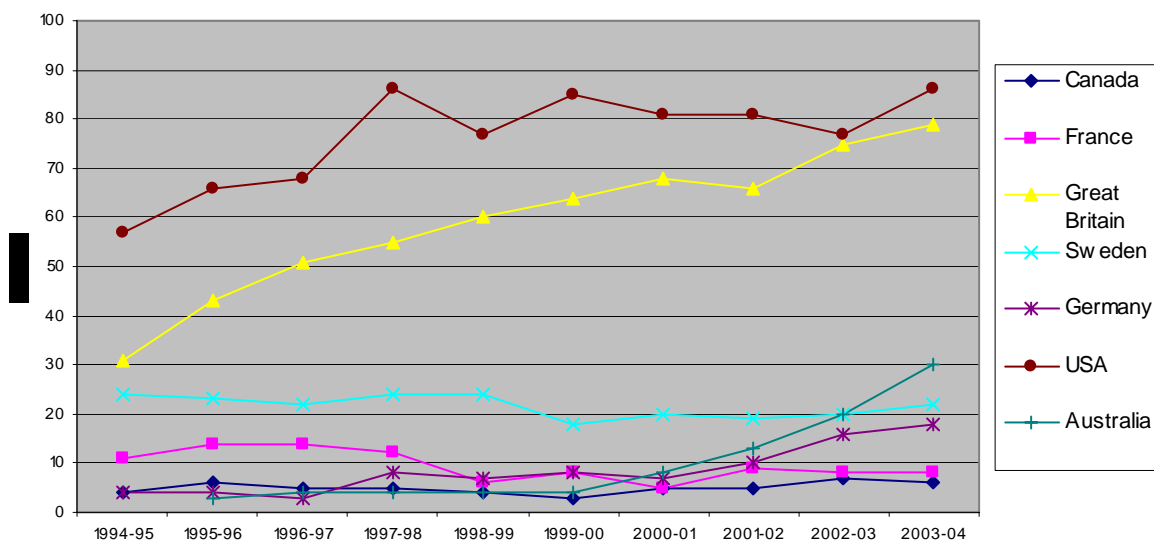
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<sup>7</sup> Although the State Education Loan Fund provides loans and grants, it has not provided loans or grants for tuition fees for PhD programs abroad. As from 2004, loans are also available to cover tuition fees for PhD programs.

<sup>8</sup> Of a total of 84 individuals who received support for PhD studies in the U.S. or Canada in 2002-2003, the State Education Loan Fund provided an average of NOK 36 000 in grants and NOK 45 000 in loans. Nearly everyone received travel grants and educational grants, but very few fully financed their researcher training on the basis of loans from the State Education Loan Fund.

<sup>9</sup> A doctoral fellowship from the Research Council of Norway consists of wages (NOK 377 000 per year in 2004, including social security) and operating capital (normally NOK 32 000 per year) for three years and an overseas allowance for the first year (NOK 120 000, or NOK 240 000 if the fellow is accompanied by his/her family). Post-doctoral fellows are paid wages of NOK 504 000 per year, while the operational and overseas allowance are the same as for doctoral fellows.

**Figure 4 Foreign students from Norway taking researcher training in selected countries with support from the State Education Loan Fund, 1994/95 – 2003/04**



The U.S. ranks first as the largest recipient country for Norwegian PhD students. Meanwhile, that trend is also demonstrating stagnation. The trend in Great Britain is on the rise, and is now on a par with the U.S. A third world power in the research arena, Sweden, has seen roughly the same trend as the U.S., but on a smaller scale. As the figure indicates, Australia is gaining ground in this area as well.

Figure 4 can to some extent be considered a continuation of the figures covering the total number of Norwegian students abroad, cf. Figure 1. If one assumes that many of the students who earn a BA, will then continue to study for a more advanced degree, an MA or perhaps a PhD, the number of Norwegian PhD students in the U.S. will probably decline further. Similarly, the number of Norwegian students in the United Kingdom will stagnate then drop, while a growing number will study at Australian institutions. However, this depends on the extent to which the students select doctoral programs at the same institution or in the same country or region as their previous studies.

Figure 5 does not include those receiving financial support for doctoral studies from the Research Council of Norway. Statistics from the Research Council indicate that the number of fellowships to PhD students in the U.S. in recent years has diminished slightly, fluctuating between 20 and 10. These fellowships account for less than one percent of the Research Council's allocations to doctoral fellowships each year.<sup>10</sup> Rising costs are an important explanation for the decline in the number of research fellows.

<sup>10</sup> There is no complete statistical material covering the Research Council's allocations over a longer period of time. An earlier study, limited to those who received funding from the Norwegian Council for Scientific and Industrial Research or the Council for Scientific Research under the Norwegian Research Council for Science and the Humanities from 1989 to 1992, indicated that 20 to 25 percent of the doctoral fellowships awarded went to applicants who intended to take their doctorates abroad. Of that number, 35 percent studied in the U.S. Many also studied in Great Britain and France, 29 and 17 percent, respectively. (Berit Karseth: *Doktorgradsstipendiater i utlandet (Post-graduate fellows abroad (in Norwegian only))*). Norwegian Institute for Studies in Research and Higher Education (NIFU), Memorandum 3, 1997.)

