STEP report **ISSN 0804-8185**

R-06
•
1998

Svein Olav Nås et al.

Formal competencies in the innovation systems of the Nordic countries: An analysis based on register data

Svein Olav Nås, Anders Ekeland, Eric J. Iversen - *STEP*
Mikael Åkerblom, Markku Virtaharju - *Statistics Finland*
Christian Svanfeldt, Jonny Ullström - *NUTEK, Sweden*

Final report from the focus group on skills and mobility.
OECD work on National Innovation Systems phase II.

STEP
Storgaten 1
N-0155 Oslo
Norway

Oslo, July 2, 1998

STEP group
Studies in technology, innovation and economic policy
Studier i teknologi, innovasjon og økonomisk politikk

Storgaten 1, N–0155 Oslo, Norway
Telephone +47 2247 7310
Fax: +47 2242 9533
Web: http://www.sol.no/step/

STEP group

STEP publiserer to ulike serier av skrifter: Rapporter og Arbeids-notater.

STEP Rapportserien

I denne serien presenterer vi våre viktigste forskningsresultater. Vi offentliggjør her data og analyser som belyser viktige problemstillinger relatert til innovasjon, teknologisk, økonomisk og sosial utvikling, og offentlig politikk.

STEP maintains two diverse series of research publications: Reports and Working Papers.

The STEP Report Series

In this series we report our main research results. We here issue data and analyses that address research problems related to innovation, technological, economic and social development, and public policy.

Redaktør for seriene:
Editor for the series:
Dr. Philos. Finn Ørstavik (1998)

Foreword

The present report has been submitted to the OECD, under the same title but in an incomplete form, during the spring of 1998. Following an agreement between the participating authors the current report replaces the earlier version dated May 6, 1998. This is the final version of the report, intended for use by the OECD, and others.

We believe the work contains information of interest to many, and the inclusion of the study in the STEP Report Series is intended to promote diffusion to a wider audience.

We take the opportunity to thank our partners both in Finland and Sweden for an inspiring joint research effort.

Oslo, July 2, 1998

Keith Smith
Director
STEP group

Preface

The mobility of human resources for science and technology is acknowledged as a major vector of the circulation of knowledge within national innovation systems (NIS) and between them. As shown by the work of NIS, the circulation of knowledge is a major factor in the ability of national economies to generate and adopt efficiently new technologies.

There are currently two inter-related efforts within the framework of the OECD that involve the mobility of human resources. In each, Sweden has played the role as leading country. One is the *Blue Sky* indicator project on mobility, which is being carried out jointly by Statistics Sweden and NUTEK. This mobility work delves into the question of how the circulation of different types of knowledge can provide the basis for new S&T indicators: patents, publications, equipment and intermediate goods etc. are being studied. The subject of the project is the mobility of qualified members of the work force. The purpose is to follow graduates of higher education as they move into, and around, in the labour market, carrying with them their skills and competencies. The project is interested in how the graduates change workplace, whether it involves a simple change in what firm or laboratory they work at, a more fundamental change in field of work, or whether it involves a geographical change that carries them and their knowledge-capabilities to other regions and countries. General patterns of such mobility are being studied in the blue-sky project, through a focal interest on graduates holding higher science and technology degrees.

A second effort, into which that indicator-oriented work is to feed, aims at describing in quantitative terms the capacity of National Innovation Systems (NIS) to absorb and distribute knowledge: this effort was initiated and is monitored by TIP. One of the several focus groups that have been set up in this context is this one, studying the mobility of human resources. The work here follows the general trajectory of the NIS work, where the aim has been to 'map' important dimensions of national innovation systems, with thoroughness rather than stringent comparability between countries being the guiding idea. The NIS focus group on mobility has consisted of Finland, Norway and Sweden, all of which have access to the labour registry data that makes

mobility studies involving entire populations possible. Denmark, where the same kind of data is available, has participated in some of the meetings and has signalled interest in joining the work in a follow up study.

The work presented in this report is the joint efforts of Finland, Norway and Sweden within the NIS focus group on mobility. The work has aimed at producing similar stock and mobility data for the three countries, with an emphasis placed on the highly educated within the fields of the natural sciences and engineering. Much effort has been dedicated to sorting out methodological questions as well as to creating a productive institutional framework for this work. We have striven at providing a set of comparable data that can help illuminate the innovation systems of the three countries and the linkages within these systems.

The resulting report should be regarded as a first attempt to utilise register data on employment to empirically map some of the aspects of innovation systems. Both the fact that this is a new and previously untested approach, and the limited available time and resources, have constrained us from doing all that was originally planned. We are confident that the main patterns emerging from our work are correct. However, the work with controlling and correcting the figures is a close to endless endeavour. We know there are still some errors, but they are marginal to the overall picture. We nevertheless urge the reader to interpret the number with caution.

Although Sweden has been designated leading country, Norway and Finland have played very active and driving roles. This is reflected in the content of this report. Much credit is due to STEP, who have had a leading role in producing and editing the report, compiling tables and figures, as well as authoring large part of the contents.

The persons involved in the work, and their contributions, are:

- Svein Olav Nås, STEP, Norway: Editor of the report, compilation of graphs and tables, writing up of chapters 3 and 4.
- Anders Ekeland, STEP, Norway: Compilation of all Norwegian data.
- Eric Iversen, STEP, Norway: Construction of flowcharts and related tables, language consultant.
- Mikael Åkerblom, Statistics Finland: Writing up of chapter 2.
- Markku Virtaharju, Statistics Finland: Compilation of all Finnish data.

- Christian Svanfeldt, NUTEK, Sweden: Writing up of chapters 1 and 5, compilation of Swedish data.
- Jonny Ullström, NUTEK, Sweden: Compilation of Swedish data.

In addition, the following persons have joined discussions in the meetings or during national work, contributing valuable comments and ideas: Göran Marklund and Lars Blixt (NUTEK, Sweden), Ingrid Pettersson (Statistics Sweden), Ina Drejer (IKE, Denmark) and Johan Hauknes (STEP, Norway).

Stockholm, July 2, 1998

Christian Svanfeldt

Abstract

This report analyses to what extent register data on employees can be utilised to study stocks and flows of personnel in a national innovation systems perspective. The registers contain information on each single employee in the three countries in the study (Sweden, Norway and Finland), including information on their age, education and employment at any particular time. This information is used partly to compare stocks of employees with different types of education across industrial sectors, and partly to describe flows of personnel between sectors. In the sectoral breakdown a particular attention has been given to higher education institutions and research institutes. Whereas the analyses of stocks can be said to describe the nodes in the innovation systems, the flow analysis adds to our capability of establishing and describing the links in the systems. By adding in information on knowledge creation, such as information on innovative activity or expenditure for R&D, the methodology allows for tracking of knowledge flows within the innovation systems. So far, however, such additional information has not been taken into account.

Although the experiences of the approach have revealed that this is a feasible and productive line of research to expand our knowledge about innovation systems, there are indeed methodological problems involved – even when comparing countries that are so alike as the Nordic ones. The problems mainly relate to differences in industrial structures and education systems, with the resulting problems of coding and updating of registers. Despite these problems we are confident that we have presented a reasonable picture of the comparative picture in the Nordic countries. At an overall level we find the same main structures in all three countries, but there are also clear differences in certain aspects. We refer to the concluding chapter 5 for details about the findings.

Keywords: National innovation systems, personnel mobility, higher education, stocks and flows, register data.

Table of contents

FORMAL COMPETENCIES IN THE INNOVATION SYSTEMS OF THE NORDIC COUNTRIES: AN ANALYSIS BASED ON REGISTER DATA

1. Introduction

Indicators that involve human resources (especially higher degrees and research credentials) serve as an important complement to the traditional R&D statistics concerned with R&D spending and R&D performance. The mobility of highly qualified personnel is an important vehicle for knowledge flows, and indicators of this movement can help us map important linkages in innovation systems. Mobility indicators can further be used to evaluate the effects different policy measures have on areas of education, research, labour markets, regional development, etc. Data that cover stocks of human resources provide richer information when inflows and outflows can be measured; especially over longer time-spans such data can help illuminate such questions as those on the effects of educational specialisation, industrial restructuring and renewal, etc.

The Nordic countries are privileged in having access to register data that covers the entire population of each country and that engenders several variables including educational level, income, occupational status, etc. These data make it possible to trace changes in individual status from one year to the next. The richness of the data can for example be used to chart how those with a research training in science and technology fare in the labour markets. (Which firms employ them? What regional distribution do they have?)

Both NUTEK and STEP have experience with human resources data. A study by STEP[1] showed that the *business-service sector* acts as a sort of second knowledge-infrastructure in that it both recruits and supplies skilled manpower from a much wider range of sectors/branches than any other sector/branch. Stock data also shows that the educational level in business services is on par with the public sector. A study by NUTEK[2] of the employment of natural scientists and engineers in industry showed that human resources mapping may provide a more accurate picture of a country's technological strength than R&D spending statistics, especially for non-

[1] Nås, Svein Olav, Ekeland, Anders & Hauknes, Johan [1998]: "Formell kompetanse i norsk arbeidsliv 1986-1994". *STEP Working paper*, forthcoming.

[2] Stenberg, L., Gustafsson, E. & Marklund, G. 1996: "Use of human resource data for analysis of the structure and dynamics of the Swedish innovation system". *Research Evaluation*, volume 6, N° 2, August 1996, pp121-132.

manufacturing sectors. The same study concluded that PhD mobility seemed like a weak mechanism of knowledge transfer, at least in the period of 1990-1993. Another study by NUTEK[3] on the internationalisation of qualified scientists and engineers showed that firm strategy regarding the recruitment and internationalisation of human resources differ significantly between European countries, and that cultural factors play a non negligible role.

1.1 Our selected focus and research questions, and their rationale

As the title suggests the focus of the work at hand is on the mapping and comparison of three national innovation systems in terms of distribution and flows of human resources. If the stocks can be said to represent the institutions in a national innovation system, then the flows can represent the links between them (or at least one form of linkage). Mobility between two organisations, two sectors, or two NIS institutions indicate that there is a knowledge transfer, and that there also is a common knowledge-base. This report represents the first attempt to compare Nordic statistics on the distribution and flows of human resources. Given certain limitations concerning the availability of data, resources and time, we have chosen a broad approach that might provide an overall picture of the stocks and mobility of human resources in Finland, Norway and Sweden. In this work, great pains have been made to attain comparability. The work is a starting point for more selective and focused studies, and it demonstrates the possibilities that exist.

Several choices have had to be made regarding the level of detail, population, years studied, etc. First of all, we have chosen to study progressively, the entire employed population, all highly educated employees, and three subgroups of the highly educated employees: these are graduates with degrees in (i) natural science and engineering, (ii) medicine, and (iii) humanities and social sciences. By 'employed' we mean an individual who is employed at least one of the years studied.

Secondly, we have defined *mobility* as a change of workplace (establishment). We could have chosen other bases for mobility, such as change of organisation, geographical change, etc., but have decided that a change of work establishment is

[3] Euro QSE

the most solid mobility indicator available. An added criterion could be used, such as change of sector, but we argue that the choice of level of detail in the sector classification would influence mobility rates too much.

Thirdly, we have striven to arrive at a sectoral breakdown that reflect the characteristics of each country's national innovation system. For practical reasons we have chosen to include what are arguably the most important NIS institutions, *the higher education sector* and *the R&D sector* (including the industrial research institutes). These two sectors also show some significant differences between the three countries. We arrived at a breakdown of 42 sectors, which are composed of aggregates on different NACE levels. These 42 sectors promise to provide a sufficiently accurate picture of the specificities of each country without being overly cumbersome. For the sake of presentation, an 11-sector aggregate has been placed over 42-sector breakdown through much of the report's main body.

A fourth choice involves the years for the stock and mobility data. For practical reasons, we have utilised the latest available years for each country. The choice of years has little effect on stocks, but mobility patterns show great variation even over shorter periods of time, depending heavily on the pervading economic climate.

1.2 Mechanisms of knowledge transfer

Mobility of highly educated labour is perhaps the most obvious mechanism of knowledge transfer. It should however be noted that, just as there is mobility without any significant knowledge transfer, so do knowledge flows and transfers take place without any prolonged physical mobility of individuals as the channel for the knowledge flow. The rapid development of information and communication technologies has made room for forms of knowledge transfer in which no permanent human mobility (if any) is involved. Knowledge transfer mechanisms other than labour-mobility include co-operations; temporary exchanges and placements of staff; virtual companies and network organisations; buyer-supplier relationships; R&D collaborations; etc. In light of this, other applicable indicators include co-authorships, co-citations, co-patenting, number of external contacts and co-operations, branch specific common activities, etc.

1.3 On the relationship between knowledge and formal education

One of the principal interests in mobility data is that human resources are supposed to represent knowledge bases and flows of knowledge within economies or innovation systems. There exist many forms of knowledge, such as formal knowledge, skills, competencies, codifiable knowledge, tacit knowledge, etc. The indicator denoting type of knowledge in this study is thus the level and field of formal education. Formal education might be the only viable alternative as a knowledge-indicator on a large scale, since indicators of other forms of knowledge would demand very elaborate means of data collection/collation. Although formal education may be misleading as a knowledge indicator in small numbers, they are probably quite useful for larger aggregates, especially where concerns recent graduates. In the case of indicators involving the highly educated (including those with research credentials) the degree of specialisation is so high that formal knowledge is probably a more than acceptable indicator of knowledge. It is much more difficult to assess the impact and extent of knowledge transfer associated with experienced personnel. Comparisons of different indicators should be encouraged, linking e.g. co-citations, co-publications, co-patenting, patent citations, research co-operations (EU framework, national and regional programmes, etc.), as well as qualitative studies of the development of competence and work experience. What a quantitative indicator such as formal education never can represent is the actual importance of key individuals, since the impact of flows and the importance of stocks can only be measured by their numbers.

1.4 Pertinent general issues for mobility data

Stock and mobility indicators of human resources complement traditional R&D statistics, especially for the non-manufacturing sectors and for small and medium sized firms. The flows of human resources can be regarded as the rate of change of the stocks and, as such, provide indications of the future situation facing different sectors. Net inflows or outflows also indicate which sectors are expanding and which are declining. It must be noted though that looking at the flows of two consecutive years (as we have mainly done in this report) can be misleading for the long term future, as mobility rates fluctuate over time due to, for instance, the economic climate and the level of employment. In this report we have focused solely on the use

of human resources data for the mapping of national innovation systems, but the data could be used for several other purposes. Typical policy issues that would benefit from the development of human resources mobility data include:

- brain-drain / brain gain (net effects of national inflows and outflows);
- size and scope of educational systems;
- bottlenecks and mismatches in educational systems and labour markets;
- job creation / job destruction (the ageing or renewal, expansion or decline of different sectors);
- substitution effects (in terms of skills and education);
- flows of highly educated to small and medium sized firms;
- inter-firm knowledge flows and clusters;
- mobility as a second knowledge infrastructure;
- effects of regional policy (regional higher education institutions, labour market measures, etc.).

1.5 Limitations of the indicator

As already mentioned, the available indicators of the employment and mobility have some limitations and drawbacks. We have already discussed the fact that the level and field of formal education is only an approximate indication of knowledge, and that human resources mobility is just one form amongst many of knowledge transfer. There are also methodological problems that will be discussed in chapter two.

Strict compatibility of data from different countries is very difficult to achieve. Whatever indicators of flows being studied, they must naturally also be related to stock of the same or broader categories, as well as population sizes. There is also a strong need for a thorough understanding of the institutional conditions of the individual countries. Discrepancies in institutional and educational systems necessarily reduce the value of direct comparisons, since it's only possible on a very basic level. Our work shows that three countries that are so similar in terms of systems of statistical collection are in practice very difficult to compare directly.

It is a limitation to our approach that we have not yet been able to take international mobility into account. This includes both permanent mobility between countries, and temporary exchange of personnel. Yet another aspect of this is visible in the Swiss case, as Switzerland scores badly in OECD comparisons of educational levels. However, the country has very strong manufacturing and pharmaceutical industries,

indicating that a high educational level is unimportant. But OECD comparisons do not take into account that Swiss firms have a large regional labour market to recruit from, incorporating parts of Germany, France, Austria and Italy. Many people working in Switzerland live in a neighbouring country, a fact that deflates the mobility figures.

1.5.1 Factors affecting mobility and mobility rates

Mobility is conditioned by the pervading system. Mobility rates are affected by social and cultural factors, political initiatives, magnetic effects (e.g., attractive regions), and obstacles to mobility (e.g., family conditions). Also, not all sectors (and not all economies), follow the same economic cycles. Norway is for instance out of pace with the rest of Europe and has not experienced severe budget cuts thanks to its oil industry. Norway is thus both forced and able to recruit for instance health care personnel from its neighbouring countries.

Some mobility is not mirrored in available statistical data, especially exchanges of a more temporary nature, which probably are very important from a knowledge flow perspective. Other forms of mobility may be inflated. For instance, it is common that fresh doctors intern at foreign universities/hospitals. By the same token, highly skilled staff in multinational firms may spend longer periods abroad in foreign subsidiaries. Not only is the mobility in neither case of a permanent nature, further, such individuals might move several times between several countries, thus distorting figures.

1.5.2 Statistics of the past

Most statistical systems are based on past industrial structures. Service industries are as result one area of the economy which is badly captured in most national statistics. This is because most classifications are based on hardware production, i.e., the physical goods that are being produced, and not on knowledge production. The three countries in this report have all based their sectoral breakdown and data classification on the NACE system. NACE is far from perfect when it comes to NIS categories or institutions (which often have to be hand picked), but as it is used by the three countries it enables direct comparability. At all events, the choice of classification has a strong impact on the possibilities to adequately describe innovation systems.

1.6 Structure of the report

The report is divided into five chapters. The first sketches the background and rationale for the work. The second chapter discusses the methodological problems that have been encountered. The third chapter gives an overview of the stocks of human resources in the three countries, in terms of age, educational level and field, as well as sectoral breakdown. This third chapter serves as a starting point for the mobility mapping of chapter four. These studies are both general for the whole population in each country, as well as specific for a few selected sectors and sub-populations. We also study the degree of specialisation of different sectors by their distributional characteristics. Chapter five sums up the report and the main findings. Attached is an appendix with the tables underlying the figures and a more detailed sectoral breakdown of both stock and mobility data.

2. Data sources and methodology

This report is based on information from register data in Finland, Norway and Sweden. We will first give a general description of the principles of the Nordic register data. There are of course country specific features of each register system, which are out of scope for the present description. After that, the methodological choices for the report will be described and some problems discussed.

2.1 Nordic register data

In the Nordic countries, each individual and each organisation (enterprise, establishment) has a unique identification number, which is used in a variety of administrative and statistical registers. For research and statistical purposes it is possible to combine information from these registers. The main administrative registers used are population registers, taxation registers, pension registers, student registers, registers of buildings and dwellings. The information from these registers are combined with information from statistical registers, such as business registers and registers of degrees.

These operations result in annual information for each individual in the Nordic countries on demographic variables, formal education, occupational status, actual occupation (only partially), enterprise and establishment of employment, salaries, etc. These registers are a very valuable and up to now rather under-utilised source of information for research. This report shows how they can be used to describe formal competencies in the innovation system.

2.2 Methodological choices

2.2.1 Population

The first question to be solved is to determine which population should be analysed in connection with the description of formal competencies in the innovation system. In a broad sense, the whole population is to a certain extent involved in the development of the national innovation system and could be considered. OECD and Eurostat have defined the HRST concept (Human Resources for Science and Technology) in the Canberra Manual. According to that concept, all persons with at

least ISCED level 5 degrees or employed in science and technology occupations as professionals (ISCO 2), technicians (ISCO 3) or certain kinds of managers (ISCO 1 partly) should be included. This definition is not very suitable to describe competencies in the innovation system, as persons leaving science and technology occupations disappear from HRST. Hence the stocks of HRST will vary with changing labour markets even if the competence base will remain the same. In addition, the definition is difficult to apply, as the occupation variable based on ISCO has not been introduced into the statistical system in all Nordic countries. The definition of HRST is also rather complex and difficult to comprehend. It seems also to be too wide for use in the analysis of potential innovation.

2.2.2 Educational classification

In this report the focus of analysis is therefore on people with certain types of formal education. The reference classification used is the International Standard Classification of Education (ISCED). People with higher education on ISCED level 6 or 7 (university graduates) are in some tables further subdivided into graduates with PhD, licentiate or other degrees. Persons with ISCED 6 or 7 level education are also divided into three broad fields of science; a) natural sciences and engineering b) medicine c) social sciences, humanities or other Scientific fields. The distinction between various levels and fields has mainly been made on the basis of the levels and fields in the national classifications of education. The educational breakdowns might be affected by differences in national classifications of education.

2.2.3 Industrial classification

The industrial classification is based on the NACE classification, which is a standard in all EEA countries. As the new NACE codes for classifying industrial establishments according to their main activity has been introduced into the register systems quite recently, data from Finland and Sweden refer to 1993-95, data for Norway to 1995/4-96.

The level of detail of the NACE classification applied varies in order to determine sectors of specific interest for the study. For example, universities and research institutes are separated as separate categories. Universities have been defined as institutions giving PhD level education. Research institutes have been further subdivided into institutes mainly serving industry and/or doing R&D in natural

sciences and engineering. All establishments within a university have been classified as universities. In general, 2-digit NACE is used for the manufacturing sectors. For service sectors broader categories have been defined. For example, the category 'other community, social and personal services' has been defined as sectors NACE 91-97 together. In the text of this report, a more aggregated version of the classification is used with only 11 sectors. This more aggregated classification is used to make the results easier to comprehend.

2.2.4 Definition of mobility

In this report mobility has been defined on the basis of change of establishment. When a person has moved from one establishment to another, to education, to unemployment or out of the labour force mobility has in principle occurred. The mobility is in this report mainly calculated on the basis of outflow (people moving between year t and year t+1/stocks in year t). Mobility could also be defined on the basis of inflow (persons moved between years t-1 and t/stocks in year t). The criterion for mobility is change of the identification number of the establishment in which the person is employed. This means that also mobility within enterprises could take place.

Another mobility measure only includes movement from employment in one establishment to employment in another establishment, excluding movements out of labour force or to education or unemployment.

Another possibility would have been to define mobility according to change of enterprise (change of identification number of enterprise). This would exclude mobility between establishments in the same enterprise. As enterprises may be more unstable than establishments, this would lead to even greater problems to define 'new' enterprises to determine mobility.

Another aspect of mobility analysis is to analyse mobility within groups of enterprises. When the group belonging has been more consistently integrated into business registers of the Nordic countries, this kind of analysis will be possible.