**Table 1 Doctoral research fellowships from the Research Council of Norway for researcher training in the U.S. and Canada, 1998-2004**

Year	1998	1999	2000	2002	2002	2003	2004
U.S.	15	20	16	17	11	14	11
Canada	3	1	1	1	1	0	1
North America, total	18	21	17	18	12	14	12

When it comes to post-doctoral fellowships from the Research Council, there has also been a decline in the number of allocations for earning complete degrees at U.S. institutions, cf. Table 2.<sup>11</sup> Post-doctoral fellowships to North America accounted for 3 to 4 percent of the Research Council's post-doctoral fellowships in the past two to three years, a somewhat higher proportion than doctoral fellowships. However, about half the Norwegian doctoral fellows who take their entire degrees at a foreign institution are in the U.S. The corresponding proportion for Norwegian doctoral students in Canada is much lower (10-15 percent).

**Table 2 Post-doctoral research fellowships from the Research Council for studies in the U.S. and Canada, 1998-2004**

Year	1998	1999	2000	2001	2002	2003	2004
Post-doctoral research fellows in the U.S.	16	15	15	10	10	9	10
Post-doctoral research fellows in Canada	1	1	0	0	2	3	1
North America, total	17	16	15	10	12	13	11

## PhDs earned

The National Science Foundation (NSF) keeps detailed statistics on all those who complete researcher training in the U.S. The graduates' data is broken down by regions and countries. Owing to the strict regulations for confidentiality that apply, the NSF does not care to make the figures for other individual countries public (with a few exceptions, e.g. Canada, Great Britain, France, Germany and Italy). In this context, Norway is part of EFTA, which presently also comprises Liechtenstein, Switzerland and Iceland. The figures for Norway in particular are not therefore known; nor is it known how many of the 86 graduates from EFTA countries in 2000 were Norwegians.

**Table 3 PhD recipients in the United States, 1990-2000**

	1991	1995	2000
Total	37 534	41 572	41 224
United States	22 929	24 793	24 464
Canada	508	526	542
EU, total	1 483	1 686	1 493
New EU member states	285	425	717
EFTA countries	69	104	86

<sup>11</sup> The table for post-doctoral fellowships applies to allocations where the entire degree is intended to be taken at an institution in the U.S. or Canada. In addition, many research fellows will study in the U.S. or Canada temporarily, while maintaining their affiliation with an institution in Norway.

An earlier study focused on the number of doctorates in the U.S. awarded to Norwegian citizens from 1961 to 1995.<sup>12</sup> During the five years from 1991 to 1995, 80 doctorates were awarded to Norwegians, i.e. an annual average of 16.

As for Canada, figures from Statistics Canada indicate that almost 4000 PhDs were awarded annually by Canadian institutions in the late 1990s. Approximately 1200 of that number came from other countries. A total of five Norwegians earned Canadian PhDs from 1991 to 2000.<sup>13</sup>

### Distribution by subject area

The State Education Loan Fund does not break down its statistical records of those receiving financial support for PhD degrees by subject. NSF's statistics for the decade from 1986 to 1995 break down as follows (NSF's subject designations):

**Table 4 The number of doctorates earned by Norwegians in the U.S. by subject area, 1986-1995<sup>14</sup>**

Physics	27
Engineering	28
Life Sciences	26
Social Sciences and Education	24
Humanities	21
Professions/Others	22
Total	148

Clearly, the Norwegian candidates for doctorates had a relatively constant distribution across subject areas during the years in question, with a certain preponderance toward the natural sciences (physics, life sciences).

### Non-degree PhD studies abroad

An evaluation of researcher training in Norway, revealed that fewer than half the PhD students surveyed had worked abroad for more than one month, and a mere 14 percent of them had spent more than six months abroad.<sup>15</sup> The sample did not include candidates for Norwegian dr.scient. and dr.polit. degrees. However, an earlier evaluation of Norway's dr.scient. training gives the same impression when it comes to studies abroad.<sup>16</sup>

Thirty percent of the students who spent time abroad studied in North America, compared with nearly 45 percent who studied in the EU. For technical subjects such as engineering, the proportion of dr.ing. students who spent time at North American institutions was as low as 25 percent.

<sup>12</sup> Randi Søgne: *Nord-Amerikas rolle innenfor norsk forskning og forskerutdanning (North America's role in Norwegian research and researcher training* (in Norwegian only)). Norwegian Institute for Studies in Research and Higher Education (NIFU) Memorandum 5, 1998.

<sup>13</sup> The figures were provided by Statistics Canada on request. These figures indicate that at the end of the 1990s, there were 6 to 7 Norwegians participating in Canadian PhD programs. This is consistent with the State Education Loan Fund's list of loan and grant recipients for this purpose.

<sup>14</sup> Reprinted from the Norwegian Institute for Studies in Research and Higher Education (NIFU), Memorandum 5/98. The NSF registers Social Sciences and Education separately, with roughly the same number of Norwegian students in each group. In Norway, education is considered a social science.

<sup>15</sup> The Research Council of Norway: *Evaluering av norsk forskerutdanning (Evaluation of Norwegian researcher training* (in Norwegian only)), Oslo 2002. The table below was excerpted from this report.

<sup>16</sup> *Evaluering av dr.-scient.-utdanningen i Norge (The evaluation of dr.scient. training in Norway* (in Norwegian only)), conducted under the auspices of the National Meeting of Faculties of Science, Oslo 2000. This survey indicates that a slightly higher proportion, 53 percent of the candidates, spent time studying abroad during their doctoral studies, while 21 percent of all the doctoral candidates spent up to two months abroad. This survey did not register the country or regions in which the candidates studied.

**Table 5 PhD students who studied abroad, by type of doctorate and place of foreign study (percentages)**

Categories	Dr.ing.	Dr.med.	Dr.art.	Dr.odont.	Dr.oecon.	Total
The Nordic countries	18	15	12	22	11	15
Europe, otherwise	47	35	52	44	26	44
U.S./Canada	25	44	28	33	59	33
Rest of the world	11	6	8	0	4	8
Total	100	100	100	100	100	100
Population (N)	(120)	(54)	(95)	(9)	(27)	(305)

### North American researchers taking PhDs in Norway

During the eight-year period from 1995 to 2002, a total of 5271 individuals earned their doctorates at Norwegian universities. Of that number, 707 or 13.5 percent, were foreign nationals. This proportion appears to be on the rise, reaching 21 percent in 2003.<sup>17</sup>

From 1995 to 2002, a total of 33 individuals from the U.S. and 10 from Canada earned Norwegian doctoral degrees. These figures accounted for six percent of all doctoral degrees awarded to foreign nationals in Norway.

### 3 Mobility and research cooperation

In this context, the term 'mobility' is understood as the movement of people across national borders, either by Norwegian researchers staying in other countries, or by researchers from other countries spending shorter or longer periods of time in Norway.

NIFU conducted questionnaire surveys among tenured academic staff at Norwegian universities in 1982, 1992 and, most recently, in 2001. Not surprisingly, one of the main characteristics that emerges is increasing internationalization. In 1992, 30 percent of the employees stated that they had taken at least one trip in the past year in connection with international research cooperation. By 2001, the figure had climbed to 50 percent.<sup>18</sup>

### Europeanization

The pattern for mobility and research cooperation is in flux. While 38 percent of university employees traveled to North America in connection with research cooperation in 1991, the proportion had dropped to 33 percent in 2000. Contact and cooperation with Europe and the Nordic countries, on the other hand, had increased significantly, while research cooperation with the rest of the world was at roughly the same level in 2000 as in 1991, cf. Figure 5.

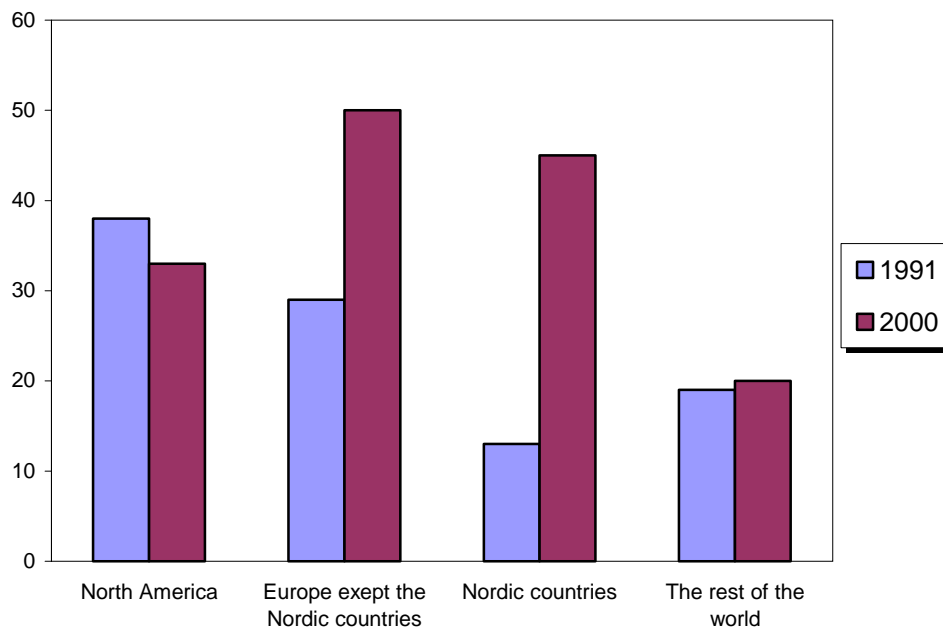
<sup>17</sup> Source: Doctoral Degree Register, NIFU, cf.

[http://english.nifustep.no/english/content/statistics/doctoral\\_degree\\_statistics](http://english.nifustep.no/english/content/statistics/doctoral_degree_statistics)

<sup>18</sup>Jarle Trondal and Jens-Christian Smeby: *Norsk forskning i verden. Norske forskeres internasjonale kontaktflater. (Norwegian research the world over. Norwegian researchers' international contacts (in Norwegian only))*. NIFU series no. 17/2001. Comparable data were not provided in the university survey from 1982. The survey indicates that in 1990, 44 percent of the university and university college staff members had not traveled in connection with professional collaboration at all during the three preceding years. In 2000, this percentage had diminished to 34 percent.