2.3 Problems

In this section we will give a short outline of some of the problems met in the analysis. These refer for example to the definition of mobility, the industry coding of enterprises, registration routines in the registers or comparability hampered by institutional differences between countries.

2.3.1 Definition of mobility

The problem is that sometimes restructuring of enterprises leads to change of the identification numbers of the establishments even if they remain the same or nearly the same in the new environment. This has in Finland been corrected for by comparing the employees of establishments with different identification numbers in different years. If 30% or more of the employees are the same the establishments are considered the same, even if the numbers have been changed. The 30% threshold has been used in business demography studies in Denmark. It could be discussed, if this threshold is the best one. The Finnish experience has shown that this kind of analysis reveals some false mobility.

2.3.2 NACE codes

There are always errors in the NACE codes either due to changes in establishment structures or misunderstanding of main activities of enterprises. Due to the critical importance of the research institutes sector and universities, these groups have been checked in more detail. In Finland the sector research institutes has been adjusted to only include units with research as the main activity. In the register many units were found, which by no means should be classified to this sector. In the other countries there has only been made minor changes in the classifications of institutes. This problem might refer to other industries too but has not been investigated.

2.3.3 Registration routines

In the combination of various registers certain rules for handling of data have to be established. In some cases the rules give results which are not fully satisfactory. This refers especially to people with several types of employment. In Finland, for example, was discovered that too many university professors were registered as entrepreneurs due to some features in the routines. The registration routines have to be changed to avoid these cases. There are always technical problems in the matching of different registers, which will effect the outcome. Lags in registrations

of employment might cause unnecessary disappearances of people from the system. Differences in registration routines might cause difficulties of comparison between countries. It has not been possible to analyse these problems in greater detail for the purpose of this report. The comparisons between countries have therefore to be interpreted with caution.

2.3.4 Institutional differences

All international comparisons are hampered by problems caused by institutional differences between countries. The sector of research institutes is comparatively big in Norway compared with Finland and Sweden. Big institutes, such as SINTEF in Norway and VTT in Finland play an important role in the innovation systems of respective countries. Sweden does not have corresponding institutes. In Sweden universities perform comparatively much industry relevant research. Finally, the comparisons are effected by differences in industrial structures between the Nordic countries. This is, however, not something unique for mobility studies. This concerns other statistical comparisons as well.

2.3.5 Differences in systems of education

The comparisons may also be hampered by differences in the educational systems. In Sweden and Finland for example, the basic degrees are shorter than in Norway, which lead to somewhat higher shares of people with PhD education or licentiates. In Finland and Norway there exists a more practically oriented engineering degree on ISCED level 6, which leads to comparatively higher relative shares of highly educated in natural sciences and engineering.

3. Knowledge stocks and industrial/sectoral structure

In this chapter we compare formal knowledge stocks in the Nordic countries. The information from this comparison both provides background for the mobility studies presented in chapter 4 below and stands alone as a comparative study in its own right. In terms of the national innovation systems perspective, this chapter describes nodes in the system whereas chapter 4 addresses linkages in the system. The questions addressed concern how different kinds of formal knowledge are distributed within the workforces of these countries: are there differences in profiles of scientific fields and educational levels, in the overall profiles, and in different sectors or institution types of the economy?

The presentation is organised as follows: Firstly, we look at the total stocks of formal knowledge by level of education, scientific field and age, but without any sectoral breakdowns. Due to the recent introduction of NACE codes and lack of re-coding from ISIC to NACE in historical data, it is not yet possible to include comparable information on the developments of stocks over time. We therefore confine ourselves to stock data for 1995, which is available for all the countries.

Secondly, we break down the information by sector, to investigate whether there are any systematic differences in the use of formal knowledge (by level and scientific field) between similar sectors in each of the Nordic countries. As a starting point, we include an overview of the total employment by sector in the Nordic countries to highlight similarities and differences in the sectoral structure. In addition, we take a closer look at three selected sectors, chosen to represent different productions systems: Information and communication technologies, pulp and paper, and public administration.

Thirdly, we investigate whether different broadly-defined scientific fields are used narrowly or more broadly in terms of number of user-sectors, and whether there seems to be differences in these patterns between the Nordic countries. To accomplish this, we utilise a measure of variance known as the Herfindahl index. The three scientific fields we specify are natural sciences and engineering, medical and health-related fields, and social sciences, humanities and other fields.

Results are presented in graphical charts. More accurate and detailed information for each single chart is found in appendix A.

3.1 The overall stock of formal knowledge by level, scientific field and age

In this section we present an overview of the use of formal knowledge in the Nordic countries, by level of education, scientific field and age of the employees. Educational breakdowns are accomplished by reference to the international ISCED standard. We have chosen to split the educational levels into the following groups:

1. Secondary education or below (12 years of education or less)
2. ISCED 5 (12-15 years, including up to 3 years of higher education)
3. ISCED 6+ (more than 3 years of higher education, but not doctoral degree or licenciates)
4. Licenciates[4]
5. PhD (or equivalent national doctoral degree)

These levels reflect the pure ISCED classification. In practice however, we have fitted the individual national classification systems to the guideline of the ISCED-levels. In this way, inherent differences in the education systems have to a certain degree been accounted for, thereby enhancing the comparability of our results. Differences in the education systems cannot be fully overcome however. For instance, the term 'graduates' (candidates) may be used more or less interchangeably in different countries, even though in certain cases the underlying level of education varies. An example is the so-called "gymnasingeniør" in Sweden (engineering education at secondary level). They consist of around 80,000 employees annually. Even if classified as secondary education, their actual function at work may be comparable to engineers at the ISCED 5 or even 6 level.

In order to take into account national differences we have included in all four categories of higher education, according to level. When focusing on the *highly*

[4] The term "licenciates" refers to an academic degree used in the Nordic countries. It is more extensive than the ordinary master level (or the longer Norwegian equivalent of a master), but not as comprehensive as a full PhD. It is separated out because the grouping of this category differs between the Nordic countries: In Sweden and Norway along with the master level, in Finland with the PhD level.

educated, the cut-off is made at ISCED level 6 (more than 3 years of higher education).

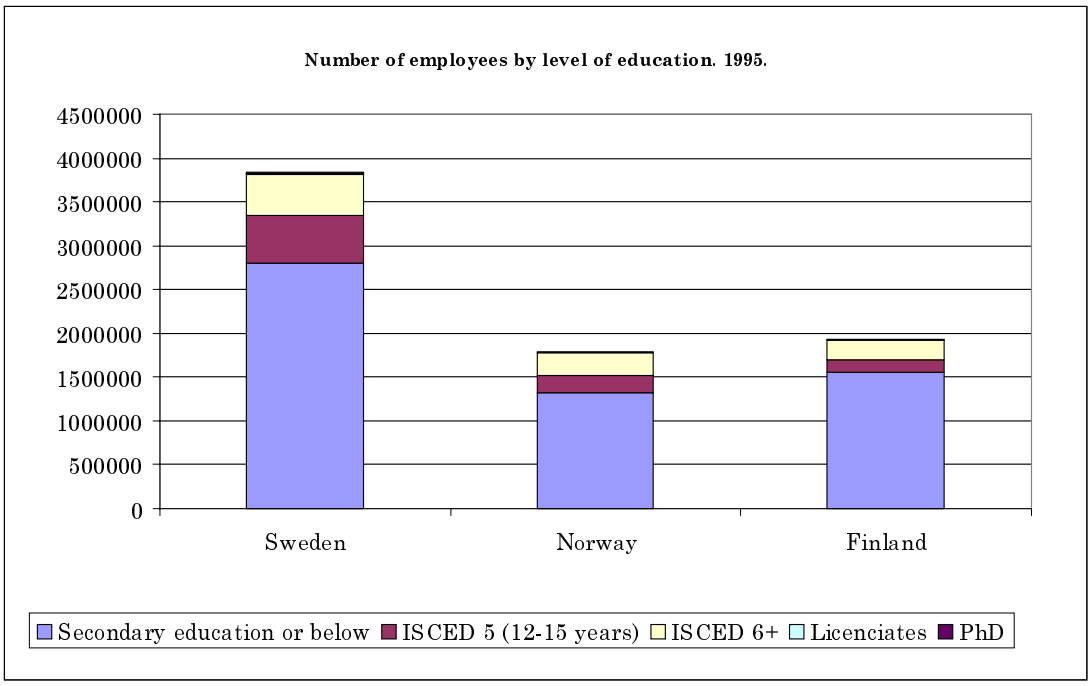
The reason for separating out the 'licenciate' is that this academic degree is weighted differently in the Nordic countries. In Norway it is of relatively minor importance and considered along the same lines as the "hovedfag" (the Norwegian equivalent of a Masters degree, though of a longer duration and for some disciplines very much like a researcher education). It is therefore classified in our group ISCED 6+ instead of with the PhDs. The same classification is preferred in Sweden, even if the degree is more often used. In Finland, licenciates however are considered a researcher education, and therefore classified along with the PhDs. Separating out this category allows comparisons in both directions: up or down in level.

The focus of our work is employees with higher education. The reason is that those with higher education presumably possess more knowledge than those without. This is not to say that education at secondary level or below is not important in an innovation perspective. For most sectors, employees with a practical or vocational training at the secondary level make up the larger share of employment and their skills are of great value. It is a matter of time and resources that they are left out in this round.

Another category of knowledge left out in our current approach is skills that are built up through practical experience. This is relevant for employees of all levels of education. It is generally difficult to obtain good indicators for such experience. A feasible solution is to use length of work experience as a proxy. It is in principle possible to obtain this information from the registry files, limited only by the number of years the files cover. Again, time and resources have not permitted inclusion of that aspect this time.

What is recorded in the registry files is the number of actively working persons each year. Firms or organisations employ the vast majority of these. In addition, there is a lesser number of self-employed consultants, farmers etc. Members of this self-employed class will generally be referred to as "employees", unless there is particular reason to separate them out.

Figure 3.1. Stock of employees by level of formal education and country. Absolute numbers. 1995. See also table A1.



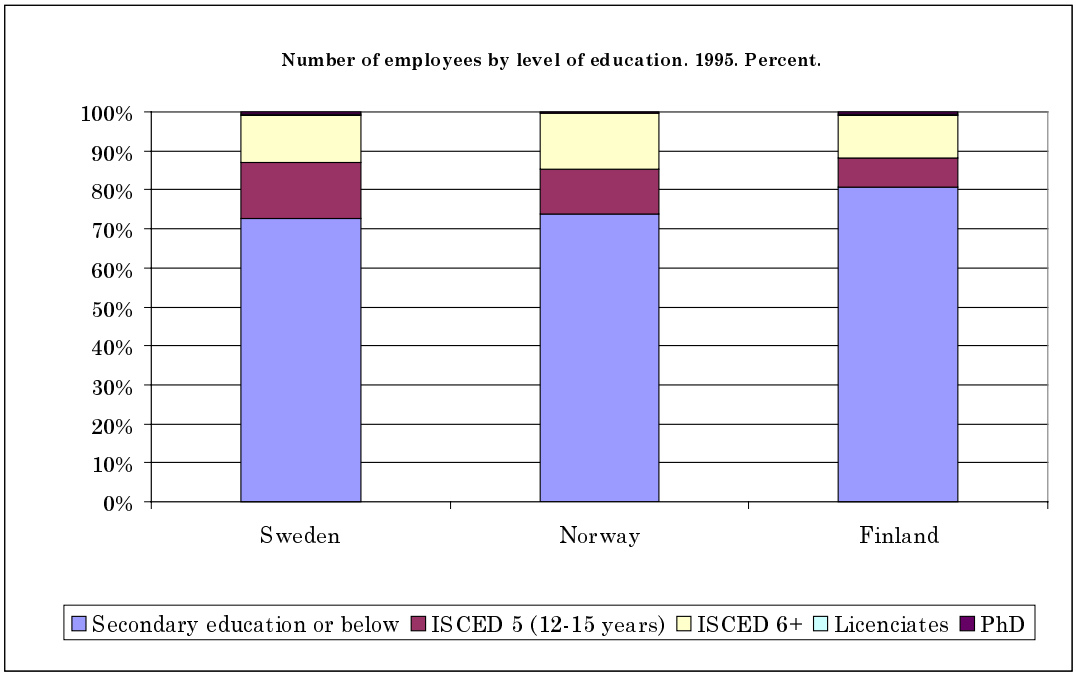
The number of employees in each country reflects the population size, with almost 2 mill persons employed in Norway and Finland, and almost twice as many in Sweden (fig 3.1).

Only minor shares of employees hold higher degrees. Around three-quarters of the employees in these countries have completed a secondary education or less (figure 3.2). The share of employees with higher education is somewhat lower for Finland than for Norway and Sweden. Using ISCED level 6 (broadly speaking more than 15 years of education) as the cut-off point, only 12-15 % of the working population is included. The trend, however, is that the share of higher educated employees is growing in all the three countries.

Taken together, those holding PhD and licentiate degrees account for a very small share of total employment – in fact hardly visible in the figure. Taking the actual numbers from table A1, the PhDs amount to almost 18,300 in Sweden, 8,500 in Finland and only 6,700 in Norway. The Swedish share is higher than that in the other countries, even after adjusting for population size. For Finland, an addition of almost 6,000 licenciates should be tallied (this degree is considered comparable to the PhD in this country: cf. above). In Sweden, almost 11,000 employees hold such a degree.

In comparison, the Norwegian share of employees with research degrees is relatively low. Part of the reason for this lies in the structure of the Norwegian educational system. The most common higher degree, the "hovedfag" normally requires 6-7 years, and produces research qualifications, though at a somewhat lower level.

Figure 3.2. Stock of employees by level of formal education and country. Percent. 1995. See also table A1.



Having established the broad picture of share of higher educated employees in the Nordic countries, how is the distribution of education by scientific field? The following comparisons are made on the basis of ISCED-6 degrees or higher (3 years or more of higher education). This class accounts for about 500,000 employees in Sweden, 300,000 in Norway and about 230,000 in Finland (fig. 3.3). Social sciences, humanities and other fields make up the largest share, amounting to between approximately 60 % (Finland) and 70 % (Sweden) (fig 3.4). While natural sciences and engineering make up close to 30% in Finland, the shares are around 20 % in Sweden and Norway. Medical and health-related education make up 10-15 %, with the greater share in Norway.

In sum, the broad picture shows a similar structure of employment by scientific field of education among the Nordic countries, albeit with a somewhat higher emphasis on natural sciences and engineering in Finland than in the other countries.

Figure 3.3. Stock of employees with higher education by scientific field and country. Absolute numbers. 1995. See also table A2.

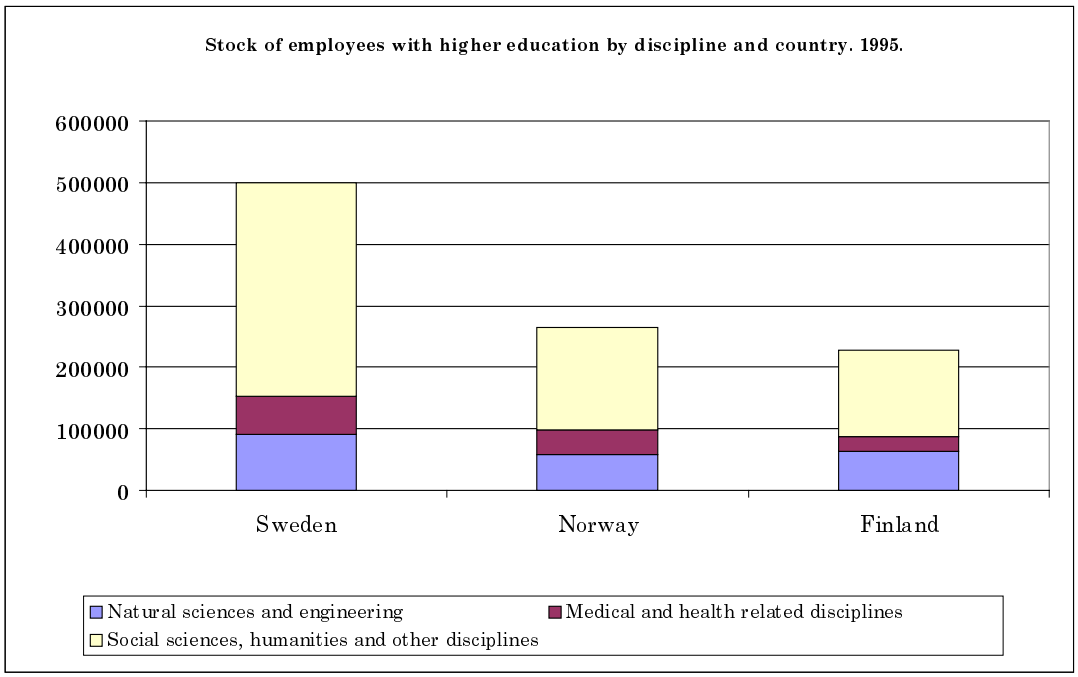
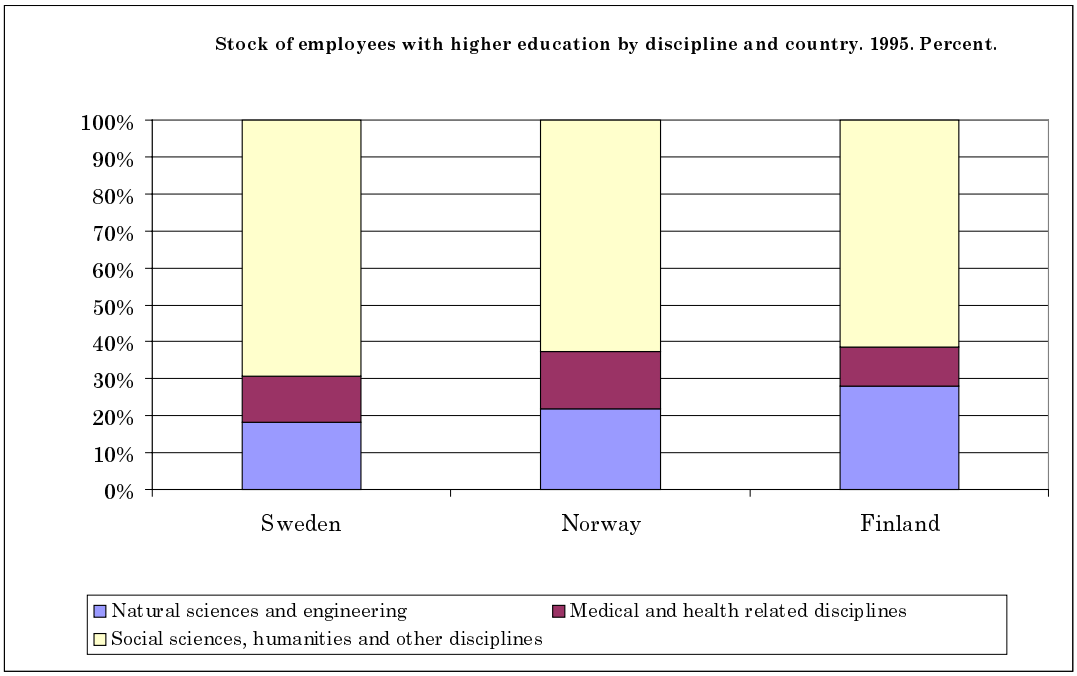


Figure 3.4. Stock of employees with higher education by scientific field and country. Percent. 1995. See also table A2.



The composition of employees with degrees in different scientific fields also varies according to age. Such age-distributions reflect inter alia the size of each generation entering higher education and the labour market, the educational choices of these

persons, the duration of each education and the capacity of the education system. In addition comes, of course, the general state of the labour market at any point in time. Given these shaping forces, the resulting age distribution of employees at a given time partly inform us about the effects of educational policies of previous years and partly about challenges ahead of us. As each generation, or cohort, reaches retirement age, the outflow must be replaced. If the in-flowing new generations or cohorts do not have the same educational distribution, one might encounter shortage of certain skills and an increased supply of others, and the composition of skills among the workers will change.

To avoid such changes, it is necessary that the age distribution of personnel with each kind of skill is more or less even. This is not the case in the Nordic countries. As can be seen from figures 3.5-3.7 below, the age distributions are rather uneven, in particular within social sciences, humanities and other disciplines. The peak of these curves - representing persons born during the 10-15 post-war years - include 45 to 55 year-olds as per 1995. Within 10 to15 years, these will retire. This will cause replacement problems, in particular in Sweden where the peak is more pronounced than in Finland and Norway. It seems that Finland and Norway have maintained a high level of recruitment to social sciences and the humanities over a much longer period than did Sweden.

For the other disciplines specified in the figures, the effect of the large post-war generation has not resulted in the same kind of massive growth in number of new graduates. This is probably due to stricter regulations of the capacity, and access, to these kinds of education. Therefore the age distributions are more even, in particular within medical and health related disciplines in all three countries. This is somewhat different in Norway, though, where the number is highest in the age classes 26-38 years. It seems to indicate a prioritisation of this kind of skill during the last 15 years or so.

The last generations to enter the labour market – i.e. those who could have conceivably finished a higher degree - are those between 25 and 30 years in 1995. In all three countries the number with degrees in the natural sciences and engineering is particularly high in these age classes – more articulated in Norway and Finland than in Sweden. This seems to indicate a priority given to such skills over the last 10 years

or so – in terms of higher demand in the labour market, higher priority from the educational authorities, and/or greater interest among young people attending universities and high schools.

Figure 3.5 Stock of employees with higher education by scientific field and age. Absolute numbers. Sweden 1995. See also table A3.