This trend has been partly explained by Norway's participation in the EU's framework programs since the late 1980s. Other explanations may be related to the relative decline in travel costs, or possibly by better financial aid opportunities. The development of the Internet and e-mail have probably also affected travel patterns. On the one hand, the Internet offers an alternative to travel, but on the other, such communication makes it easier to establish contacts abroad, which may, in turn, result in more travel.

**Figure 5 Share of tenured academic staff with at least one international research project in 1991 and 2000, by continent. Percent<sup>19</sup>**



### Post-doctoral fellowships to the U.S. and Canada

The above-mentioned survey applied to the entire academic staff. A special survey for post-doctoral fellowships indicates that half of these research fellows spent time abroad during their fellowship period, and that 35 percent of them spent more than six months studying abroad.

However, a relatively high percentage of the research fellows who traveled chose to spend time at an institution in the U.S. or Canada. The largest percentage was for medical studies, where 75 percent of the post-doctoral fellows who spent time abroad went to North America. The lowest relative figure was for the natural sciences and technical subjects (45 percent).<sup>20</sup>

### Incoming mobility

In 2003, a committee appointed by the Research Council of Norway submitted a proposal on the incoming researcher mobility of academic staff. The report states that 12.5 percent of researchers at institutions of higher learning and in the institute sector came from foreign backgrounds (first registered nationality).<sup>21</sup> The proportion was highest at the universities (16

<sup>19</sup> The figures are based on the report by Jarle Trondal and Jens Christian Smeby: *Norsk forskning i verden. Norske forskeres internasjonale kontakflater (Norwegian research the world over. Norwegian researchers' international contacts* (in Norwegian only)). NIFU series no. 17/2001.

<sup>20</sup> Svein Kyvik, Terje Bruen Olsen and Agnete Vabø: *Postdoktorordningen (The post-doctoral scheme* (in Norwegian only)). NIFU series no. 37/2003.

<sup>21</sup> The committee's recommendation was submitted to the Research Council of Norway: *Forskermobilitet til Norge. Rapport fra Utvalget for inngående forskermobilitet (Researcher mobility to Norway. Report of the Committee for Incoming Researcher Mobility* (in Norwegian only)), Oslo 2003. The basic material and data are discussed in Lars Nerdrum, Inge Ramberg and Bo Sarpebakken: *Inngående forskermobilitet til Norge. Omfang og erfaringer (Incoming researcher mobility to Norway. Scope and experience* (in Norwegian only)). NIFU series no. 10/2003.

percent). Examining occupational categories, the most foreign nationals were to be found among professors (14 percent). As many as 20 percent of the individuals in recruitment positions (incl. post-docs) were registered as foreign nationals.

A total of 253 of the academic staff came from the U.S. or Canada, i.e. less than 10 percent of those with foreign backgrounds.<sup>22</sup> The percentages are roughly the same in the higher education and institute sectors. North Americans account for about 20 percent of the total number from the OECD area.

### **The largest groups, relatively speaking, are in social sciences and the humanities**

The academic staff with a North American background is unevenly distributed. The North American contingent of social scientists is relatively high: 35 percent of academic staff members from North America are social scientists.

As indicated in Figure 6, the percentage of social scientists is significantly higher among North Americans in particular, than among the foreign academic staff as a whole. On the other hand, North American staff members at Norwegian institutions are poorly represented in science and technology.

The reason for this skewed distribution is not apparent, but it bears out the impression of traditionally strong trans-Atlantic ties in the social sciences. The under-representation of North American researchers in Norwegian natural science and technological specialist groups may be explained by the fact that the conditions offered for this kind of work in Norway are not competitive with North American conditions, as opposed to what is the case for the social sciences.