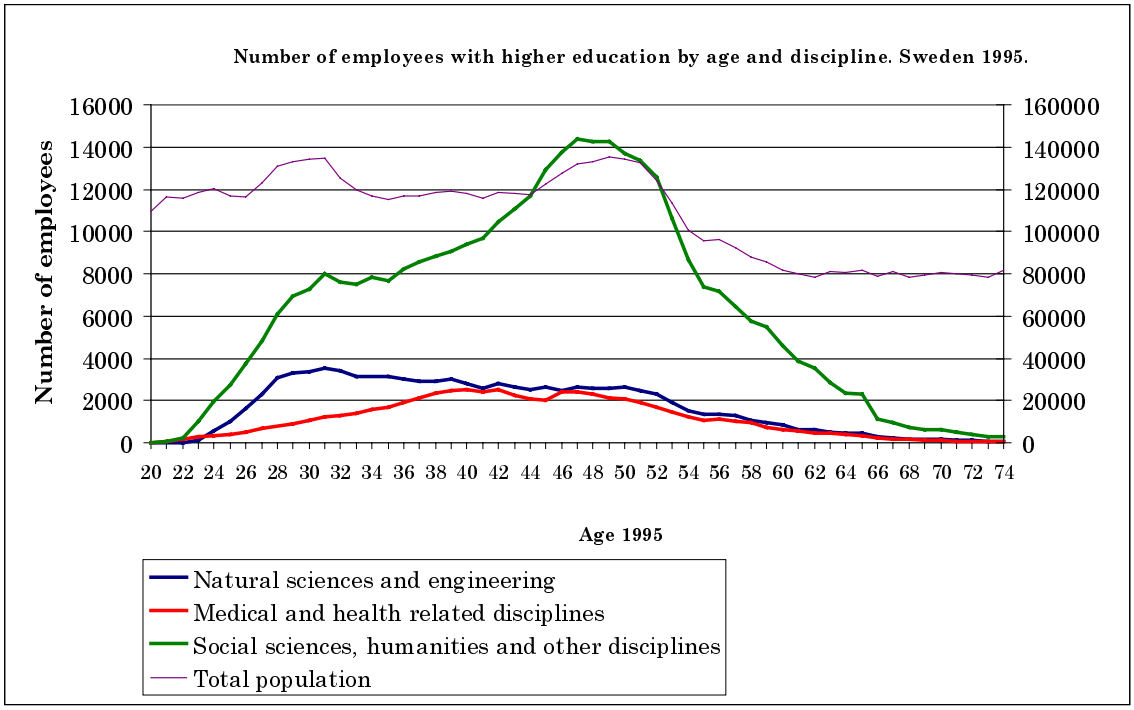


Figure 3.6 Stock of employees with higher education by scientific field and age. Absolute numbers. Norway 1995 . See also table A3.

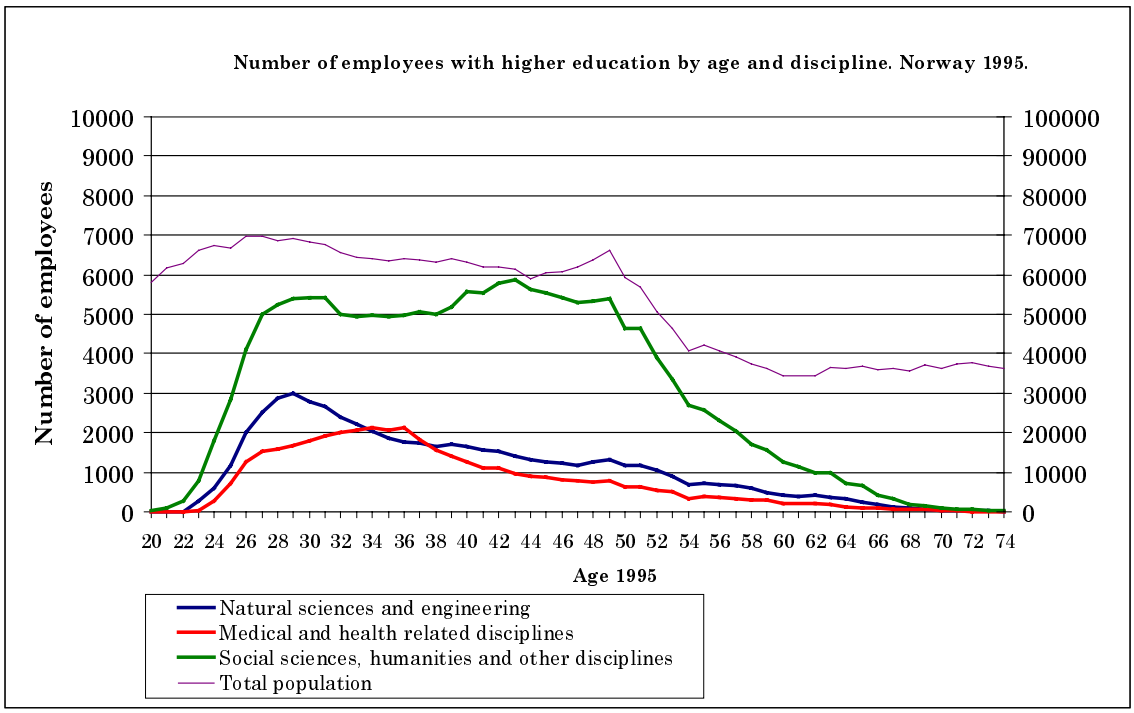
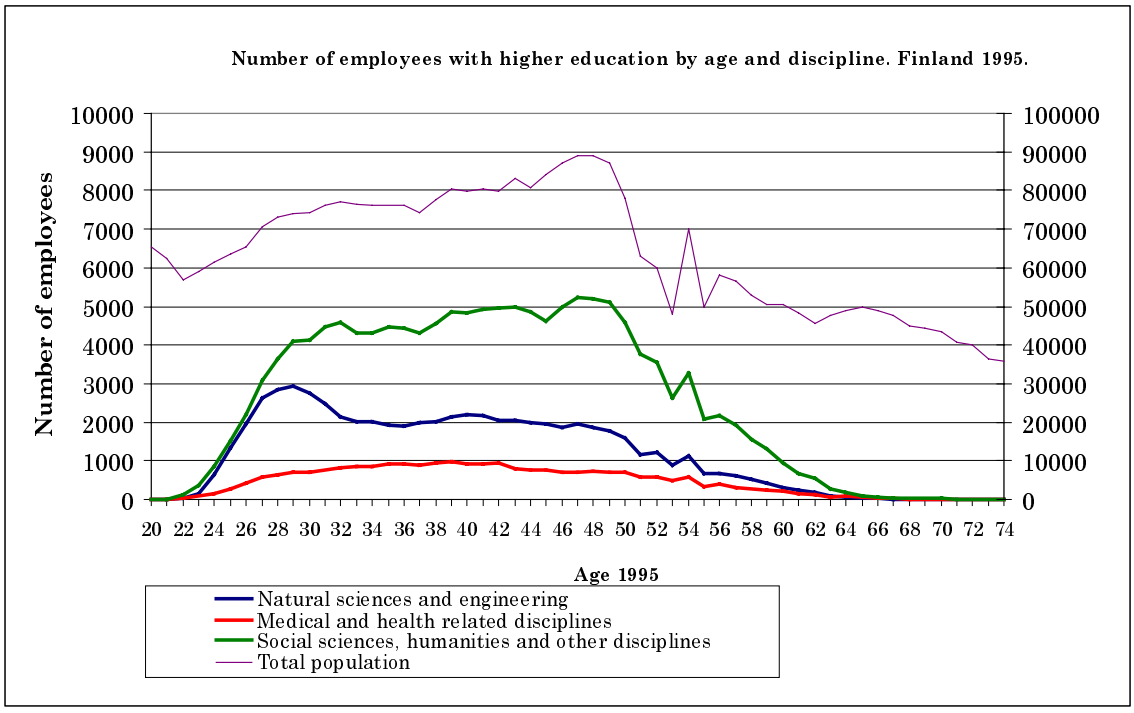


Figure 3.7 Stock of employees with higher education by scientific field and age. Absolute numbers. Finland 1995. See also table A3.



3.2 Sectoral breakdown of stock of formal knowledge by level and scientific field

In this section we break down the distribution of employees with different kinds of education by sector. It is in principle possible to disaggregate such a distribution as far as the NACE sector-classification goes, but the results of such an exercise is difficult to analyse and present. In order to present the results, we have aggregated the economies into nine broadly defined sectors and two institutional types of particular interest in a NIS perspective: R&D institutes and higher education institutions. In the appendix, however, a more disaggregated distribution into 42 categories can be found.

Of course there is always room for discussions about such aggregations. Our concern has been to keep each category as homogenous as possible, while keeping the number of categories as low as possible. The list should also be a reasonable representation of all the Nordic economies. An overview of the categories and their definition by NACE code is given in table 3.1.

As regards the longer list of 42 sectors, it is biased towards manufacturing as 20 of the categories belong to manufacturing. This reflects an existing bias in the classification system, and in most statistical analysis of this kind. As a result, employment in each of the categories varies quite a lot. This affects in particular the analysis of effective user sectors below.

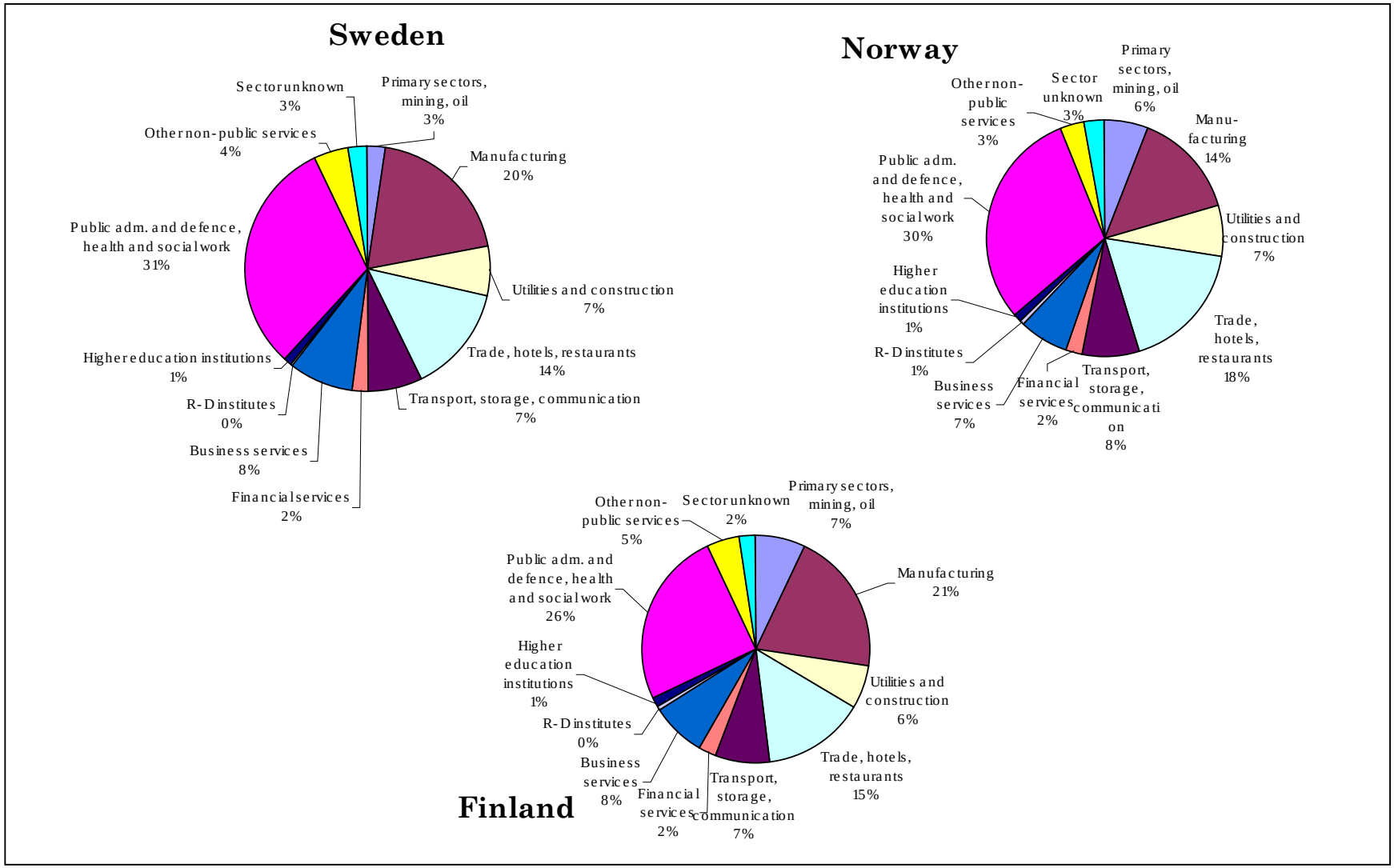
Another concern for the analysis is that the industrial or sectoral structure is different in the three countries. Ideally this should be corrected for in the analysis, which can be done for example by constructing a common Nordic structure as a weight for the national distributions. Available time and resources have not permitted that this time. On the other hand, sectoral differences do exist and will probably continue to do so, creating different challenges for each of the countries in terms of demand for and availability of different skills.

Table 3.1 Sectoral breakdown for presentation in figures (11 sectors):

No.	Title	NACE code
1	Primary sectors, mining, oil	A+B+C
2	Manufacturing	D
3	Utilities and construction	E+F
4	Trade, hotels, restaurants	G+H
5	Transport, storage, communication	I
6	Financial services, real estate	J
7	Business services	K-73
8	R&D institutes	73
9	Higher education institutions	80.3
10	Public adm. and defence, health and social work	L+M+N-80.3
11	Other non-public services	O+P+Q

Such differences in sectoral structure between the three countries are, however, more pronounced with the 42-sector breakdown than with the 11 categories used in the majority of analyses. In figure 3.8 below total employment is distributed into the 11 categories for the three countries. Even if there are clear differences, the most striking feature of the figure must be said to be the similarities. The same three sectors are dominant: Public administration, health etc, manufacturing, and trade, hotels and restaurants. Together they make up almost two thirds of employment. Certain differences do of course exist, too: The share of public administration, health etc is somewhat larger in Sweden and Norway than in Finland, whereas Norway has a smaller manufacturing sector than the other.

Figure 3.8 Sectoral distribution of employment by country. 1995.



The small sectoral differences that exist between the Nordic countries, in terms of employment, do not show up when we compare the distribution of employment by educational level between countries (figures 3.9-3.11). The differences in number of graduates with higher education, as pointed out in figure 3.2, are of course present. The similarities are however striking. When sectors are ranked according to their share of highly educated employees, the rankings for the different countries are practically identical. The use of skills – defined by level of education – seems, therefore, to be an inherent property of the operations of the different sectors, and not a factor that is influenced strongly by the national system. Higher education and research institutes represent a class by themselves, as expected. In addition both public administration and health, and all kinds of business-related services are the most intensive employers of graduates with higher education. At the other end of the scale we find the goods-producing sectors along with utilities and construction, trade and transport and storage.

Figure 3.9. Stock of employees by level of formal education and industrial sector. Percent (each industrial sector=100). Sweden 1995. See also table A5 and A5B.

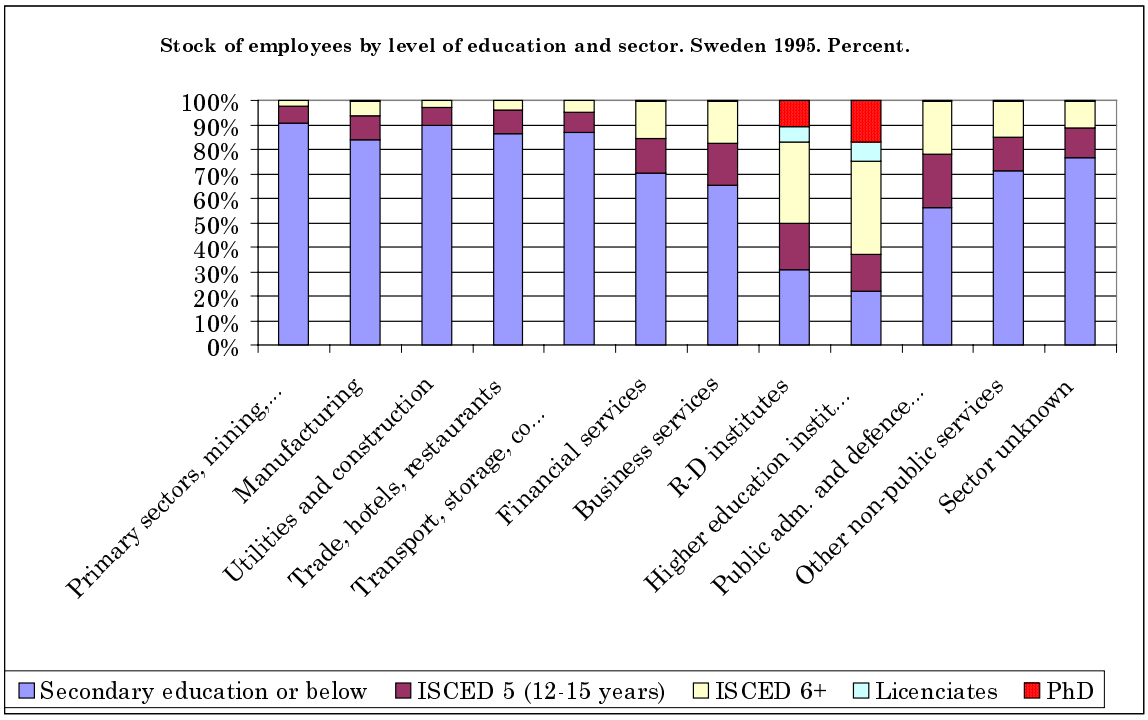


Figure 3.10. Stock of employees by level of formal education and industrial sector. Percent (each industrial sector=100). Norway 1995. See also table A6 and A6B.

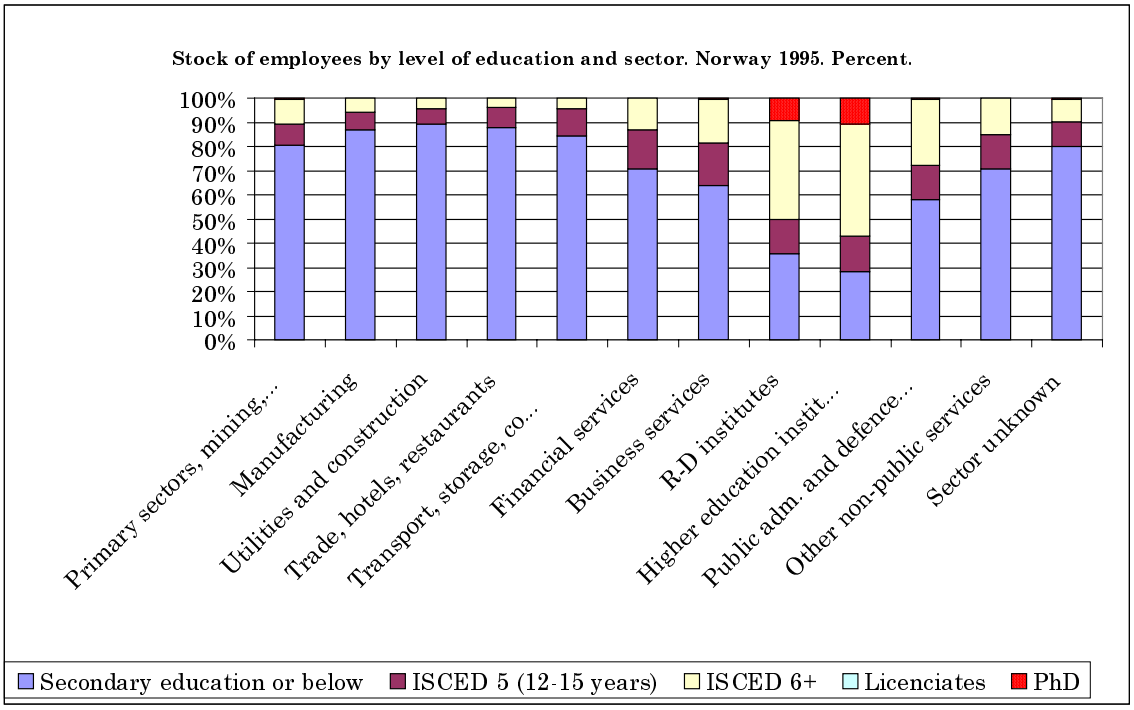
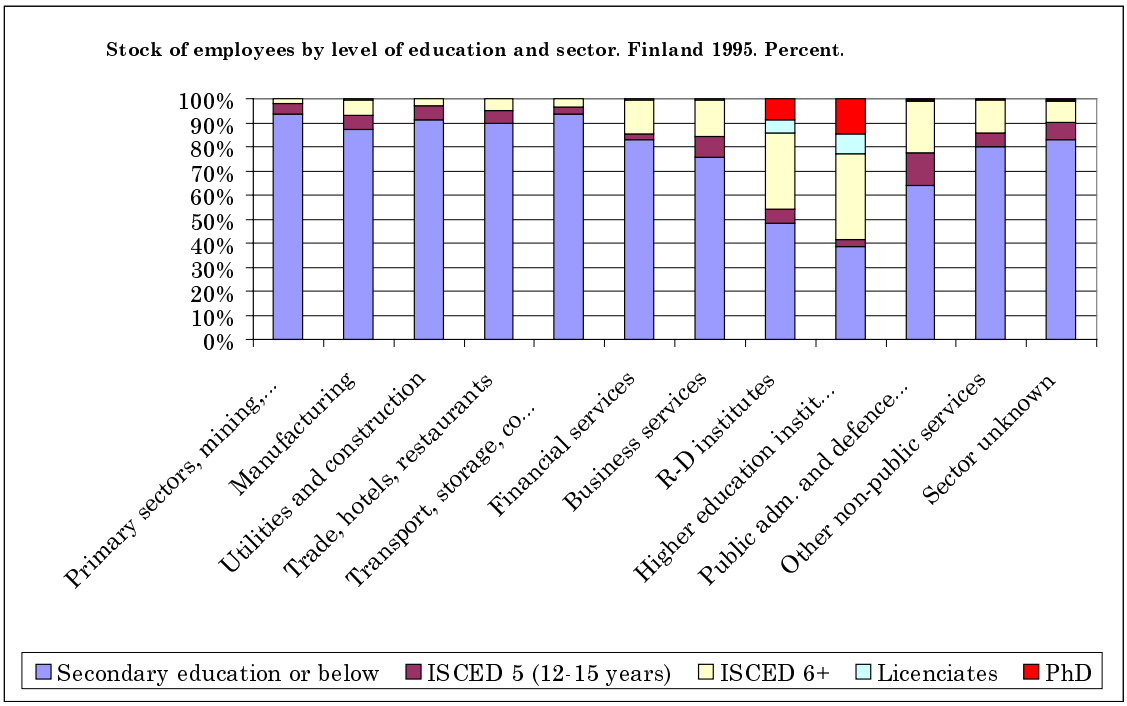


Figure 3.11. Stock of employees by level of formal education and industrial sector. Percent (each industrial sector=100). Finland 1995. See also table A7 and A7B.



Even when comparing the distributions of education in different scientific fields among the sectors, there are broad similarities across countries (figures 3.12-3.14). This confirms our conclusion above that the kind of activity within the different sectors are more important as a determinant for the skills they use, than is nationality. This, of course, only holds given that institutional differences between the countries are not too large, and the availability of skills is more or less the same. This is the case for the Nordic countries.

Even if the basic structure is more or less the same between the countries, differences do exist. To a certain extent this is due to industrial differences. In Norway, for example, natural sciences and engineers make up a larger share within primary sectors, mining and oil. This is due to the oil industry in Norway, intensive in the use of engineering skills and at the same time practically non-existent in the other countries. Another difference is found in the share of natural scientists and engineers in manufacturing and utilities and construction. In these sectors, the share is clearly lower in Norway than in the other countries, and particularly high in Finland.