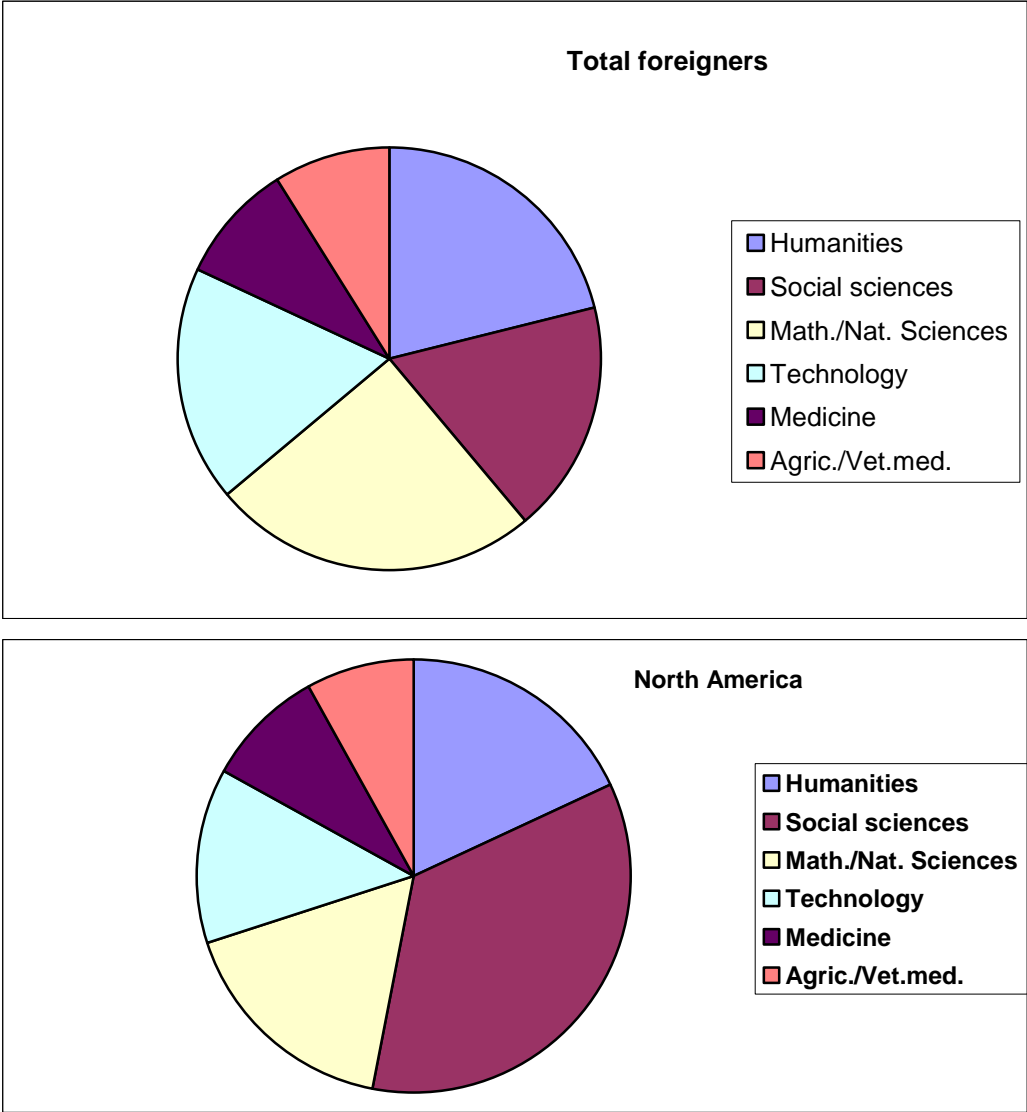
There may also be characteristics of Norway and Norwegian research that affect who applies to Norwegian research communities. A survey conducted under the auspices of the Research Council of Norway generally indicated that both personal and professional factors motivated researchers to work in Norway.

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The data sources are NIFU's research personnel register, combined with Statistics Norway's Social Statistics. Limited to North America in this context, these data are not published basis data from the NIFU report.

<sup>22</sup> Foreign employees are registered by nationality. However, the figures do not specify whether any of them had temporary stays or courses of study in other countries. For example, is it possible that individuals from Third Party States have taken researcher training in the U.S. or Canada.

**Figure 6 Percentage of individuals with foreign backgrounds in the higher education and institute sectors in 2001, i.e. total foreign nationals and North American nationals, respectively**



**Visiting foreign researchers and professional stays abroad in the institute sector**

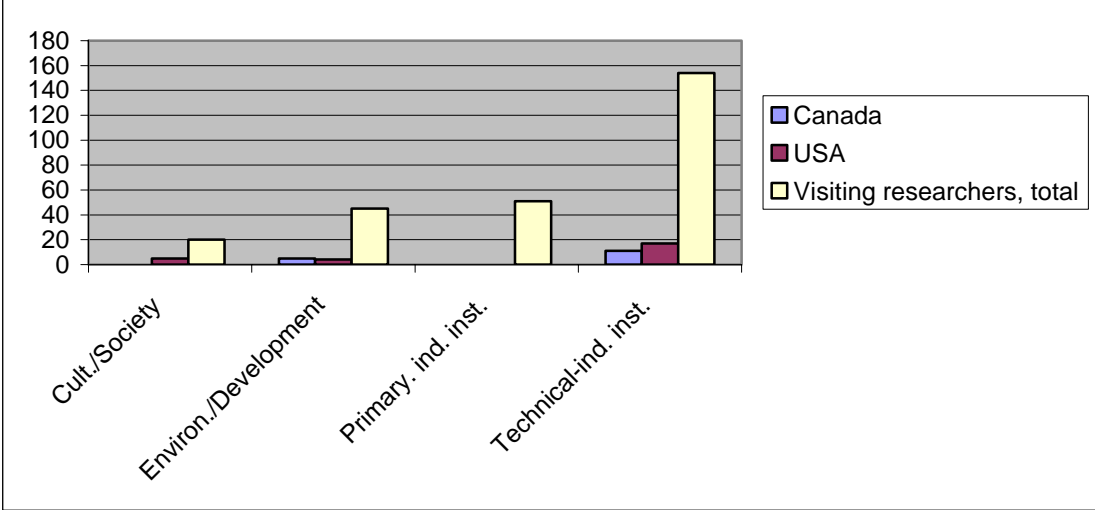
The annual report from the research institutes provides information about visiting foreign researchers and Norwegian researchers who spend time abroad for professional reasons. Figure 7 shows the total man-months of labor spent in Norway by visiting foreign researchers from the U.S. and Canada in 2001 and 2002, and Figure 8 shows the number of Norwegian researchers who spent time in the U.S. and Canada during the same period. Both figures show the numbers for North America relative to the total numbers (all countries and regions).<sup>23</sup>

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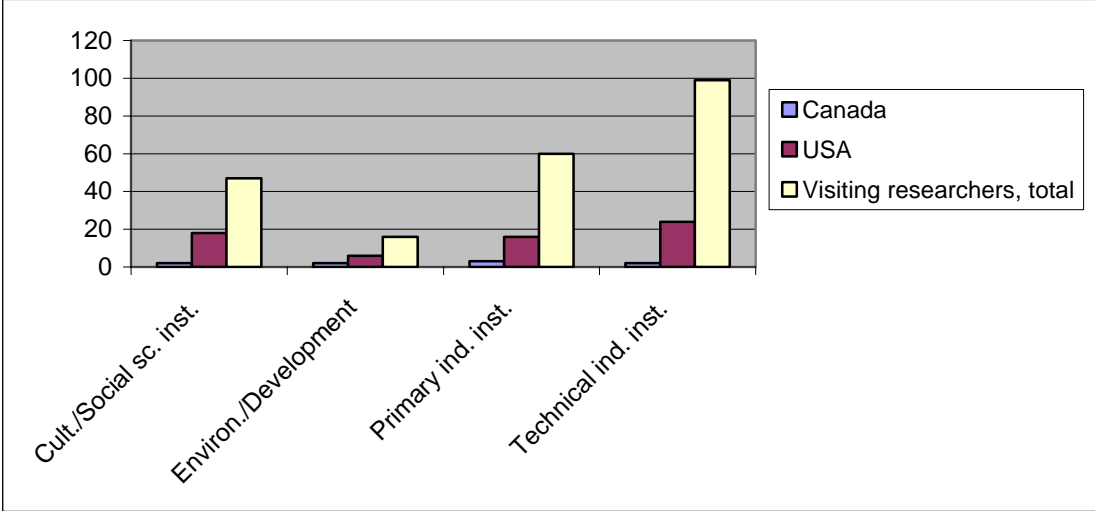
<sup>23</sup> The Research Council of Norway: *Årsrapport fra forskningsinstituttene*, overall reports for 2001 and 2002 (Annual report for the research institutions for 2001 and 2002 (in Norwegian only)). The annual reports are published both as overall reports and for groups of institutions. The reports mainly encompass the research institutions covered by the *Guidelines for government funding of research institutions*, which account for some 80 percent of the aggregate R&D activities in the institute sector.

The institutes are divided into four groups, i.e. culture and society, environment and development, primary sector and technical–industrial. The number of visiting foreign researchers and Norwegian researchers spending time abroad is relatively high in the technical-industrial institutes. Notwithstanding, these institutes have a relatively moderate contingent of researchers from North America. The number of Canadian researchers working at the technical-industrial institutes is relatively high.

**Figure 7 Visiting foreign researchers at the institutes, aggregate 2001 and 2002.**



**Figure 8 Institute staff staying abroad, aggregate 2001 and 2002**



As far as the cultural and social science institutes are concerned, North American researchers account for a substantial percentage, roughly one fourth. Furthermore, researchers in the cultural and social science institutes are particularly willing to travel to the U.S., since nearly every other foreign trip with a duration of more than two months was to the U.S. North America is to a lesser extent a destination for employees in the primary industry institutes and technical-industrial institutes. The figures for the institutes in the environment and development sector are small in both absolute and relative terms.

**International research cooperation in the university sector**

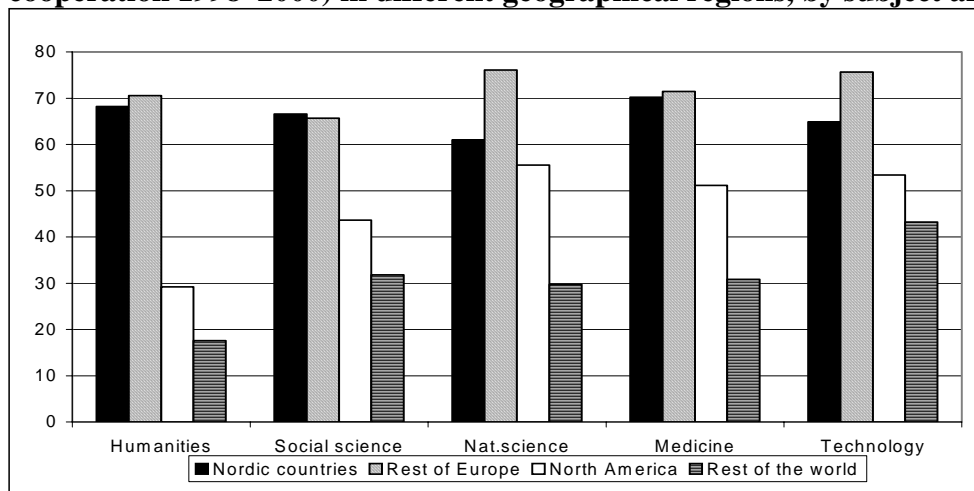
Norwegian researchers in the university and university college sector engage in extensive international cooperation. Such research cooperation is closely associated with mobility, e.g. research performed at institutions in other countries often leads to cooperation on research

projects, or vice-versa, i.e. that joint international projects lead to mobility when researchers visit other institutions, as well as conferences, network meetings, etc.