One should be aware when studying these figures that values are presented as percentages within each sector. The number of employees within each sector varies considerably. An example is medical and health related disciplines, which seem to be rather spread out on the sectors in these figures. That is certainly not the case. As is clear when consulting tables A8 and A8B, medical and health related disciplines are concentrated within the category of public administration and health.

Figure 3.12. Stock of employees with higher education by Scientific field and industrial sector. Percent (each industrial sector=100). Sweden 1995. See also table A8 and A8B.

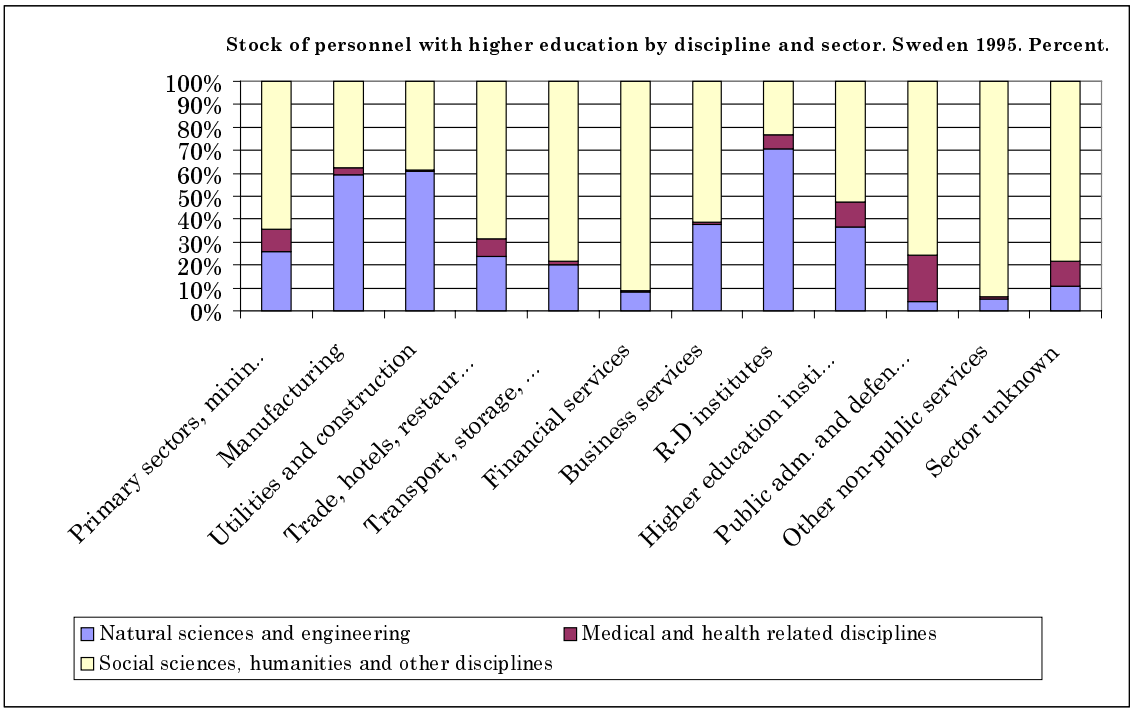


Figure 3.13. Stock of employees with higher education by scientific field and industrial sector. Percent (each industrial sector=100). Norway 1995. See also table A8 and A8B.

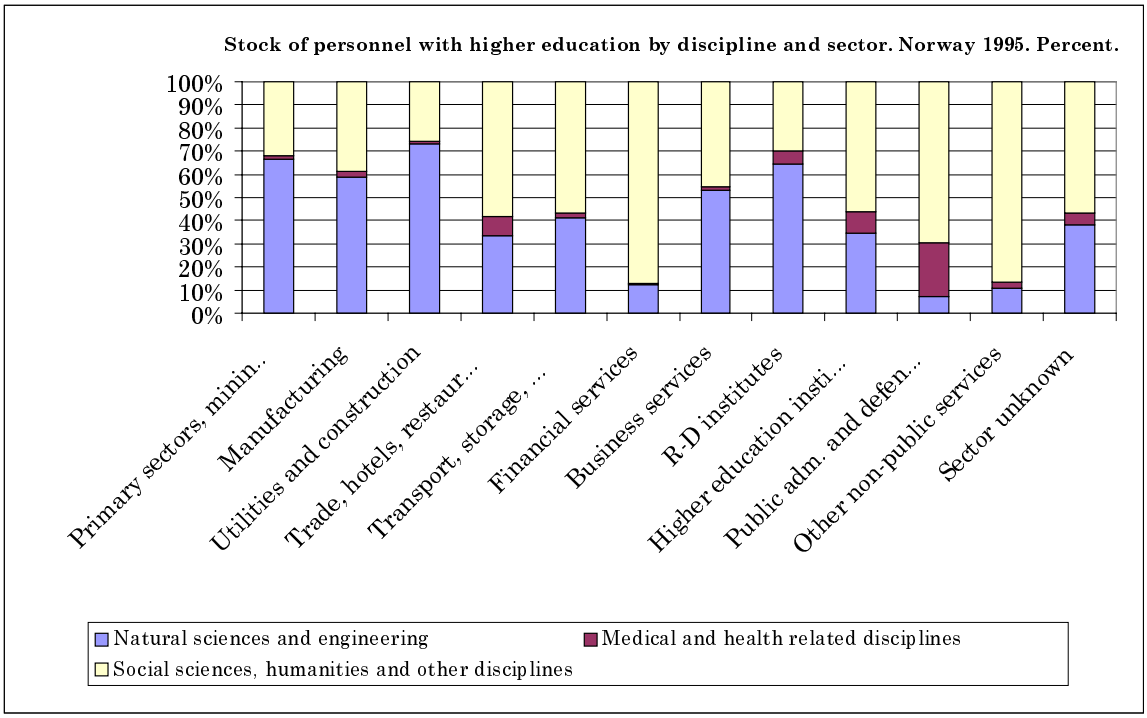
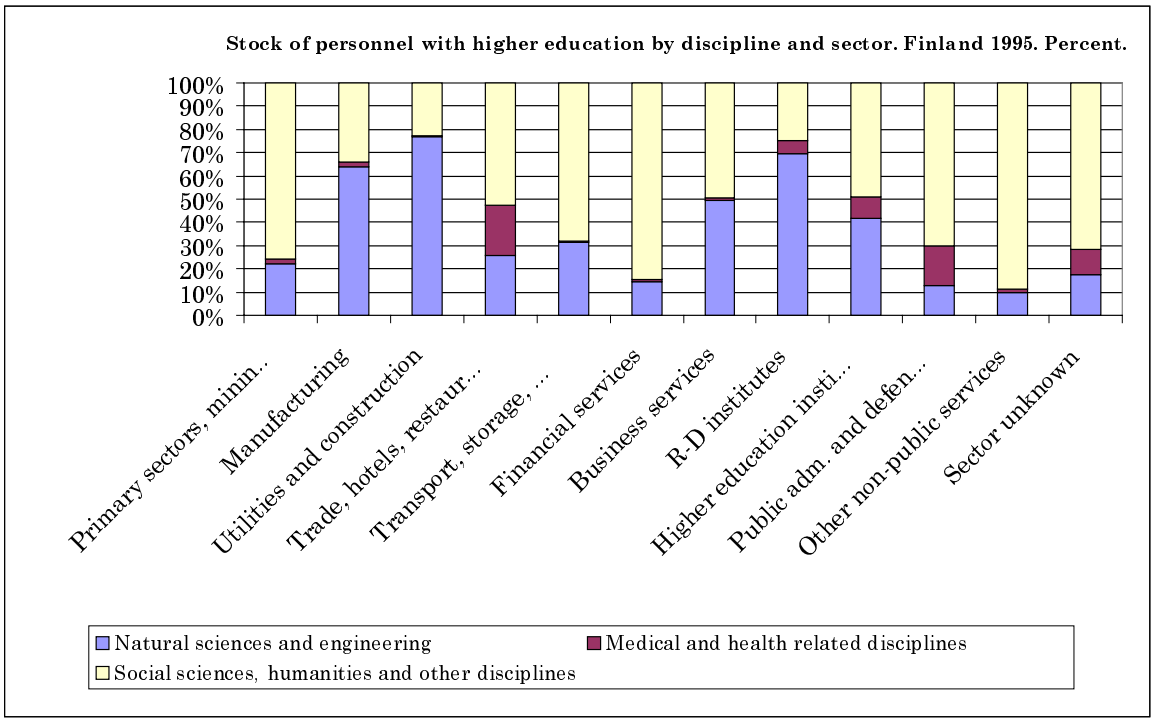


Figure 3.14. Stock of employees with higher education by scientific field and industrial sector. Percent (each industrial sector=100). Finland 1995. See also table A8 and A8B



3.3 Examples of the use of formal knowledge in specific sectors

The broad sectoral categories studied so far may be so broad as to blur differences that may exist in the use of formal knowledge – between sectors, and between countries. Such differences can be studied in greater detail, as stated above. In this section, we focus on three sectors that are somewhat more narrowly defined. These sectors are chosen to represent different types of occupations: Information and communication technology (ICT) as a representative of a modern, "high-tech" and growing industry, pulp and paper as the "traditional" and process intensive industry, and public administration as a "service sector" outside ordinary market competition. The indicator we use is share of employees with education below ISCED 6 (3 years of higher education), and a disciplinary distribution of persons with education at ISCED 6 or above.

The general picture that emerges is basically the same as in the comparisons above: The sectors are different in their use of formal knowledge, but the distribution by fields of science and level of education is very similar in the different countries. Public administration has the higher share of highly educated personnel, defined as ISCED 6 or higher, closely followed by ICT. The disciplinary distribution is clearly different between the two, with ICT dominated by natural scientists and engineers, public administration by social sciences, humanities and other sciences. In pulp and paper, less than 5 % of employees are highly educated according to the present definition. Natural scientists and engineers make up the majority of these, but social sciences and humanities are clearly present as in manufacturing as a whole.

Figure 3.15. Employees with and without higher education, by scientific field and country 1995. ICT sectors (NACE 30+32+72+64.2. For Sweden 64.2 is not included). Percent. See also table A9.

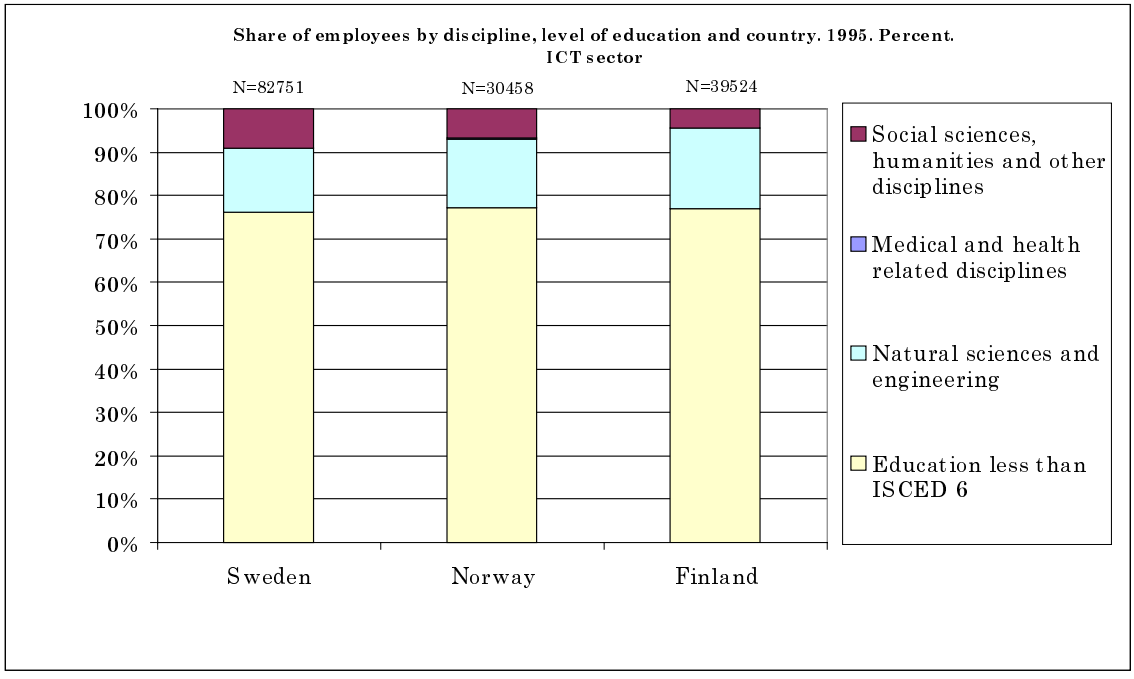


Figure 3.16. Employees with and without higher education, by scientific field and country 1995. Pulp and paper (NACE 21). Percent. See also table A10.

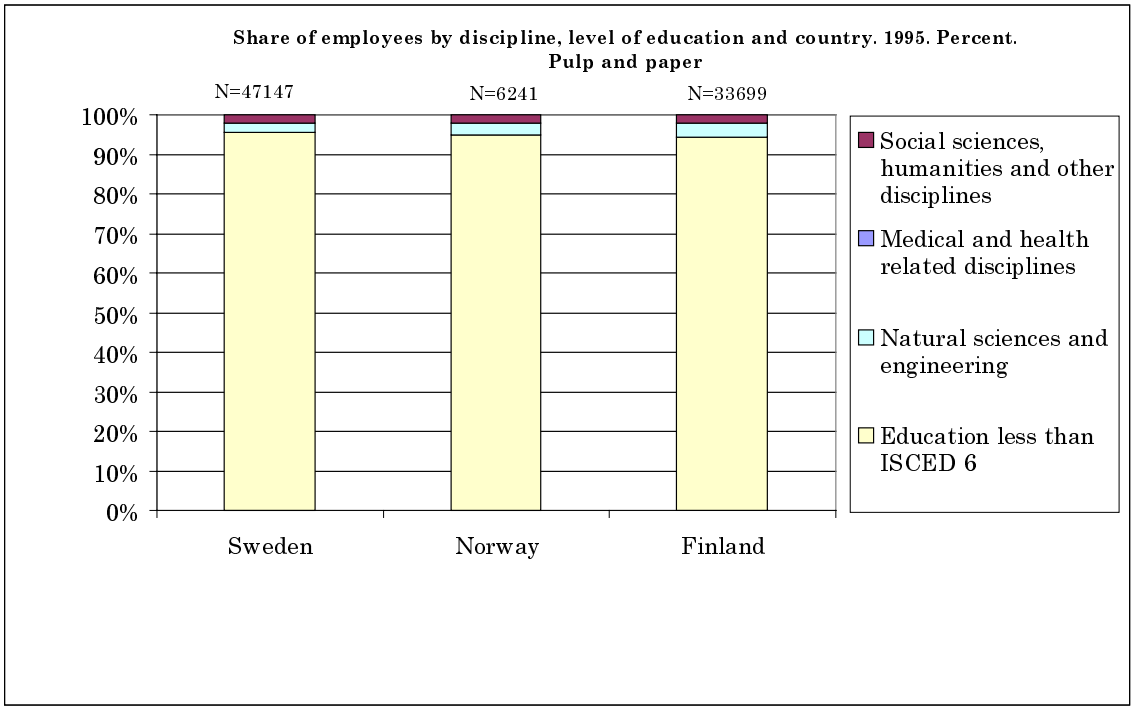
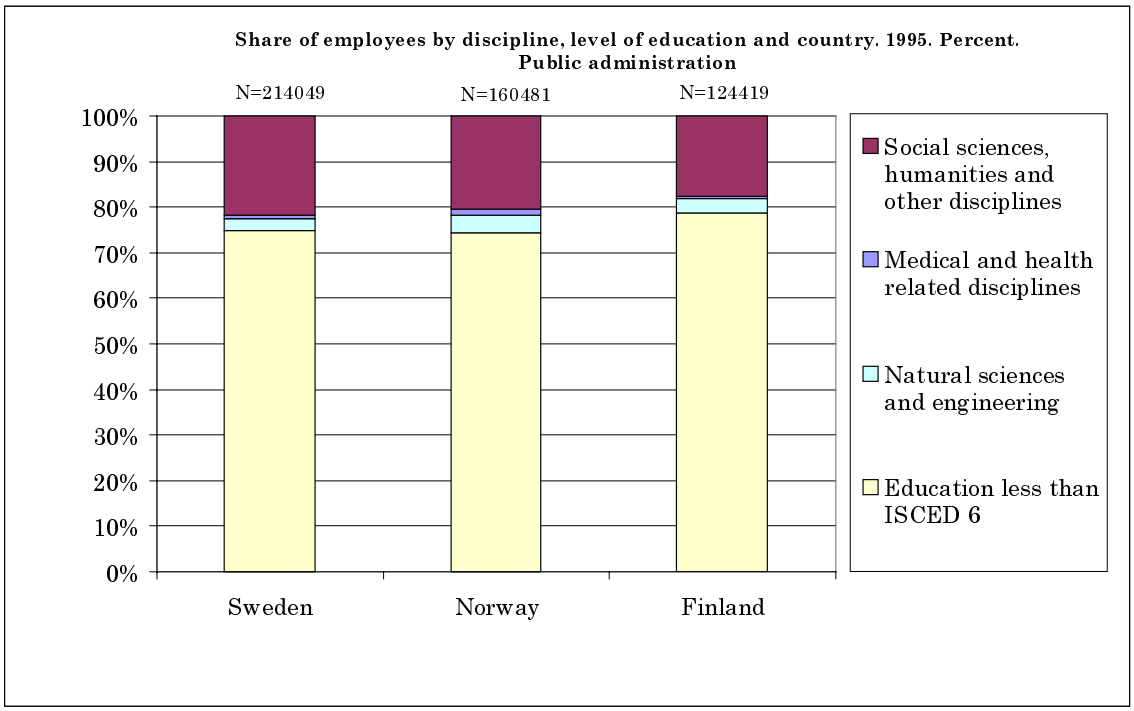


Figure 3.17. Employees with and without higher education, by scientific field and country 1995. Public administration (NACE 75). Percent. See also table A11.



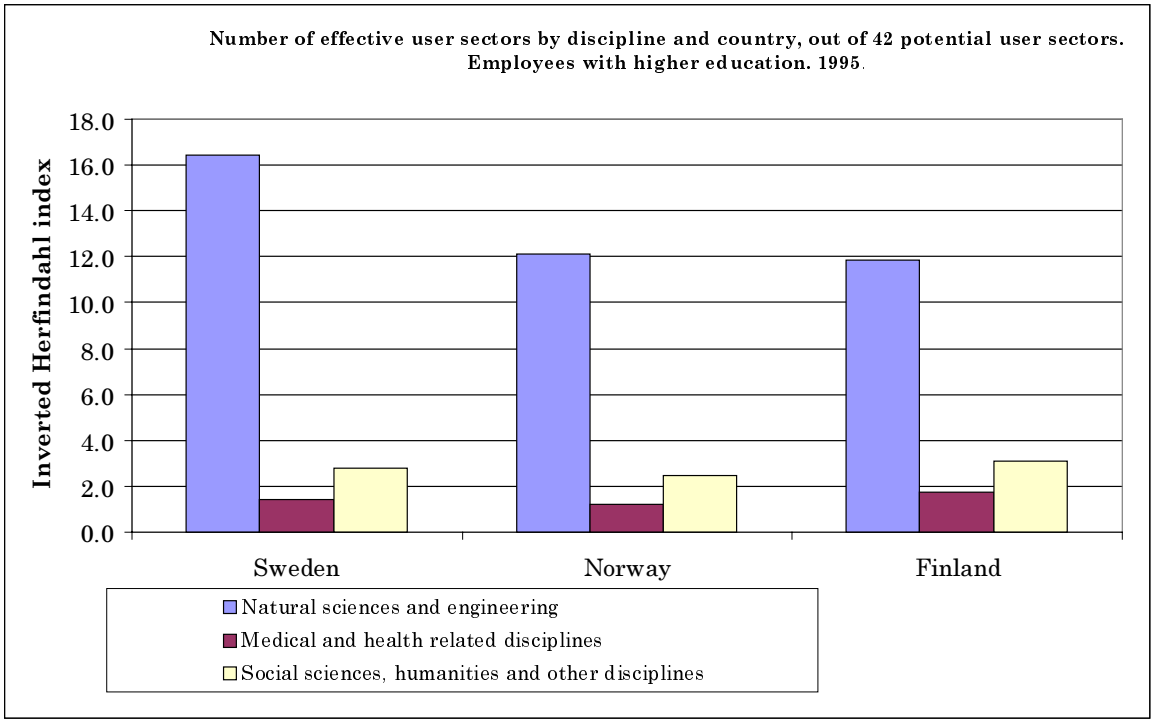
3.4 Disciplinary variance in the number of user sectors

We have seen so far that all three scientific fields specified are used in all the sectors. There are, however, clear differences where regards the degree to which the different scientific fields are evenly distributed between the potential user sectors. To investigate what this distribution looks like, we have utilised a measure known as the "Herfindahl index" – simply a measure of variance.[5] The index varies between 1 and the inverse of the number of categories used. If the distribution on the categories is even, the number becomes small and close to the inverse of the number of categories. If the distribution is concentrated to one or a few categories, the Herfindahl index increases towards its maximum, 1. Taking the inverse of the Herfindahl index we get an indicator for the number of "effective user sectors". It can be viewed as an indicator of the number of categories, or sectors in our case, which dominate the distribution. The number of categories, and the distribution on the categories of total number of employees, affects the indicator.

Results are presented in figure 3.18 below. As can be seen, the results are clear cut and the same for all countries: Natural sciences and engineering are used widely in the sectors specified, with a number of effective user sectors in the order of 12-16. Medical and health related disciplines have a far more focused user group; between 1 and 2 effective user sectors. Even social sciences, humanities and other disciplines are strongly focused with 2-3 sectors out of the 42 dominating as users.

One should be aware, however, that the classification used is biased towards the manufacturing sectors. Around half the categories belongs to manufacturing, a much higher share than their actual share of employment justifies. The public sector and private services are split into broader categories than manufacturing. As a result, it is a higher number of sectors where those looking for work in manufacturing can go. It is more relevant for the natural scientists and engineers, and explains part of, but not all of, the higher number of user sectors for this educational group.

Figure 3.18 Inverted Herfindahl indexes for the number of effective user sectors (broken down by 42 sectors), by scientific field. See also table A12.



[5] The Herfindahl index is calculated as follows: $H_j = \sum_i s_{ji}^2$ where s_{ji} = share of total in sector i for educational category j. In this case, i=1-42, whereas j represents three different education types. In this case, the minimum possible value for the inverse of Hj (presented in figure 3.18) is 1, the maximum is 42.

4. Knowledge transfer by mobility of skilled labour

In this chapter we address the core questions of this investigation: What are the patterns of knowledge transfers, measured by labour mobility, between sectors of the Nordic economies? To what degree are there significant differences in the patterns of these countries, and to what degree are there generally applicable, structural similarities that transcend national context? And, lastly, to what degree is this approach to mapping knowledge transfer valuable in understanding how national innovation systems are constituted and work?

Whereas chapter 3 profiled the Nordic labour markets, according to sectors, age and education, this chapter studies how employees move between these nodes.

As we have established, the richness of the data and the potential for analysis are practically boundless. This fertility becomes particularly apparent in this chapter, where the study of mobility examines a plethora of possible links, types of links and node-specifications. In the presentation of results from such an ongoing analysis, one has necessarily to be very selective. Here, the selection has been guided by a wish to demonstrate that there are important lessons to be learned from this kind of analysis, even beyond those which the limited time and resources available shaping the present analysis have allowed.

Thus, for the sake of presentation, much has had to be simplified. For example, sectoral breakdowns have been reduced in order to present results graphically, while more disaggregated results are included in Appendix A. We have also left out analysis of trends, including how persistent any differences that emerge is over time. This is mainly due to the practical problems of recoding historical data from ISIC to NACE codes for industrial sectors. In principle, however, such trend studies are possible and of great interest but will have to be left to future work. Another aspect that does not fit into the present context involves mobility between single enterprises and single institutions. This could be interpreted as (part of) the “true” innovation networks, as each single enterprise or institution is dependent upon their own relations, independent of what other

enterprises within the same industry do. This has to be left to more in-depth studies. At present, the focus is to establish whether such networks do exist at the sectoral/industrial level, independent of the distribution of participating firms.

The chapter is organised as follows. First we compare the overall mobility of employees from one year to the next in the Nordic countries. Relevant questions include whether this describes a marginal phenomenon, or more extensive employee mobility. Further, do higher educated employees shift jobs more often than do those without such formal skills? Are there any patterns in the age distribution of personnel that is moving or sticking to their employer? What are the numbers and shares of enterprises actually experiencing labour mobility between themselves and NIS institutions (HEI and R&D institutes)?

Second, we take a closer look into a number of sectors - including some specified NIS institutions (HEI and R&D institutes) - to study what the main delivering and receiving sectors are. Are the emerging patterns different between the higher educated and those with a lower level of formal education? What about the important group of those with higher degrees in natural sciences and engineering; are their mobility patterns different from the rest? Are the patterns similar in the different Nordic countries?

Third, we study the degree to which different sectors recruit broadly (do they draw their employees from many different sectors) or more narrowly (with a strong focus on one or just a few delivering sectors)?

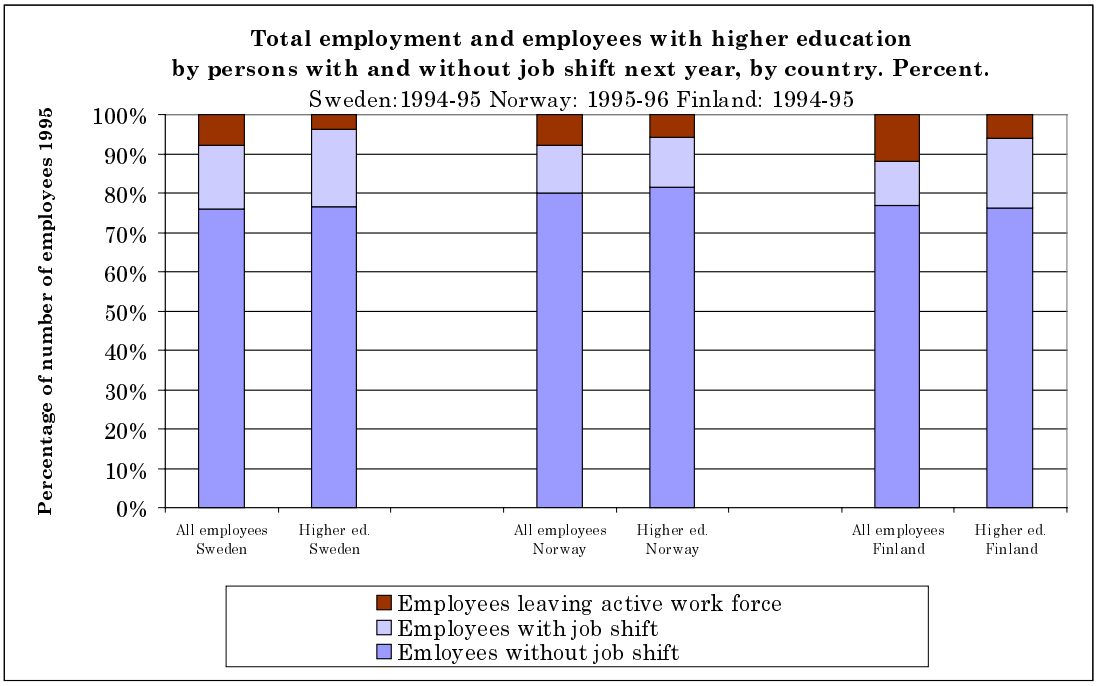
Lastly, we sum up our main finding from the mobility analysis and discuss what the scope and limitations of these kinds of analysis might be.

4.1 The overall level of labour mobility as recorded in the employment registers

In this section we study the emergence of overall mobility as recorded in the registry files. Mobility rates will vary according to how they are defined: shaping factors include how long a period one examines, whether one includes or excludes new entrants or persons leaving the active work force, and so forth. Here we have focused on mobility

between two consecutive years. That influences the kind of information available: You can tell how many that have left or changed job by the second year in the comparison, but you have no information on how many new employees there are in the first year. The basic breakdown is therefore between employees who work for the same employer both years, employees that work for different employers both years, and employees who have left the active work force by the second year (for retirement, unemployment, further education or any other reason). To nuance the concept of mobility, we have also included a comparison over three years in order to decompose the types of mobility looking at both the inflows and outflows. This allows us, among other things, to compare mobility rates between existing and newly employed persons. Lastly, we introduce employee age to determine whether the switching of one's work situation occur more often among the younger employees, as one might expect.

Figure 4.1: Total employment and employees with higher education. Number of permanent employees first year and persons who have left by next year. Sweden, Norway, Finland. Percent.



As depicted in figure 4.1, employee mobility is by no means a marginal phenomenon. Between a quarter and a fifth of the employees are recorded to have left their employer

one year later (see also table 4.1 below). The level is roughly the same for the group of higher educated as for all employees independent of education, with a somewhat higher mobility in Finland and Sweden than in Norway. The majority of those that change their employment situation move between jobs. For Norway there are only marginal differences between the more highly educated and all employees. In Finland and Sweden a somewhat higher share leaves the active workforce from the ranks of all employees than from the ranks of the highly educated. On the other hand, a higher share of the latter group shift between employers in Finland and Sweden compared to Norway.

If mobility, or turnover in employment, were at the level recorded here for every single enterprise each year, the total staff would have been changed in only four to five years (given that it is only the “old” employees leaving). That is of course not the case. An important reason for that is the entry and exit of enterprises. A large share of mobility results from enterprises going out of business or being restructured in such a way that they change identity in the registers upon which we base our definition of mobility. To what extent this is the case it is not yet possible for us to judge. That issue must be addressed before too firm conclusions can be drawn from this material. Another factor to be touched upon below, is that to a certain degree it is the same people moving over several years.

One could argue that changing job should be the core focus when studying knowledge transfers, as this includes persons bringing their knowledge from one workplace to another. On the other hand, the turnover in companies resulting from retirement and other reasons for leaving, facilitates the employment of new employees, be they from another company, unemployment or newly graduated candidates. All of these groups bring new knowledge into the organisation and contribute to the flow and renewal of knowledge.

In order to get an idea of the degree of stability of employment over a longer time span, we have looked up how many of the employees in Norway in 1986 that are found with the same establishment in 1994; an 8 year period. The results show that almost a third of the employees are found with the same establishment after 8 years (31,5 % of the

employees in 1986, and 30,7 % of the employees in 1994). A similar Swedish exercise revealed that over a 7 year period from 1986 to 1993, only 20 % of the original employees are found with the same establishment. Even if this uncovers some degree of stability, it implies that between 70 % and 80 % of the employees stay with their employer less than 7-8 years. In consequence, a lot of new knowledge is brought into the organisations by exchanging personnel – and a lot of knowledge is necessarily lost. Preserving knowledge within the organisation when staff is leaving thus poses a major challenge besides the more positive effect of gaining new knowledge from new personnel.

Table 4.1. Mobility rates. Total employment and employees with higher education, broken down by technical, medical and social sciences and other. Sweden, Norway, Finland. Percent of total employment first year. Wide type of mobility: Including persons leaving active work force. Narrow type of mobility: Excluding those leaving active work force.

Type of employees	Type of mobility rate	Sweden[1]	Norway	Finland
All employees	Wide	24,0	20,1	23,3
All employees	Narrow	16,2	12,4	11,5
All higher educated employees	Wide	23,4	18,6	23,9
All higher educated employees	Narrow	19,5	12,8	17,9
Natural sciences and engineering	Wide	22,4	19,9	23,3
Natural sciences and engineering	Narrow	19,0	14,6	17,8
Medical fields of science	Wide	25,1	21,4	26,7
Medical fields of science	Narrow	21,9	14,7	21,2
Social sciences, humanities and other fields of science	Wide	23,3	17,4	23,6
Social sciences, humanities and other fields of science	Narrow	19,2	11,7	17,4

[1] For Sweden only persons working in establishments with valid NACE codes both years are included.

Breaking down mobility rates by type of higher education reveals much the same patterns between the countries as over all mobility, with generally higher mobility rates in Sweden and Finland than in Norway. In general there is not very much variation, but it seems like mobility is somewhat higher high among the medical and health related disciplines. This, of course, is affected by the age distributions in current employment, as depicted in figures 3.5-3.7 above.

Bringing in one extra year - as we have done in figures 4.2-4.3 below - allows us to decompose mobility of the middle year according to both inflow and outflow. Combining inflows with outflows and the stable employees results in a total of 9 categories. The possible states include employees with the same employer during all three years, employees changing employer from previous year or to the subsequent year, and persons that are neither active in the workforce the previous year nor the following year. The total for each year is set at 100 %.

The results reveal a high degree of turnover. Only around 60 % of the employees stay with the same employer in the sense that they have the same employer two years in a row. National differences in this share are marginal or non-existent: 62 % for Norway

and 62 % for Finland. In other words, the mobility rate when taking both inflows and outflows into account is around 40 % over a two-year period. Inflows are marginally greater than outflows, indicating a small increase in employment.

As the figures illustrate, mobility takes on many forms. The majority of mobility involves those who change states from one year to the next, and then become stable (within our short time horizon of one extra year). Among these are employees who continue to work for the same employer also in the following year. This group will encompass those who have accumulated experience working for one employer and may be viewed as the most valuable recruit for the subsequent employer. The group of employees that have accumulated work experience with one employer before starting work with a new employer accounts for around 7-8 % of employment (Norway and Finland). In addition there is a small group of "experienced workers" who are employed for each of the three years, but who change employer each year. These may be called "experienced nomads", and they make up around 3 % of employment (Norway and Finland). Another group of 'nomads' involves those who were not employed in the first year, work for an employer the next year, but who change employer again the subsequent year. Such "inexperienced nomads" involve, probably to a large degree, newly educated looking for a suitable job. This group is even smaller, only around 2 %.

Figure 4.2 Permanent and mobile employees broken down by type of mobility. Norway 1992-1994. Percent. See also table A14.

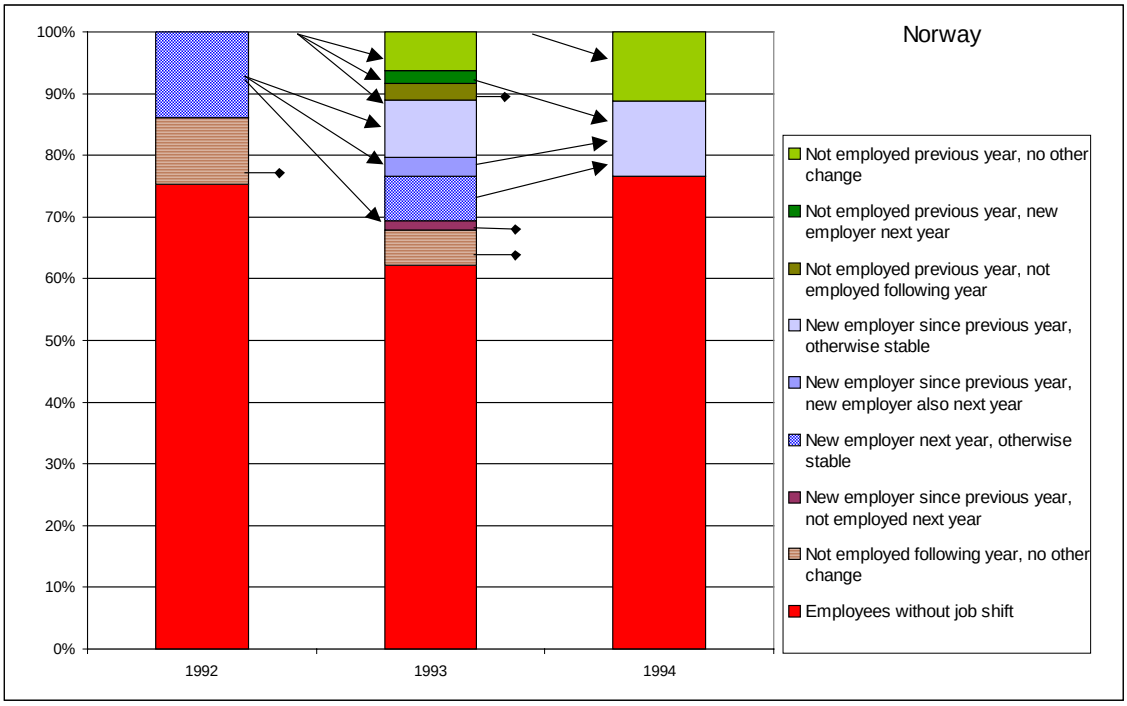
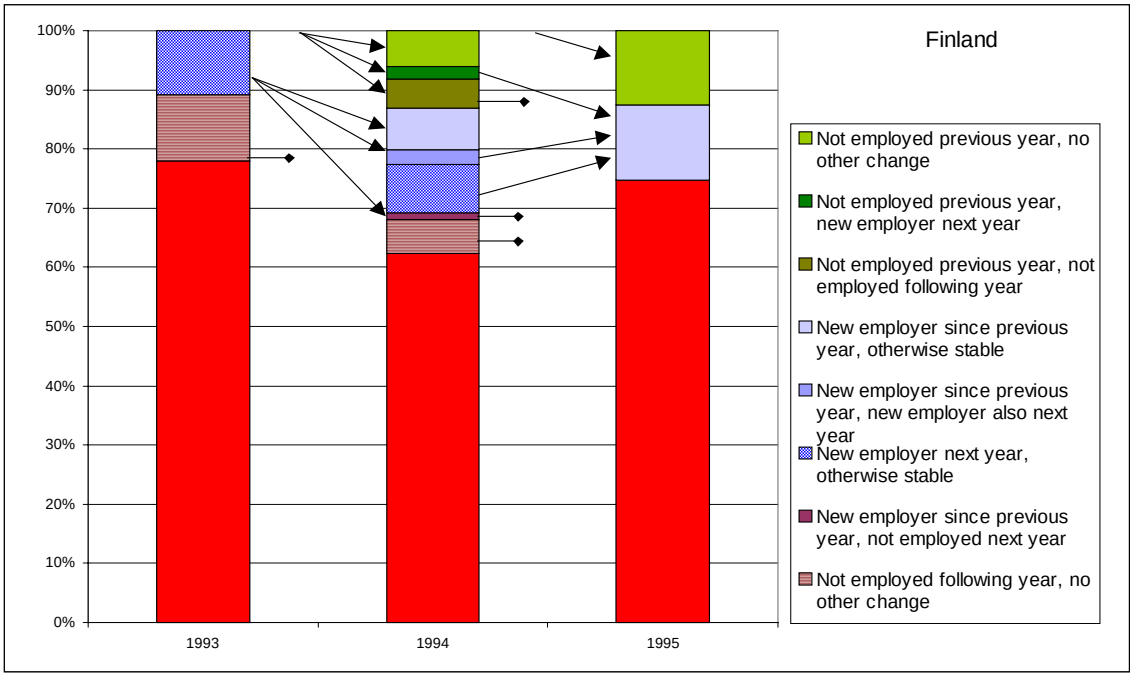
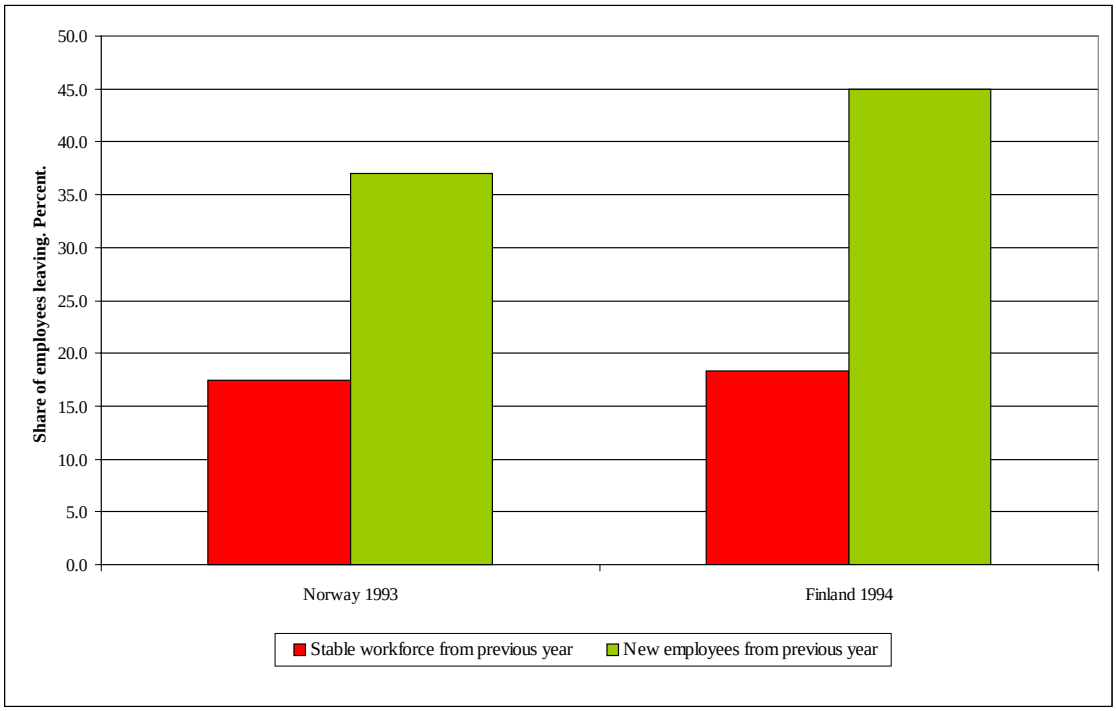


Figure 4.3 Permanent and mobile employees broken down by type of mobility. Finland 1993-1995. Percent. See also table A15.



It is possible to separate out two distinct groups from the mobility patterns above: those who were not employed by the same employer previous year ("new employees"), and those who were employed by the same employer the previous year ("stable workers"). Checking their employment status the following year allows us to compute mobility rates separately for these groups. As is evident from figure 4.4 below, the patterns are clearly different. From the group of stable workers, about 17-18 % (Norway and Finland) have left by the following year, whereas as many as 37-45 % (Norway and Finland) of the new employees have left the following year. From the perspective of the employer, the loss of experienced workers is assumedly more serious than is the loss of new recruits. The high mobility rate among the new employees should probably be interpreted as representing a kind of trial and error process, a sort of 'shopping around' situation both for the employer and employee.

Figure 4.4. Mobility rates for "stable employees"(same employer previous year) and "new employees" (not same employer previous year), by country. Percent. See also table A16.



A last issue to be considered in characterising stable and mobile employees is the age distribution of the different groups. In figures 4.5-7 below we again revert to studying

changes between two adjacent years. The categories are employees showing no change, those with a new employer, and those leaving the active work force for whatever reason. In addition, we have included in the figures the total number of employees and the total population by age.

It becomes evident that the size of any of the specified mobility groups is mainly determined by variations in population-size and employment irrespective of age. The distribution of the populations by age roughly follows the same pattern but with a more pronounced peak in Finland for the post-war (WWII) generation than in Norway. High birth rates lasted even longer in the Norwegian case, yielding a more even size of the generations.

In terms of number of persons, the 40-50 year olds make up the largest share of employees without any change in job. This is due to the large size of these generations. For persons changing jobs, the largest numbers are to be found among the younger employees. In order to better see whether a larger share of the younger shift jobs, we have calculated the percentage of each age group with and without a change (see figure 4.5-7x). The results indicate a very similar pattern across countries: The share of employees at each age without any change increases with age, while the share that change jobs (from one employer to a different employer) falls steadily with age. This seems, therefore, to be a relatively robust and typical characteristic of the mobility patterns.

Certain differences however do exist between the countries. Stability is generally higher in Norway than in Finland, and this difference is particularly visible among employees over 50 years of age. The higher rate of unemployment in Finland seems to hit these age groups relatively hard, as the residual group of people moving out of the active work force makes up the difference. In addition, the earlier retirement age of 65, versus 67 in Norway, is clearly visible in the figure.

Fig 4.5 Age distribution all employees by type of mobility. Absolute numbers. Sweden 1994-95. See also table A17.