Figure 9 is based on the University Survey from 2001, and demonstrates how international scientific cooperation breaks down by region and subject area.<sup>24</sup>

In most subject areas, Norway's largest number of partners are in the Nordic countries or other European countries. Nonetheless, a large number of researchers state that they engage in trans-Atlantic cooperation. More than half the academic staff in the natural sciences and technological and medical subjects state that they cooperate with colleagues in the U.S. or Canada, as do about 40 percent of social scientists and 30 percent of those in the humanities.

**Figure 9 Percentage of academic employees' contacts (travel 2000 and research cooperation 1998–2000) in different geographical regions, by subject area.**



### Increase in international co-authorship – strongest for Europe

International research cooperation can also be measured through international databases on publications. Research is usually documented and presented in different types of publications, and scientific articles are published in peer reviewed journals. Having an article in a peer reviewed journal is therefore a goal for researchers, so high publication figures are indicative of high quality and productivity in research. Such articles are registered in international databases, providing a basis for statistics.<sup>25</sup>

Such statistics provide information about the co-authorship of articles and the authors' national and institutional affiliations. Thus the data on co-authorship is an expression of the scope of research cooperation across institutions and national borders. Publication in scientific journals is most common in the natural sciences and medicine, while researchers in the social sciences and the humanities publish their work in other types of publications as well. The figures should therefore be used with caution, and primarily be understood as being indicative of tendencies at the macro level. Generally speaking, in recent decades there has been a tremendous increase in international publication. The percentage of articles with international co-authorship has risen steeply, approaching half of all the scientific articles.

<sup>24</sup> The figure was excerpted from Jarle Trondal and Jens Christian Smeby: *Globalisation or Europeanisation? International Contact among University Staff*. Article in *Higher Education*, 2004.

<sup>25</sup> Co-authorship between Norwegian and North American researchers is discussed at length in Appendix IV, *Research Cooperation on Scientific Articles*, by Gunnar Sivertsen.

Nearly one-third of the Norwegian articles with international co-authorship had at least one other co-author with an institutional address in the U.S. The U.S. maintains a corresponding position in other Nordic and European countries when it comes to international co-authorship. As far as Norway is concerned, Sweden and Great Britain are also important partners, with shares in excess of 20 percent. The scope of co-authorship with Canada is relatively limited, although it differs from one subject area to the next.

One important, distinct characteristic of the trend is that co-authorship is on the rise in relation to all countries. However, the rise is weakest in relation to the U.S., and weak for Canada as well, while it is stronger for European countries. Gunnar Sivertsen and Liv Langfeldt have called this the 'Europeanization of research'.<sup>26</sup> One obvious explanation for this trend is Norway's participation in the EU's research programs since the late 1980s. That being said, this trend is not peculiar to Norway.

#### **4 Industrial R&D collaboration**

North America is not only a world leader in R&D. The U.S. and Canada are both leaders when it comes to industrial innovation and research and development work.<sup>27</sup> However, there is some uncertainty attached to the importance of the U.S. and Canada in relation to industrial R&D in Norway.

#### **Innovation cooperation**

The 2001 Innovation Survey covers the years 1999 to 2001, when figures were collected for cooperative partners engaged in different types of economic activities. The international partners are divided by countries and regions. The survey included a total of 1408 units (enterprises). Generally, it appears as though innovation cooperation is primarily directed toward other Norwegian enterprises. In mining and manufacturing, some 40 percent of the enterprises cooperated with one or more other Nordic countries to achieve innovation, a figure comparable to the figure for other EU states, while the figure was significantly lower for cooperation with the U.S. (19 percent).<sup>28</sup>

The largest enterprises are the most active with a view to innovation, and they are also the ones that cooperate most extensively with enterprises abroad for the purpose of innovation. If we limit the survey to enterprises with more than 500 employees, the percentage of international cooperation is more than 20 percentage points higher than the overall average for the Nordic countries, as well as for the EU and the U.S.

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<sup>26</sup> Gunnar Sivertsen and Liv Langfeldt: *EU-forskningen forandrer Norges samarbeidsprofil. Forskningspolitikk (EU research changes Norway's cooperation profile. Research policy (in Norwegian only))*, no. 1, 2003.

<sup>27</sup> *The Confederation of Norwegian Business and Industry's (NHO) Competition Barometer* gives such indications for the U.S. Canada is not included on NHO's list.

<sup>28</sup> Source: The Innovation Survey 2001/Statistics Norway, see <http://www.ssb.no/emner/10/03/innov/> and related tables.

**Table 6 Innovation partners by country and industry from 1999 to 2001, key figures. Percentage of enterprises engaged in cooperation.**

Industry (SN94)	Industry	Number of collaborating units	Norway	The other Nordic countries	EU outside the Nordic countries	New EU member states	U.S.	Japan	Others
10, 13-37	Total, industrial and mining operations	579	89	43	46	5	19	5	8
51-74	Total, services	627	87	27	24	1	12	3	10
05-74	Business and industry, total	1 408	90	31	33	3	14	4	8

In terms of geography, the figures show that the desire for cooperation declines proportionate to the increase in distance. This may be because costs are higher, or there may be other practical, technical, legal or cultural barriers to seeking innovation cooperation.