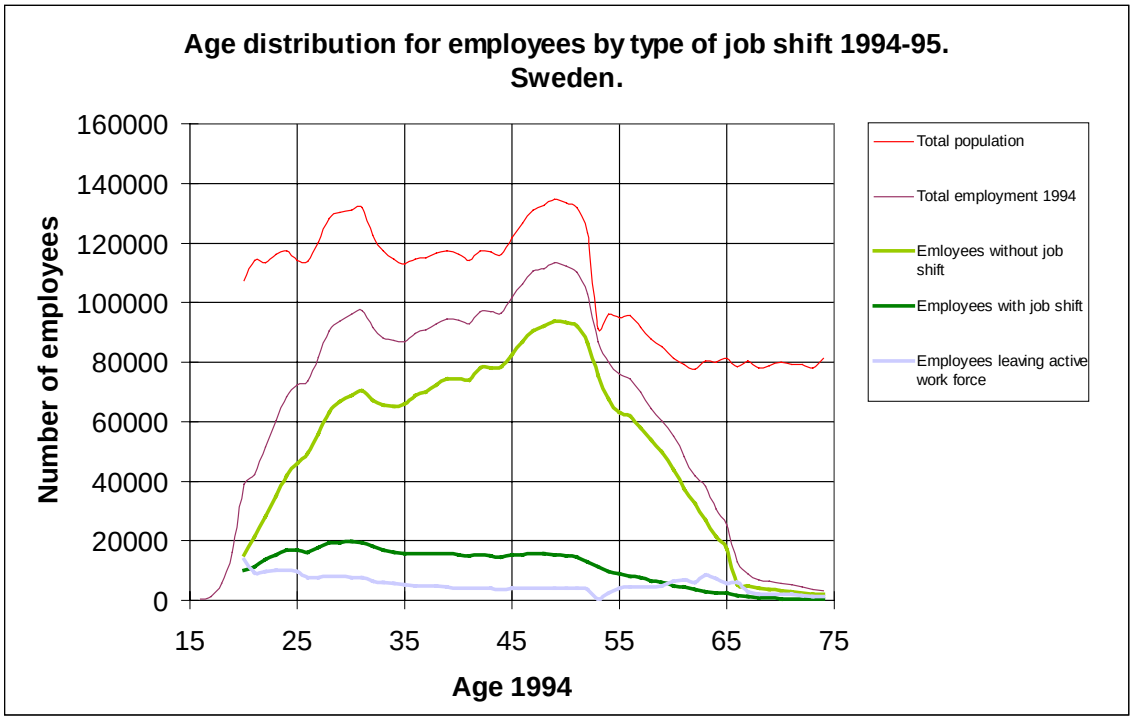


Fig 4.6 Age distribution all employees by type of mobility. Absolute numbers. Norway 1995-96. See also table A18.

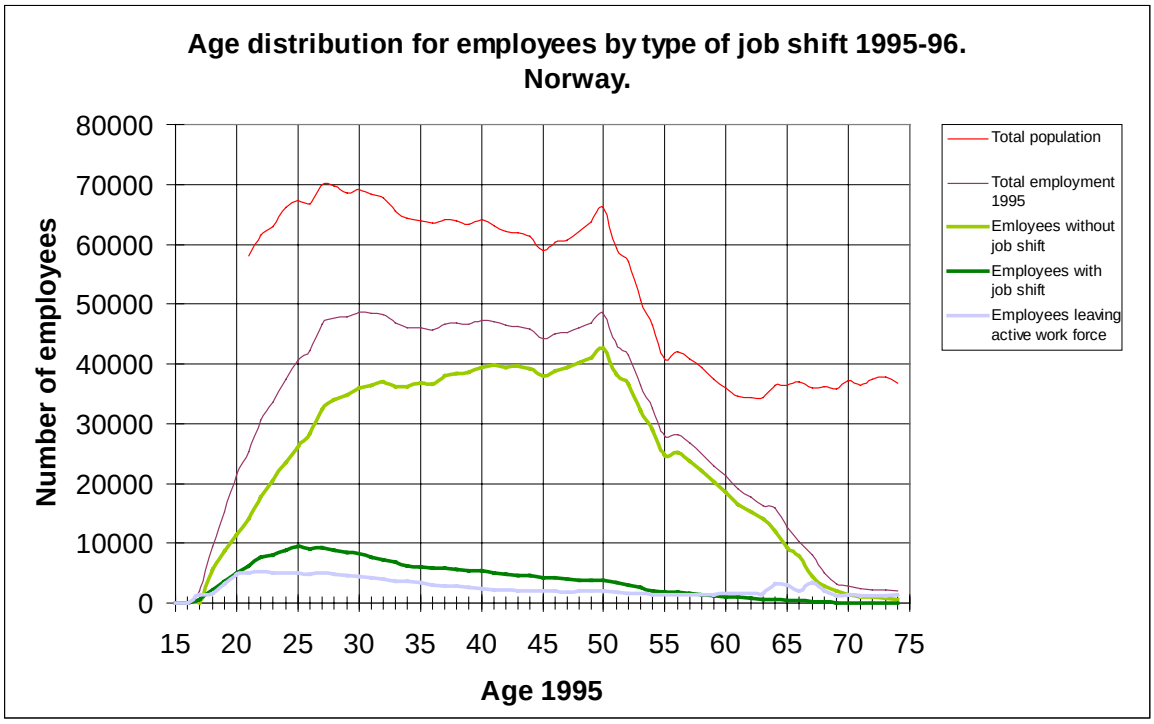


Fig 4.7 Age distribution all employees by type of mobility. Absolute numbers. Finland 1994-95. See also table A19.

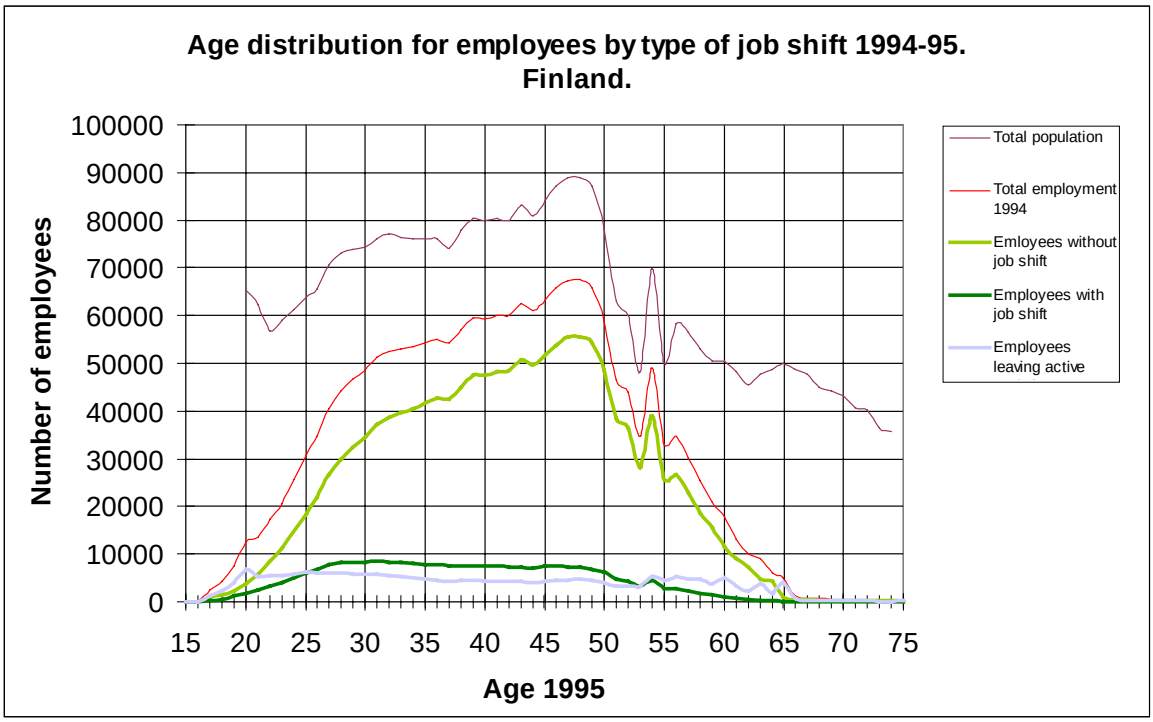
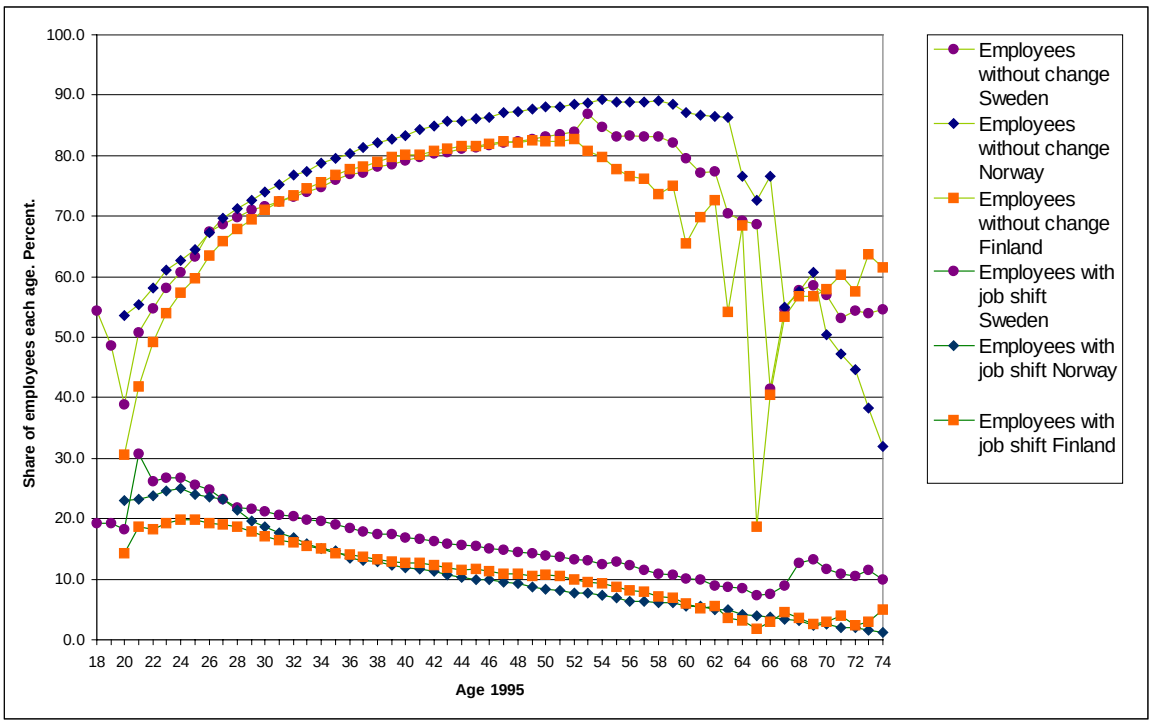


Fig 4.5-7X. Age distribution all employees by type of mobility and country. Percent.



In most of this report the unit of analysis is the single employee. Having established what we consider to be high rates of personnel mobility between two consecutive years, one get the impression that such personnel flows affect the entire economy with all its organisations and establishments. With our particular focus on the NIS institutions we have investigated how many establishments which have received any personnel from higher education institutions or R&D institutes. Results are presented in table 4.2 below, and it is clear that this kind of mobility only affects a limited number of establishments or firms – in particular as a relative share of the number of existing units. Well under 1 % of the units have received any personnel from NIS institutions in both Finland and Norway. The shares are somewhat different in the two countries, partly due to differences in the specification of the unit. We see, however, a similarity in the pattern of which sectors that is mostly involved. First of all, the higher shares are found within the NIS institutions themselves, due to their limited number and the flow of personnel both within each of the sectors and between them. Of the other sectors, the higher shares are found in business services and financial services/real estate in both Finland and Norway. In addition manufacturing scores relatively high, but more so in Finland than in Norway. The shares are, however, generally low, so the main conclusion is that a very small share of establishments and firms receive personnel from the NIS institutions every year. In a follow up study it is of course important to investigate how the situation looks over a longer time span; is it more or less the same units involved so that the share of firms are kept low also in a longer time perspective? What kind of firms are these?

Table 4.2: Number (N mob) and share of firms (calculated with all existing firms in each sector=100 %) with labour mobility (inflow, independent of education) from NIS institutions (HEI and R&D). By country.

	Sweden 1994-95		Norway 1995-96		Finland 1994-95	
	N mob	**%**	**N mob**	**%**	**N mob**	**%**
Primary sectors, mining, oil	44	na	26	0.2	17	0.61
Manufacturing	356	na	92	0.7	203	1.27
Utilities and construction	34	na	19	0.1	23	0.17
Trade, hotels, restaurants	232	na	50	0.1	91	0.26
Transport, storage, communication	63	na	14	0.1	23	0.18
Financial services, real estate	27	na	17	0.9	19	2.23
Business services	588	na	167	1.0	216	1.40
R&D institutes	42	na	64	27.9	27	36.49
Higher education institutions	4	na	64	30.2	..	..
Public adm. and defence, health and social work	124	na	345	1.4	112	2.72
Other non-public services	75	na	64	0.6	86	1.07
Total	**1589**		**933**	**0.6**	**818**	**0.76**

[1] The units for Norway are establishments, including public organisations. The units for Finland and Sweden are firms. In most cases a firm encompasses only one establishment, so that the units are the same. In addition, only private firms are included for Sweden and Finland, and not public organisations.

4.2 Overall mobility by delivering and receiving sectors

In this section we study labour mobility by explicitly bringing in the delivering and receiving sectors. By now it is evident that these flows involve a considerable number of people, even when focusing only on two consecutive years. Is this mobility concentrated on a limited number of sectors, or is it more evenly distributed? Which links are possible to establish between sectors using this methodology?

The flows make up a very complex pattern that is difficult to analyse and even more difficult to present. In order to manage the information, we break down the delivering and receiving sectors into the same 11 categories as we have used before. With the focus of national innovation systems applied, that means separating out the higher education institutions and R&D institutes. Where appropriate, the longer list of 42 sectors is used.

In terms of organisation, we present first the total flows independent of education; next we present the same picture for personnel with higher education (ISCED level 6 or higher); and lastly, we separate out the natural scientists and engineers.

4.2.1 All employees independent of education

To start our analysis of sectoral flows (all employees independent of education), we present mobility rates as broken down into 42 sectors. Two different mobility rates are used. The first is the wide definition that includes both those who change employer as well as those who leave the active workforce in the second year. The second is a narrow definition that only includes those employed both years. All rates are calculated as a percentage of the total number of employees the first year.

In general there is quite a lot of variation between sectors (see table 4.2.1x). It is therefore misleading to speak of a single overall rate of mobility, or attach too much importance to the general average. Even within the sectors specified here there are necessarily such variations. We also expect there to be variations over time for each sector[6].

As can be seen, levels of mobility vary between countries. A simple correlation of the rates in Norway and Finland results in a correlation coefficient of 0,54 for the wide definition and 0,31 for the narrow definition. Taking rank correlations, the coefficient increases slightly to 0,61 for the wide definition and 0,63 for the narrow definition. This is due to a slight difference in the general level of mobility rates in the two countries. The correlations signify a certain similarity across countries, in particular in terms of rank. Differences in national conditions in the respective labour markets however seem to influence the mobility rates more than does the individual sector under study.

[6] Again, we have not yet had time to investigate whether the differences between sectors are persistent

Table 4.2.1X. Mobility rates between two consecutive years .Total employment broken down by sector. Sweden, Norway, Finland. Percent of total employment first year. Wide type of mobility: Including persons leaving active work force. Narrow type of mobility: Excluding persons leaving active work force.

Sector	Sweden		Norway 1995-96		Finland 1994-95	
Type of mobility rate:	**Wide**	**Narrow**	**Wide**	**Narrow**	**Wide**	**Narrow**
Agriculture, hunting and related service activities	17.4	10.8	30.2	17.2	13.5	1.5
Forestry, logging and related service activities	21.3	9.9	24.7	13.6	22.0	7.4
Fishing, oper. of fishing hatcheries and fish farms	24.7	14.1	19.1	10.7	17.6	4.1
Mining and quarrying	27.2	16.8	17.0	10.9	20.9	8.5
Food products, beverages and tobacco	14.1	7.9	21.9	12.8	22.0	10.4
Textiles and textile products	22.3	12.2	19.7	10.6	20.2	5.3
Wood and products of wood	28.0	19.6	15.7	9.0	21.3	6.8
Pulp, paper, paper products	17.8	11.1	7.8	2.9	14.6	8.7
Publishing, printing, repr. of recorded media	12.3	7.9	16.9	9.5	21.0	12.3
Coke, ref. petr. products, nuclear fuel [1]	21.7	13.5	10.7	5.3	9.3	5.9
Chemicals and chemical products[1]			7.5	3.1	16.8	8.6
Basic chemicals	23.4	16.9	14.3	8.1	13.8	8.8
Pharmaceutical preparations	21.0	16.4	12.6	7.2	23.4	17.6
Rubber and plastic products	8.6	4.3	17.8	11.5	13.3	4.8
Non-metallic mineral products	20.6	13.6	13.8	8.1	18.2	5.9
Basic metals	13.3	9.2	12.4	6.7	10.7	5.7
Fabricated metal products	19.4	12.6	19.8	12.6	15.9	7.0
Machinery and equipment n.e.c.	17.4	12.7	14.8	9.6	13.6	7.6
Office machinery and computers	45.7	39.1	71.2	58.2	18.2	10.6
Electrical machinery and apparatus n.e.c.	18.9	13.9	14.5	9.6	17.5	10.0
Radio, tv and communication equipment	13.7	8.1	14.0	7.5	30.2	23.2
Medical, precision and optical instruments	14.7	9.8	16.4	10.9	15.8	9.1
Transport equipment	11.0	6.3	22.9	15.4	15.4	8.4
Manufacturing n.e.c.	19.2	10.4	14.8	8.6	16.9	5.9
Electricity, gas, water supply	12.1	7.7	10.6	5.8	15.6	10.5
Construction	19.1	10.6	19.7	12.3	27.6	10.4
Wholesale and retail trade	24.6	13.1	18.5	12.7	23.7	11.2
Wholesale of machinery and equipment	22.0	15.6	24.0	15.1	18.3	10.8
Transport and storage	17.4	10.0	22.5	14.4	19.3	10.9
Post and telecommunications	13.3	6.1	21.1	12.5	19.1	10.9
Financial intermediation	14.5	8.6	11.3	6.3	29.8	21.0
Other, mainly private services	30.7	19.1	22.0	13.7	29.8	13.4
Computer and related services	21.7	17.0	21.0	16.3	20.4	15.3
Research institutes, technology	24.4	20.4	15.9	10.6	23.5	12.5
Research institutes, social sciences	25.8	19.8	18.0	12.2	22.8	12.7
Other business activities	27.4	16.9	33.9	21.4	26.6	12.9
Architectural and engineering activities	20.0	12.9	19.8	13.4	19.1	8.9
Technical testing and analysis	10.6	6.1	30.8	25.2	16.7	9.1
Public administration	18.0	10.1	17.5	10.6	25.2	14.4
Higher education	22.8	16.7	19.2	10.8	36.6	21.5
Other non-public services	23.5	12.3	21.3	12.2	22.0	9.2
Total	**20.0**	**11.7**	**19.8**	**12.2**	**23.3**	**11.5**

[1] For Sweden chemicals and chemical products are grouped with coke, ref. petr. products, nuclear fuel.

In order to visualise the main flows within the system we have included a series of flow charts. The focus in the flowcharts is higher education institutions (HEI) and R&D institutes. Therefore flows between the other sectors are not shown. These, and the other underlying numbers, can be found in the appendix tables. In order that the charts not become too complicated, we have simplified by aggregating all sectors except HEI and R&D into three groups: Public administration and social services, private services, and goods producing sectors. The latter consists of all of primary sectors, manufacturing, utilities and construction. In the charts, arrows are scaled to represent the number of persons moving. The boxes representing different sectors are not scaled; instead number of employees (in the base year) are supplied in order to take size of the different sectors into account. Accompanying each chart there is in addition a table showing the share of persons moving out of each sector by receiving sectors. One should be aware when evaluating these results that the sizes of the delivering and receiving sectors influence the shares. To check for this, please consult the appendix tables containing the absolute numbers.

In the Swedish case the dominating flows are around the higher education institutions (fig 4.8 and table 4.3. See also appendix table A20 for absolute numbers). This sector is however about four times bigger than the R&D institutes. Taking this into account, the links with both the goods producing sectors and private services are stronger for R&D institutes than for the HEIs. For HEIs links with the public sector are the stronger relationship.

Looking at flows between the two NIS type of institutions at the centre, they are in the Swedish case very unbalanced. Flows go from HEIs to R&D institutes, and only to a marginal extent the other way. As we shall see this pattern differs from what is found in the other Nordic countries, where these links are weak in both directions.

Flows out of the NIS institutions are somewhat larger than the inflows from both goods producing sectors and private services. For the public sector the net flows are in the opposite direction.

Addressing the more detailed overview in table 4.3, we see that for most sectors internal mobility dominates along with mobility out of active work. That is to say, people moving from one employer to another within the same sector are the most common form of mobility. Looking at the NIS institutions in particular, 17 % of persons moving out of HEIs change to another HEI institution. For the R&D institutes, the same rate amounts to 13 %. The largest recipient of personnel from R&D institutes is manufacturing, which receives 21 % of those leaving institutes of higher education. For HEIs, public sector is the largest recipient besides the sector itself (17 %) and the public sector (16 %).

Figure 4.8 Overall mobility by delivering and receiving sectors. Absolute numbers. Sweden. 1994-95

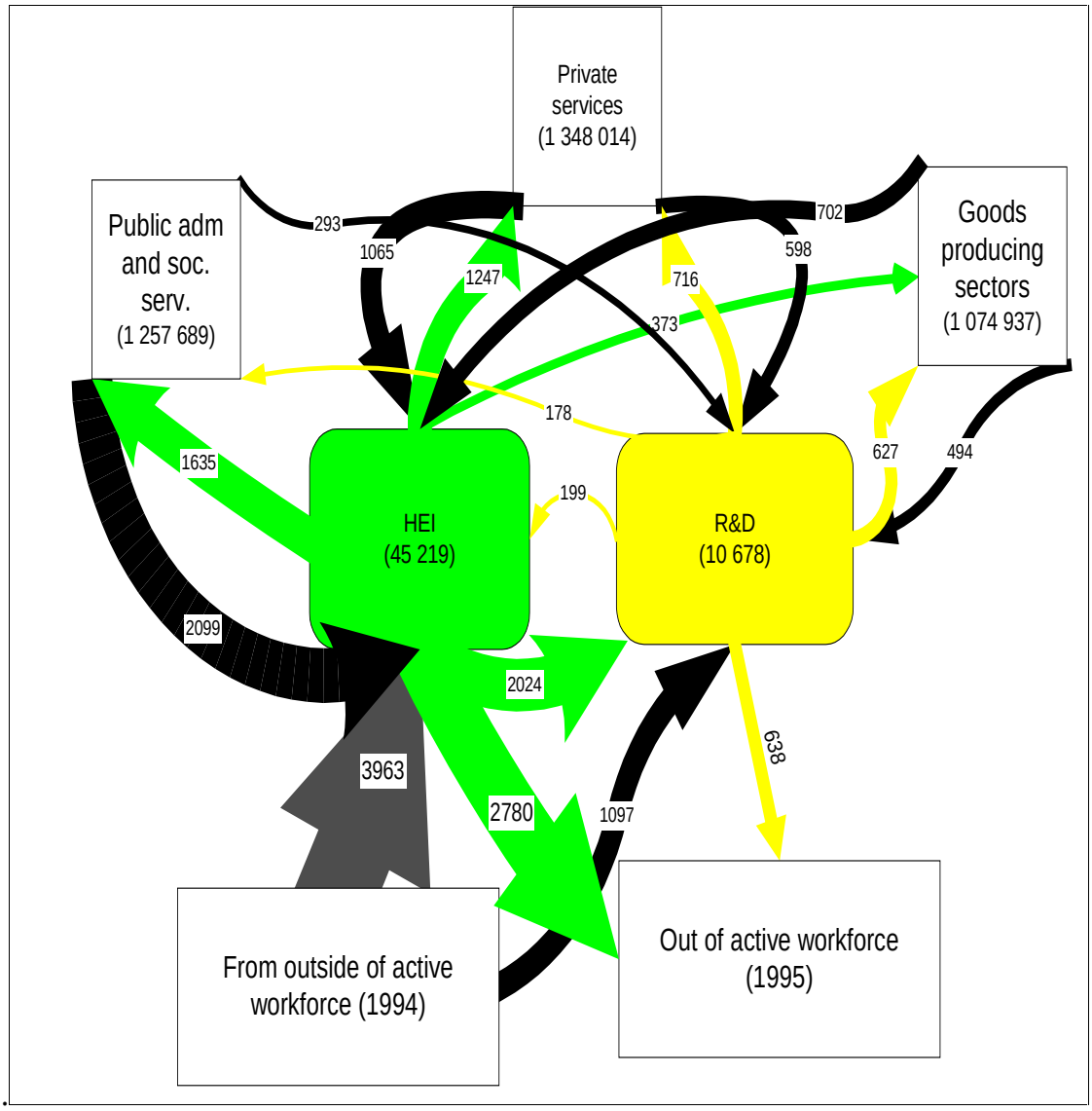


Table 4.3 Overall mobility 1994-95 by delivering and receiving sectors. 11 sectors. Percent (delivering sectors 1994=100 %). Sweden.

Delivering sectors (1994) → **↓ Receiving sectors (1995)**	**Primary sectors, mining, oil**	**Manufac-turing**	**Utilities and construc-tion**	**Trade, hotels, restaurants**	**Transport, storage, communi-cation**	**Financial services, real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence, health and social work**	**Other non-public services**	**Out of active work force**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	11.2	0.9	1.7	0.6	1.1	0.8	0.8	1.2	0.5	0.7	1.1	2.5	18 572	97 105	19.1
Manufacturing	7.5	40.1	9.9	8.6	6.8	3.4	9.2	20.9	6.0	3.0	5.1	18.9	159 477	754 374	21.1
Utilities and construction	4.1	2.4	16.1	1.8	3.0	0.8	5.3	0.7	0.4	1.3	2.0	6.2	46 590	252 892	18.4
Trade. hotels. Restaurants	4.2	7.3	6.9	24.8	8.6	5.9	8.4	6.4	2.0	3.3	6.1	19.5	140 845	543 948	25.9
Transport. storage. communic.	2.7	2.3	2.8	2.9	18.0	3.3	5.5	6.5	0.8	1.1	2.7	6.1	47 784	260 138	18.4
Financial services. real estate	0.6	0.2	0.3	0.6	0.6	21.4	1.6	0.6	0.5	0.3	0.5	1.1	10 512	82 369	12.8
Business services	3.4	5.9	9.7	6.3	6.6	13.8	19.1	11.1	6.0	4.1	5.8	10.2	92 436	322 996	28.6
R&D institutes	0.1	0.3	0.1	0.1	0.1	0.2	0.4	13.2	19.6	0.1	0.2	0.3	4 889	12 816	38.1
Higher education institutions	0.2	0.2	0.1	0.2	0.2	0.5	0.5	7.2	16.7	0.9	0.9	1.1	9 529	44 434	21.4
Public adm. health, social	7.6	2.6	4.4	5.3	5.0	5.6	7.7	6.5	15.9	25.5	13.3	23.0	173 301	1 204 250	14.4
Other non-public services	2.8	1.1	1.9	1.8	2.5	1.8	2.9	1.3	2.9	2.6	11.4	5.0	38 894	166 433	23.4
Out of active work force	50.3	35.5	43.8	45.2	45.6	40.8	36.4	23.2	27.0	44.0	47.0	0.0	315 936	315 936	100.0
Total[1]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	61635	85927	0.717295
N persons moving (=100 %)	21 352	127 758	46 095	129 761	40 644	12 202	81 675	2 751	10 314	226 740	38 319	363 336			
N persons employed	99 885	722 655	252 397	532 864	252 998	84 059	312 235	10 678	45 219	1 257 689	165 858	363 336			
Mobility rate out	21.4	17.7	18.3	24.4	16.1	14.5	26.2	25.8	22.8	18.0	23.1	100.0			

[1]Total includes a l residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1994. The value for this residual varies between 0,0% and 13,1%(Public administration), with an average of around 3% for each category represented in the table

Also in the Norwegian case flows to and from institutes of higher education dominate the picture in terms of absolute number of employees (fig 4.9 and table 4.4. See also table A21). In Norway, this sector is twice the size of R&D institutes (as opposed to four times in Sweden). Taking the differences in size into account, HEIs show a stronger link to the public sector than do R&D institutes. Links to private services and more particularly to manufacturing sectors are generally much weaker than those with the public sector. There is not much difference in these links between R&D institutes and HEIs when their relative sizes are taken into consideration.

As in the Swedish case, a somewhat higher number of persons move out of the NIS institution to goods producing sectors and private services than move in. Again the public sector is an exception with a net outflow to the NIS institutions.

A limited number of employees moved between HEIs and R&D institutes in our period. HEIs delivered around 100 to and received 200 from R&D institutes – a direction of net flow that is opposite to that of the Swedish case.

Looking at table 4.4, two kinds of flows are dominant for each of the 11 sectors. The first such flow involves the dominant tendencies of those labourers who do change jobs to do so within the same sector. The second dominant flow involves the migration of workers either into the active workforce or out of it in the course of the two years we study. Another type of flow that is interesting in our context is where employees who move out of R&D institutes subsequently find work. Here we see that for the most part those leaving research institutes find new jobs in business services (16 %), institutes of higher education (HEI: 11 %) and the public sector (10 %): only about five percent move into manufacturing industries. What about those who leave positions within institutes of higher education (HEI)? Of those moving out from HEIs without shifting to another HEI or out of the active workforce, many move into the public sector (18 %), while four percent move to manufacturing industries. Only three percent find new work in R&D institutes.

Figure 4.9 Overall mobility, independent of education, by delivering and receiving sectors. Absolute number of people moving. Norway 1995-96.

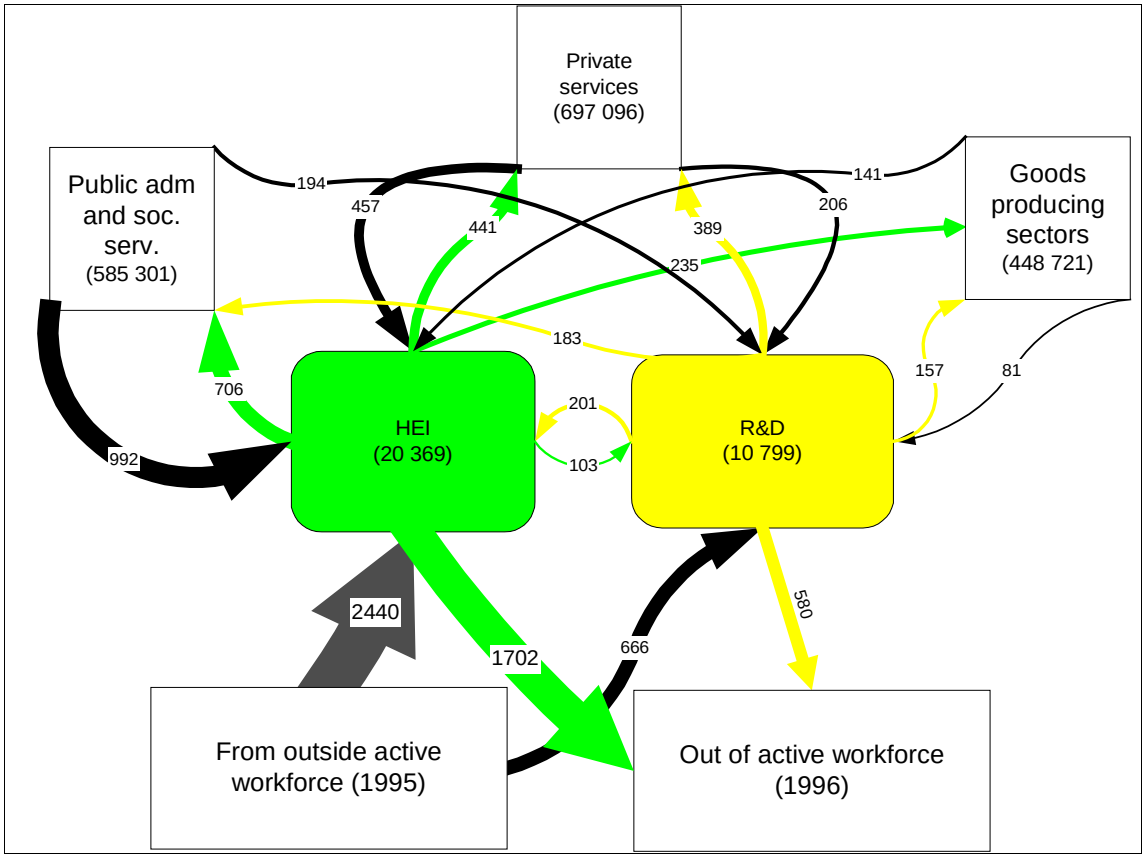


Table 4.4 Overall mobility 1995-96 by delivering and receiving sectors. 11 sectors. Percent (delivering sectors 1995=100 %). Norway. Revised

Delivering sectors → **↓ Receiving sectors (1996)**	**Primary sectors, mining, oil**	**Manufac-turing**	**Utilities and construc-tion**	**Trade, hotels, restaurants**	**Transport, storage, communi-cation**	**Financial services, real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence, health and social work**	**Other non-public services**	**Out of active work force**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. mining. Oil	18.4	1.9	1.7	0.9	0.9	0.5	1.9	2.9	1.1	0.6	1.2	0.4	12155	56892	21.4 %
Manufacturing	8.7	33.3	9.8	6.1	4.2	2.1	7.2	4.8	4.2	2.4	5.7	1.6	55570	280817	19.8 %
Utilities and construction	4.4	3.5	30.7	2.0	2.2	1.0	2.6	1.1	0.6	1.5	2.1	0.8	26082	121620	21.4 %
Trade. Hotels. Restaurants	11.2	8.6	6.4	33.9	7.5	4.7	12.1	3.4	2.2	4.5	7.6	2.9	88678	342722	25.9 %
Transport. storage. Communic.	3.8	2.8	2.8	3.0	35.9	1.8	4.1	1.0	0.9	1.4	2.5	1.0	33221	143583	23.1 %
Financial services. real estate	0.4	0.3	0.2	0.5	0.5	25.2	1.7	1.0	0.7	0.3	0.4	0.1	4899	45707	10.7 %
Business services	4.3	5.1	4.0	7.2	5.0	13.4	26.1	15.5	5.0	2.9	5.2	1.3	42773	133082	32.1 %
R&D institutes	0.2	0.1	0.0	0.1	0.1	0.3	0.3	14.9	2.6	0.2	0.2	0.0	1552	10567	14.7 %
Higher education institutions	0.3	0.1	0.1	0.2	0.2	0.4	0.4	11.3	18.4	1.0	0.8	0.2	4975	21426	23.2 %
Public adm. Health, social	6.7	3.9	4.9	8.4	5.0	5.1	8.1	10.3	18.0	44.2	13.7	3.7	115146	598457	19.2 %
Other non-public services	0.9	0.9	0.9	1.3	1.1	0.9	1.7	1.0	2.4	1.5	20.2	0.5	14054	58329	24.1 %
Out of active work force	40.2	39.1	37.8	35.7	37.1	43.9	33.2	32.5	43.4	39.3	40.1	87.4	1376952	1376952	100.0 %
Total[1]	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**1.0**	**4269**	**18393**	**23.2 %**
N persons moving (=100 %)	13333	48577	21289	77043	31183	5211	31479	1784	3918	101990	12382	1421146			
N persons employed	58070	273824	116827	331087	141545	46019	121788	10799	20369	585301	56657	1421146			
Mobility rate out	23.0 %	17.7 %	18.2 %	23.3 %	22.0 %	11.3 %	25.8 %	16.5 %	19.2 %	17.4 %	21.9 %	100.0 %			

[1]Total includes a very small residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1995. The value for this residual varies between 0.2% and 1.0% for each category represented in the table

The Finnish case is very similar to the Norwegian (fig. 4.10 and table 4.5. See also table A22). A first point of similarity is that the sizes of the sectors in Finland are roughly the same as in the Norwegian case. A second important similarity is that the patterns of labour mobility for these two counties have very much in common. In both cases, institutes of higher education emerge in the flowcharts as central nodes, with strong linkages (in terms of employees coming and going) to the other sectors. The main link in both cases is with the public sector. Beyond this important likeness, the Finnish case however demonstrates a somewhat more intensive link between the manufacturing sectors and institutes of higher education (HEI) than what is the case in Norway, and a less intensive connection between R&D institutes and private services. The number of people moving between HEI and R&D institutes is even lower than in Norway.

A further point of similarity exists between Finnish and Norwegian patterns of labour mobility, and that involves entry and exit from the active workforce. In Finland the numbers who enter into the workforce and exit are even larger than in both the Norwegian and the Swedish case. The link is pronounced for those entering or leaving positions in institutes of higher education. This appears to be due in large part to the extensive use of short-term contracts, where one-year engagements (for ex. fellowships) are common. This rate is however not peculiar to HEIs, the entry/exit link is generally high for all the sectors specified (see table 4.5).

Beyond such external flows, mobility between different enterprises within the same sector in Finland dominates flows in the same way as noted for the Swedish and Norwegian cases. The public sector is the main recipient of those leaving both NIS institutions, with a share of nine percent from each. Manufacturing industries receive six percent of those leaving R&D institutes and four percent of those leaving higher education institutions – a level that is comparable to the Norwegian case, but considerably lower than in Sweden, where 20 % of those leaving R&D institutes go to manufacturing. A mere one percent of those leaving HEIs go to R&D institutes. The institutes of higher education on the other hand, receive 6 % of those leaving R&D institutes.

As we found for Sweden and Norway above, also in Finland flows out of the NIS institutions to goods producing sectors and private services are bigger than the

inflows. For the public sector net flows go in the opposite direction, once again similar to the Swedish and Norwegian cases.

Figure 4.10 Flowchart, overall mobility 1994-95 by delivering and receiving sectors. Absolute numbers. Finland 1994-95.

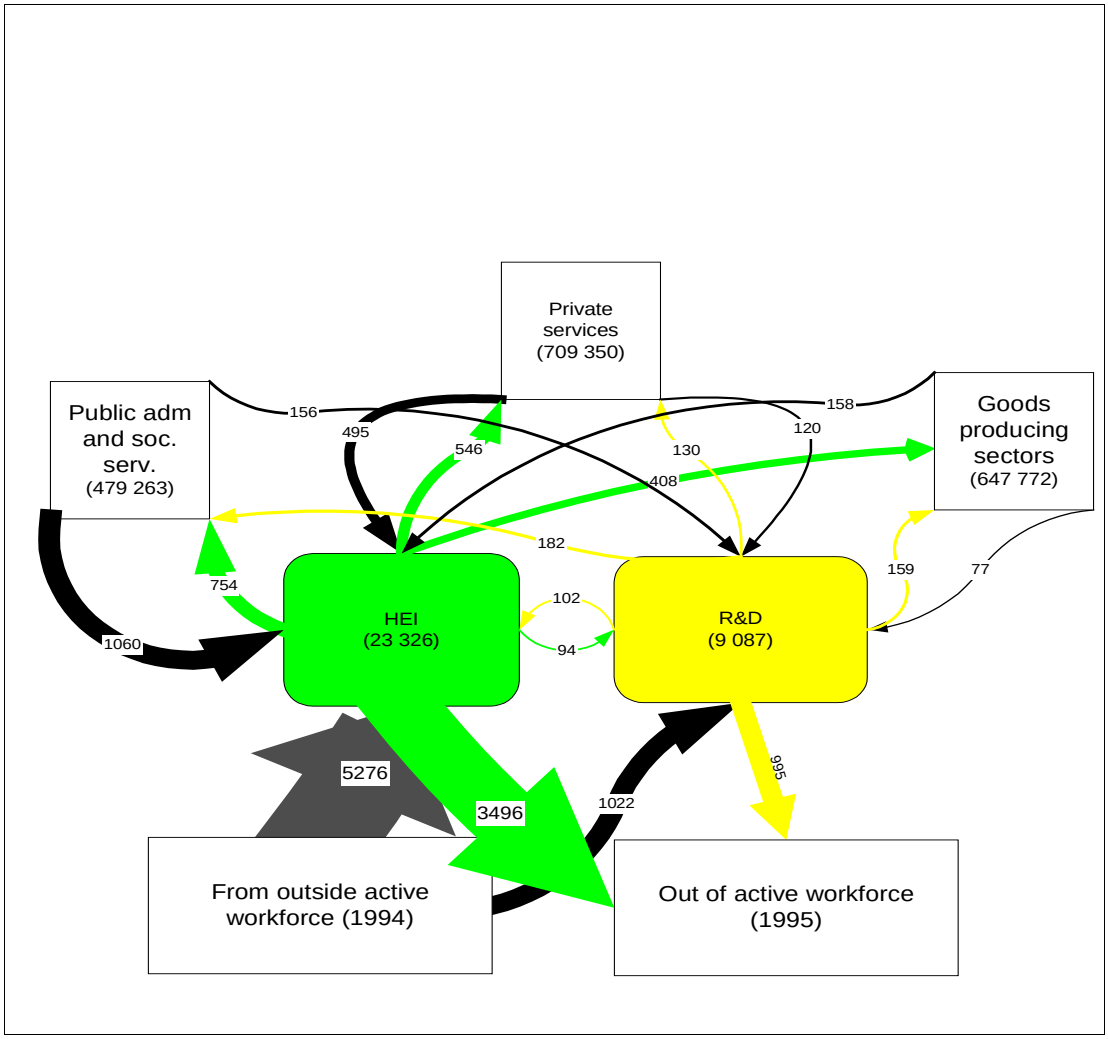


Table 4.5 Overall mobility 1994-95 by delivering and receiving sectors. 11 sectors. Percent (delivering sectors 1994=100 %). Finland.

Delivering sectors (1994) → **↓ Receiving sectors (1995)**	**Primary sectors. Mining. Oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence. health and social work**	**Other non-public services**	**Out of active work force**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	7.7	0.8	1.3	0.5	1.0	0.3	0.4	1.2	0.1	0.2	0.6	3.6	12897	130339	9.9 %
Manufacturing	2.2	34.3	7.1	5.9	3.1	1.3	6.5	5.8	4.4	1.4	3.6	16.7	77517	352709	22.0 %
Utilities and construction	0.9	2.4	22.4	0.8	1.8	0.2	2.1	0.5	0.2	0.3	1.6	7.3	29233	98211	29.8 %
Trade. Hotels. Restaurants	0.9	4.4	1.9	30.2	2.7	1.9	5.1	1.5	1.0	1.4	3.9	15.8	67953	241421	28.1 %
Transport. storage. Communication	0.6	1.8	1.5	1.9	42.5	1.0	2.0	0.6	0.5	0.4	1.3	4.8	28403	132793	21.4 %
Financial services. Real estate	0.0	0.1	0.1	0.3	0.1	58.7	0.9	0.1	0.2	0.2	0.3	0.7	11667	46607	25.0 %
Business services	0.4	2.6	3.3	3.3	2.3	4.6	22.9	2.8	3.1	1.8	3.5	9.3	41266	131197	31.5 %
R&D institutes	0.1	0.1	0.0	0.0	0.0	0.0	0.1	25.9	1.1	0.1	0.1	0.4	2044	7612	26.9 %
Higher education institutions	0.1	0.2	0.1	0.2	0.1	0.1	0.4	4.8	24.3	0.9	0.8	2.2	9284	18823	49.3 %
Public adm. and defence. Health and social work	1.3	2.2	1.5	3.1	1.6	1.4	5.7	8.5	8.9	45.1	7.3	26.2	133266	427746	31.2 %
Other non-public services	0.4	0.7	0.9	1.1	0.7	0.5	1.7	1.1	1.6	1.1	17.3	5.0	19925	79988	24.9 %
Out of active work force	83.9	50.0	58.8	51.7	43.3	29.7	50.8	46.6	41.1	43.0	58.1	0.0	225975	241727	93.5 %
Total[1]	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**			
N persons moving (=100 %)	21799	68188	29190	63627	27432	15444	36494	2134	8502	120891	20328	241727			
N persons employed	148348	383967	115457	276019	142735	51813	146496	9087	23326	479263	92287	241727			
Mobility rate out	14.7 %	17.8 %	25.3 %	23.1 %	19.2 %	29.8 %	24.9 %	23.5 %	36.4 %	25.2 %	22.0 %	100.0 %			

[1]Total includes a residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1995. The value for this residual varies between 0,01% and 8.0% (by far the largest; for "from outside the workforce") for each category represented in the table

4.2.2 Employees with higher education

We now turn our attention to the labour mobility of those with higher education (ISCED 6 and over: i.e. at least 3 years of higher education). A central question is whether the mobility of educated employees differs qualitatively from the overall patterns studied above. We begin our study here as we have above by looking at mobility rates in all of the 42 sectors that make up our most disaggregated level of analysis. Having done this, we pursue the same structure as in the previous chapter by exploring the way these highly educated employees change jobs through the now-familiar flowcharts and input-output tables.

As was found for all employees, mobility rates vary considerably between sectors. In addition there is no clear pattern between the countries in where the rates are high, and where they are low. A simple correlation of the numbers in Finland and Norway reveals no correlation at all, except a weak correlation coefficient of about 0,4 in terms of ranks. This implies, as far as we can see, that national differences in the labour markets have a stronger impact on the mobility rates than does the particular skill- or educational needs of each sector.

Table 4.2.2X: Mobility rates 1995-96.Employees with higher education broken down by sector. Sweden, Norway, Finland. Percent of total employment, 1995. Wide type of mobility: Including persons leaving active work force. Narrow type of mobility: Excluding persons leaving active work force.