### Patent cooperation

An overview of patents in the U.S., by the rightsholder's address, indicates that there was a substantial increase in the number of patents in the U.S. applied for by individuals living in Norway from 1999 to 2001.

**Table 7 Number of patents notified in the U.S. by inventor's address, 1990-2001, selected countries<sup>29</sup>**

Country	1990-93	1994-97	1998-2001	Annual average	Change from 1994-97 to 1998-2001 (percent)
Norway	448	537	936	160	74.3
Denmark	758	980	1 729	294	83.1
Austria	1 453	1 364	1 960	397	43.7
Finland	1 289	1 566	2 594	454	65.6
The Netherlands	3 607	3 256	5 046	992	55.0
Sweden	2 746	3 233	5 946	994	83.9
Canada	7 808	8 723	13 225	2 429	51.6
U.S.	204 053	234 616	336 887	64 629	43.6
Total	586 717	659 339	961 423	183 957	45.8

As the annual averages show, the Norwegian level is relatively low. However, patenting as such is not indicative of R&D or innovation cooperation with other countries; patenting is done for commercial purposes. Consequently, these figures are more important for Norway's economic relations with other countries than as an indication of the country's R&D and innovation cooperation.

<sup>29</sup> Source: U.S. Patent and Trademark Office/TAF Data Base/Norwegian Institute for Studies in Research and Higher Education (NIFU).

A special study on patent cooperation with the U.S. and Canada is presented as a separate appendix.<sup>30</sup> EU collaboration has had a major impact in this context as well; Norwegian patenting in the U.S. based on EU cooperation increased by more than 400 percent from 1996/97 to 2001/02. Cooperation with the U.S. also increased significantly. Nordic activities are relatively less important, and Canadian activities are of little importance as partners for patenting, both in the U.S. and in Canada.

## **6 Conclusions**

### **Students**

Given the extent of the trans-Atlantic ties described in this memo, the decline in the number of students is the most conspicuous and pronounced change that has taken place. This applies to technological and business-related subjects in particular. As of today, there is no sign that the trend of recent years is tapering off. Although there has been an increase in the number of Norwegian students in Canada, it is far from sufficient to compensate for the decline in the U.S. If this trend continues, the importance of this region as a knowledge supplier to Norway will diminish.

### **Researcher training**

There is reason to believe that the decline in the total number of Norwegian students will eventually affect recruitment to advanced and doctoral studies. The stagnation and moderate decline registered for the U.S. will probably continue unless adequate measures are implemented.

Recruitment to doctoral studies and post-doctoral studies generally take place with funding from the State Educational Loan Fund, the Research Council of Norway and the Fulbright Foundation. The total number of such fellowships is relatively moderate. The aggregate number of doctoral fellowships allocated by the Research Council for researcher training in North America accounts for one percent of all its fellowships, and the proportion is diminishing. The percentage is somewhat higher for post-doctoral fellowships. In addition, a relatively large percentage of the post-doctoral fellows affiliated with Norwegian institutions choose to work in North America for a period of time.

### **Mobility and research cooperation**

Meanwhile, there is reason to underline that North American institutions are still important partners for Norwegian research communities. Norwegian researchers travel more frequently than before, and they travel to a wide variety of destinations. However, their choice of destinations has not changed dramatically over the past decade. North America, and in particular the U.S., is still an important destination for many researchers, but its relative importance is diminishing compared with the other Nordic countries and Europe. One important reason people prefer the U.S. is the auspicious tax regime associated with working at an American university. This must be continued.

Although U.S. researchers have correspondingly favorable terms for working in Norway, this country is not often chosen as a destination for U.S. researchers' foreign travel. In this context, Norway faces competition from numerous strong research nations. The improvement of research quality is one of the main reasons Norwegian research groups are interested in attracting researchers from other countries.

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<sup>30</sup> See Appendix V, *Patents that document cooperation between Norway and North America*, by Antje Rapmund.

If Norwegian research communities are to attract North American researchers on a broad basis for shorter and longer stays, special incentives are required in addition to continued focus on quality, attractive terms and the development of strong research communities.

Norway's international research cooperation and co-authorship are increasing, but the growth is clearly stronger in respect of other Nordic and European countries than in respect of both the U.S. and Canada. Norway's stronger orientation toward Europe has been deliberate, and a response to participation in the EU's framework programs. Any weakening or deterioration of the trans-Atlantic ties over time as a result of this could be risky, and constitute a threat against Norwegian research and knowledge development.

### **Industrial R&D cooperation**

The data available on Norway's industrial R&D cooperation do not give an adequate picture of cooperation with relevant activities in North America. Norway's orientation toward Europe is pronounced in this context as well.

The U.S. is an important partner for patent cooperation, but plays a less prominent role than Europe in innovation cooperation. In light of the strong position the U.S. enjoys as a knowledge supplier, economic superpower and Norway's close political ally, this is nevertheless worthy of note.

Norway's cooperation with Canada is poorly developed. In light of the strong focus on R&D-based economic development in this country, there is a huge potential for additional collaboration that would be of mutual benefit to Norway and Canada alike.