Sector	Sweden		Norway 1995-96		Finland 1994-95	
Type of mobility rate:	**Wide**	**Narrow**	**Wide**	**Narrow**	**Wide**	**Narrow**
Agriculture, hunting and related service activities	23.0	16.5	31.8	21.6	11.8	4.0
Forestry, logging and related service activities	41.4	30.8	29.5	22.0	15.5	9.0
Fishing, oper. of fishing hatcheries and fish farms	46.3	34.1	19.9	14.6	16.7	12.5
Mining and quarrying	17.8	13.2	18.3	12.8	15.0	8.3
Food products, beverages and tobacco	24.9	19.5	25.9	19.0	31.8	24.4
Textiles and textile products	35.1	30.2	26.5	16.4	17.6	11.2
Wood and products of wood	24.7	19.0	20.9	15.8	21.8	14.3
Pulp, paper, paper products	16.8	13.5	12.9	6.8	22.2	17.7
Publishing, printing, repr. of recorded media	27.3	20.1	19.0	12.2	21.7	16.2
Coke, ref. petr. products, nuclear fuel [1]	41.5	36.4	18.4	9.2	14.1	11.7
Chemicals and chemical products [1]	..	..	9.6	5.3	19.6	15.7
Basic chemicals	22.2	18.8	14.4	8.2	16.0	10.3
Pharmaceutical preparations	7.6	5.5	15.5	10.7	25.2	21.0
Rubber and plastic products	29.8	24.8	19.8	15.1	14.8	11.4
Non-metallic mineral products	19.9	12.7	19.4	13.4	21.0	13.4
Basic metals	16.5	13.7	17.7	11.3	14.7	10.7
Fabricated metal products	22.2	17.0	23.1	17.3	20.1	14.3
Machinery and equipment n.e.c.	18.2	14.7	21.0	15.8	18.5	14.2
Office machinery and computers	39.2	36.7	71.4	64.3	25.4	21.8
Electrical machinery and apparatus n.e.c.	22.4	20.1	18.6	14.2	20.2	16.3
Radio, tv and communication equipment	14.7	9.7	12.4	8.2	36.3	32.6
Medical, precision and optical instruments	16.0	14.0	20.2	15.8	17.2	13.4
Transport equipment	11.8	8.5	31.1	25.8	26.4	21.3
Manufacturing n.e.c.	29.2	21.6	17.7	13.6	21.1	14.9
Electricity, gas, water supply	12.3	9.4	15.4	9.9	14.5	11.2
Construction	22.3	17.3	20.4	15.3	26.2	16.3
Wholesale and retail trade	28.3	20.7	26.3	21.1	21.4	14.9
Wholesale of machinery and equipment	25.1	19.9	26.5	19.4	18.7	12.9
Transport and storage	20.5	13.9	23.9	16.7	18.7	12.2
Post and telecommunications	15.8	11.7	20.8	15.5	17.9	13.5
Financial intermediation	17.6	14.0	16.0	10.5	31.3	25.3
Other, mainly private services	32.3	23.8	19.2	14.4	29.4	21.6
Computer and related services	19.5	16.5	20.3	16.1	20.7	17.2
Research institutes, technology	33.8	30.3	18.2	13.5	19.9	15.2
Research institutes, social sciences	25.0	21.2	21.0	14.5	22.0	13.1
Other business activities	21.6	16.3	33.4	23.7	17.5	12.0
Architectural and engineering activities	16.9	11.9	20.3	13.8	18.7	10.9
Technical testing and analysis	16.4	13.0	41.3	35.6	15.0	10.3
Public administration	13.4	9.3	16.7	11.3	24.1	19.1
Higher education	22.1	17.5	18.5	11.4	32.5	22.5
Other non-public services	20.4	14.0	20.1	13.0	17.8	11.1
Total	**17.1**	**12.5**	**18.5**	**12.7**	**23.9**	**17.9**

[1] For Sweden chemicals and chemical products are grouped with coke, ref. petr. products, nuclear fuel.

In examining how highly educated workers change jobs across sectoral boundaries, the flows are necessarily much smaller than for that of total populations. However, in the Swedish case, the basic pattern is very much the same as that seen in the flow of all employees (cf. fig. 4.11 and table 4.7 below. See also appendix table A23 for absolute numbers). Here again, internal flows are important for all sectors. Flows concentrate around the higher education sector, due to its larger size compared to the R&D institutes. The dominant links for institutes of higher education are with the public sector, which account for 18 % of those leaving HEIs. R&D institutes also receive a large number of employees from HEI (23 %), however this is in a strongly asymmetric relationship as the flow in the opposite direction is very limited.

The links to manufacturing sectors (goods) does not involve a large contribution from any of the two NIS institutions, though in relative terms these links are far more important for the R&D institutes than for higher education institutions. Almost a fourth of those leaving R&D institutes move to manufacturing industries, whereas only 7 % of those leaving higher education institutions find new work there.

As was the case with all employees, the net flow of persons with higher education move out of NIS institutions to goods producing sectors and private services. Again we find that the net flow is in the opposite direction for the public sector.

Within the aggregate group of private services, the subgroup ‘business services’ plays an important role as recipient of personnel from R&D institutes. This link is stronger from R&D institutes than from institutes of higher education. It accounts, however, for only about half the share of persons moving out of R&D institutes compared to the link with manufacturing.

To characterise the “degree of openness” towards sectors outside the NIS institutions themselves, one can simply calculate the difference between total mobility and the share of persons changing jobs within the NIS institutions. Doing this reveals R&D institutes as substantially more interactive with other sectors of the economy than are institutes of higher education. In the latter case, around 50 % of those leaving a position in a higher education institution change to another job in the same sector or to one in a R&D institutes. For those leaving a job in an R&D institute, the same share is only about 25 %, meaning that these employees carry their expertise to a

wider share of the economy. In addition comes a somewhat higher mobility rate out of R&D institutes than from higher education institutions. In numerical terms, however, the institutes of education institutions are more important as they are larger, and consequently disseminate and receive greater numbers of highly educated workers. This is particularly so in the Swedish case, where higher education institutes are about five times larger than R&D institutes in terms of personnel with higher education.

Figure 4.11 Flowchart, mobility of employees with higher education by delivering and receiving sectors. Absolute numbers. Sweden 1994-95.

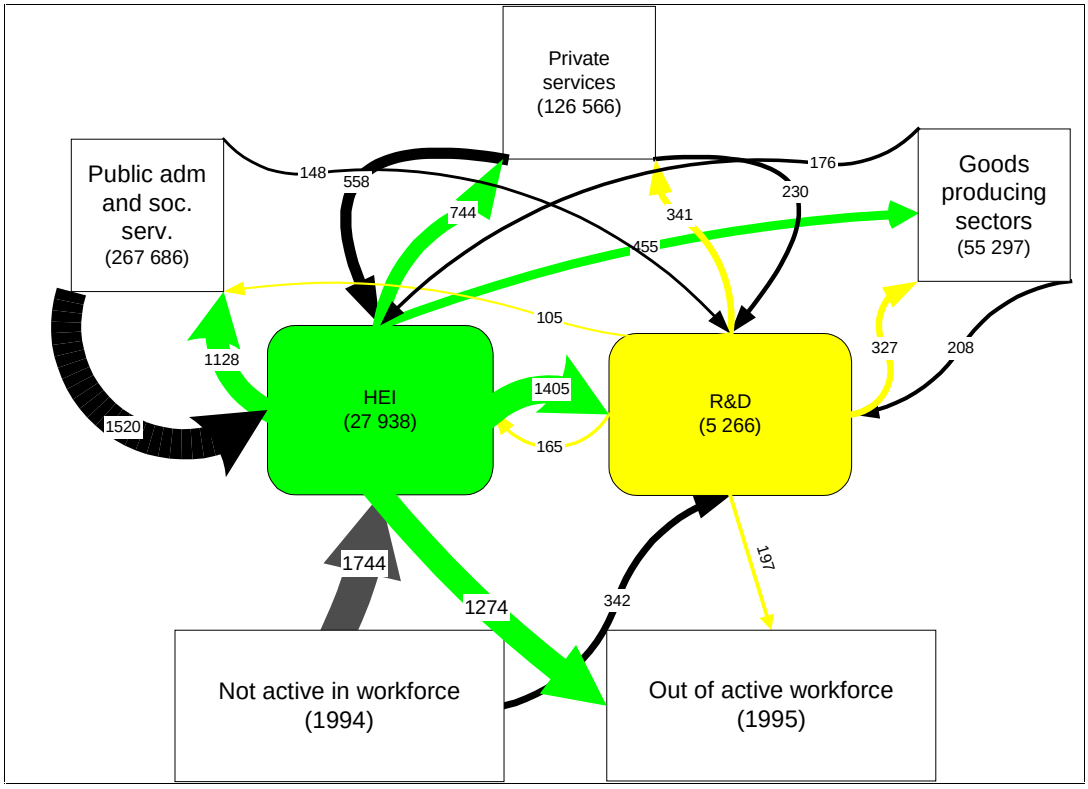


Table 4.7 Mobility of employees with higher education 1995-96 by delivering and receiving sectors. 11 sectors. Percent (delivering sectors 1994=100 %). Sweden.

Delivering sectors (1994) → **↓ Receiving sectors (1995)**	**Primary sectors, mining, oil**	**Manufac-turing**	**Utilities and construc-tion**	**Trade, hotels, restaurants**	**Transport, storage, communi-cation**	**Financial services, real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence, health and social work**	**Other non-public services**	**Out of active work force**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. mining. oil	8.9	0.4	0.4	0.3	0.1	0.3	0.4	0.1	0.1	0.3	0.6	0.6	444	2252	19.7
Manufacturing	9.1	38.8	9.3	11.9	7.2	4.1	11.9	23.5	6.8	2.1	3.6	10.7	8989	46126	19.5
Utilities and construction	1.4	1.2	11.3	0.8	1.3	0.5	2.4	0.8	0.4	0.6	0.4	1.4	847	5560	15.2
Trade. Hotels. Restaurants	2.6	6.9	8.1	21.2	4.2	3.9	6.5	4.0	1.3	1.7	2.7	6.7	4969	21536	23.1
Transport. storage. communic.	1.8	2.0	1.8	2.8	19.9	3.0	3.3	7.1	0.6	0.7	1.4	3.1	2132	12534	17.0
Financial services. real estate	0.4	0.9	0.9	1.8	1.7	28.8	3.9	0.7	0.5	0.5	0.5	1.9	1775	12397	14.3
Business services	12.1	16.3	21.7	17.0	15.9	22.1	25.5	12.4	6.6	5.7	6.8	13.6	11289	51511	21.9
R&D institutes	0.0	2.2	1.0	0.7	0.8	0.6	1.1	13.8	22.8	0.4	0.6	1.2	2027	4861	41.7
Higher education institutions	3.0	1.7	0.8	1.3	1.1	1.5	2.0	12.4	16.8	4.2	3.9	6.2	4637	26547	17.5
Public adm. Health, social	17.4	5.4	16.6	12.5	11.6	10.5	12.4	7.9	18.3	36.4	23.2	42.7	41376	284093	14.6
Other non-public services	10.7	1.9	2.0	2.4	3.2	2.2	4.1	1.3	3.1	3.7	19.7	5.9	2002	6374	31.4
Out of active work force	26.9	21.1	22.6	25.2	30.5	20.8	23.6	14.7	20.7	30.4	31.3	0.0	3492	14325	24.4
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**			
N persons moving (=100 %)	475	7605	929	5143	2001	1907	9604	845	6118	42900	1623	3734			
N persons employed	2283	44742	5642	21710	12403	12529	49826	3679	28028	285617	5995	14567			
Mobility rate out	20.8	17.0	16.5	23.7	16.1	15.2	19.3	23.0	21.8	15.0	27.1	25.6			

[1]Total includes a residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1994. The value for this residual varies between 0,0% and 13,3%(Public administration), with an average of around 4% for each category represented in the table.

In the Norwegian case (fig. 4.12 and table 4.8 below, and appendix table A24) the same basic conclusion holds as for Sweden. As above, the mobility pattern for personnel with higher education is very similar to what we found for total employment independent of education, though again the numbers are much smaller than that for the working population as a whole.

Institutes of higher education dominate the picture in accordance with their larger size. Their links with the public sector are greater than their external links with other sectors, and stronger than the links from R&D institutes to the public sector. Only four percent of those leaving higher education institutions go to R&D institutes, whereas 14 % of those leaving R&D institutes move to higher education institutions. This situation is different from the Swedish case both in terms of number and share of people, and the net direction of flows.

As was the case with all employees and the Swedish case above, the net flow of persons with higher education move out of NIS institutions to goods producing sectors and private services. Once again we find that the net flow is in the opposite direction for the public sector.

As we found for all employees, internal mobility – between different employers within the same sector – is high for most sectors. The importance of internal mobility however is different for higher education institutions and R&D institutes: it is more important in the higher education sector than in R&D institutes. This should be considered in relation to the greater degree of mobility from R&D institutes to higher education than in the other direction, a difference that more or less balances this picture. Therefore it seems that the mobility patterns to a certain degree reflect a typical career pattern moving from R&D institutes to higher education, and subsequently changing positions within the higher education sector.

As above, “the degree of openness” of our NIS institutions (i.e. their interaction with sectors other than themselves) is calculated as the difference between total mobility and the share of persons changing jobs within the NIS institutions. This reveals a somewhat higher degree of interaction involving R&D institutes than higher education institutions – a difference in the order of 15 percentage points. This is

similar to the findings for Sweden, except that the difference in the Swedish case is somewhat larger. However, in terms of the number of highly educated employees that change working situation, the importance of institutes of higher education is greater, due in part to their larger size.

The shares of those moving from both types of NIS institutions to manufacturing industries are limited to four to five percent, or about the same level as for the working population as a whole, independent of education. Again this result differs from that witnessed in the Swedish case, where the links from R&D institutes to manufacturing were far stronger than from higher education institutions.

The dominating links from R&D institutes are with business services. 17 % of higher educated employees leaving R&D institutes move to this sector – a clearly higher share than for higher education institutions. The same structure was found for Sweden.

Looking at disappearance from the active work force, a large share of persons who change job situations move out of the active work force. This share is however lower for the more highly educated than for the workforce at large. Focusing on the NIS institutions, a somewhat greater share leave the active workforce from higher education institutions than do from R&D institutes, 38 % versus 27 %.

Figure 4.12 Flowchart, mobility of employees with higher education by delivering and receiving sectors. Absolute numbers. Norway 1995-96.

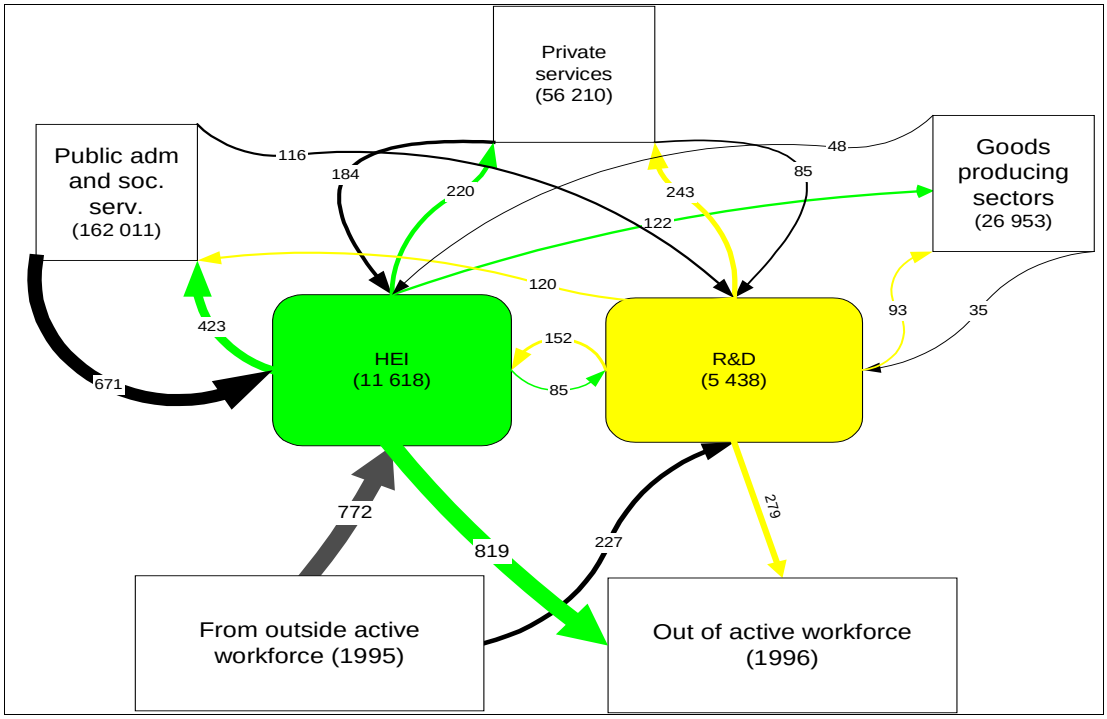


Table 4.8 Mobility of employees with higher education 1995-96 by delivering and receiving sectors. 11 sectors. Percent (delivering sectors 1995=100 %). Norway.

Delivering sectors (1995) → **Highly educated** **↓Receiving sectors (1996)**	**Primary sectors. mining. oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence. health and social work**	**Other non-public services**	**Out of active work force**	**N persons moving**	**N persons employed**	**Mobility rate out**
Primary sectors. Mining. Oil	27,4 %	1,5 %	1,1 %	1,2 %	0,7 %	0,7 %	1,7 %	3,2 %	1,0 %	0,4 %	0,7 %	0,3 %	963	5977	16,1 %
Manufacturing	3,7 %	38,4 %	9,2 %	6,9 %	4,4 %	3,3 %	6,6 %	4,8 %	4,2 %	1,2 %	3,2 %	1,4 %	3551	15911	22,3 %
Utilities and construction	0,5 %	1,9 %	28,5 %	1,6 %	1,7 %	1,5 %	2,1 %	0,9 %	0,5 %	0,6 %	1,2 %	0,4 %	1050	5181	20,3 %
Trade. hotels. Restaurants	19,8 %	7,3 %	4,5 %	28,8 %	5,7 %	3,6 %	6,9 %	3,1 %	1,5 %	1,9 %	3,0 %	1,5 %	3655	13127	27,8 %
Transport. storage. Communic.	3,0 %	3,8 %	2,0 %	2,8 %	30,6 %	1,9 %	4,1 %	0,6 %	0,4 %	0,6 %	1,0 %	0,7 %	1580	6280	25,2 %
Financial services. Real estate	0,6 %	0,7 %	1,3 %	1,7 %	1,4 %	31,7 %	2,2 %	1,3 %	1,0 %	0,3 %	0,7 %	0,3 %	930	6050	15,4 %
Business services	6,0 %	12,1 %	11,8 %	14,9 %	10,9 %	14,6 %	36,5 %	17,2 %	4,5 %	2,6 %	6,6 %	2,8 %	6355	23669	26,8 %
R&D institutes	1,0 %	0,6 %	0,3 %	0,5 %	0,5 %	0,4 %	0,7 %	14,0 %	3,8 %	0,4 %	1,1 %	0,3 %	710	5110	13,9 %
Higher education institutions	0,6 %	1,1 %	0,6 %	1,1 %	1,2 %	1,5 %	1,1 %	14,6 %	22,4 %	2,5 %	3,4 %	1,2 %	2318	11781	19,7 %
Public adm. health, social	6,9 %	4,2 %	11,8 %	12,5 %	12,5 %	5,3 %	8,6 %	11,6 %	19,6 %	55,5 %	22,5 %	11,8 %	25165	160168	15,7 %
Other non-public services	0,5 %	1,3 %	1,3 %	1,6 %	1,7 %	1,0 %	1,7 %	1,2 %	2,8 %	1,6 %	22,0 %	1,0 %	1804	8663	20,8 %
Out of active work force	29,6 %	26,5 %	27,0 %	26,0 %	27,7 %	33,0 %	26,7 %	26,9 %	38,0 %	32,0 %	34,2 %	78,1 %	65949	65949	200,0 %
Total[1]	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**			
N persons moving (=100 %)	1296	3232	958	3412	1381	972	5232	1038	2155	27008	1748	14308			
N persons employed	6516	15592	5089	12884	6081	6092	22546	5438	11618	162011	8607	14308			
Mobility rate out	19.9 %	20.7 %	18.8 %	26.5 %	22.7 %	16.0 %	23.2 %	19.1 %	18.5 %	16.7 %	20.3 %	100,0 %			

[1]Total includes a very small residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1995. The value for this residual varies between 0,3% and 1,3% for each category represented in the table.

Lastly, we address the flow of higher educated personnel in the Finnish case (see fig. 4.13 and table 4.9. See also appendix table A25 for absolute numbers). As for Sweden and Norway, the basic structure of mobility is very similar to that for employment as a whole, independent of education. Flows are dominated by the larger higher education sector, and these flows are particularly strong to and from the public sector – as in Norway and Sweden. A relatively small number of persons move between the NIS institutions, but calculated as shares of total flows from each of them, the flow from R&D institutes to higher education institutions is the larger.

What seems to be a rather robust pattern across countries and types of education is even confirmed here: net flows go out of the NIS institutions to goods producing sectors and private services, but in the opposite direction to the public sector.

For R&D institutes, a somewhat greater share of those who change their work situation go to manufacturing than was the case for all employees independent of education (10 %). This is somewhat higher than in the Norwegian case (5 %), but considerably lower than the 23 % found in Sweden. The same kind of difference is not found for higher education institutions. On the other hand, links to business services, which were found to be rather important for Sweden and Norway, seem to be somewhat weaker in Finland.

The Finnish case is particularly different from the two other countries in the share of personnel changing employer from one R&D institution to another. This share is as high as 39 %, with the comparable numbers as low as 14 % for Norway and Sweden. In addition, there is a much higher mobility rate of persons leaving institutes of higher education than from R&D institutes. As a result, the degree of openness to other sectors seems to be smaller in the Finnish case than in the other Nordic countries. In fact, there is more interaction from higher education institutions in Finland to other sectors than there is from R&D institutes, both in relative terms and in absolute numbers.

Another aspect of the Finnish case that differs from the Norwegian and Swedish cases is the greater difference in the ratio of the highly educated leaving active workforce than for all employees. This share is particularly high for *all employees*; 41 % and 47 % of those changing jobs in higher education institutions and R&D

institutes, respectively. The comparable shares for the highly educated are down to 26 % and 27 %.

Figure 4.13 Flowchart, mobility of employees with higher education by delivering and receiving sectors. Finland 1994-95.

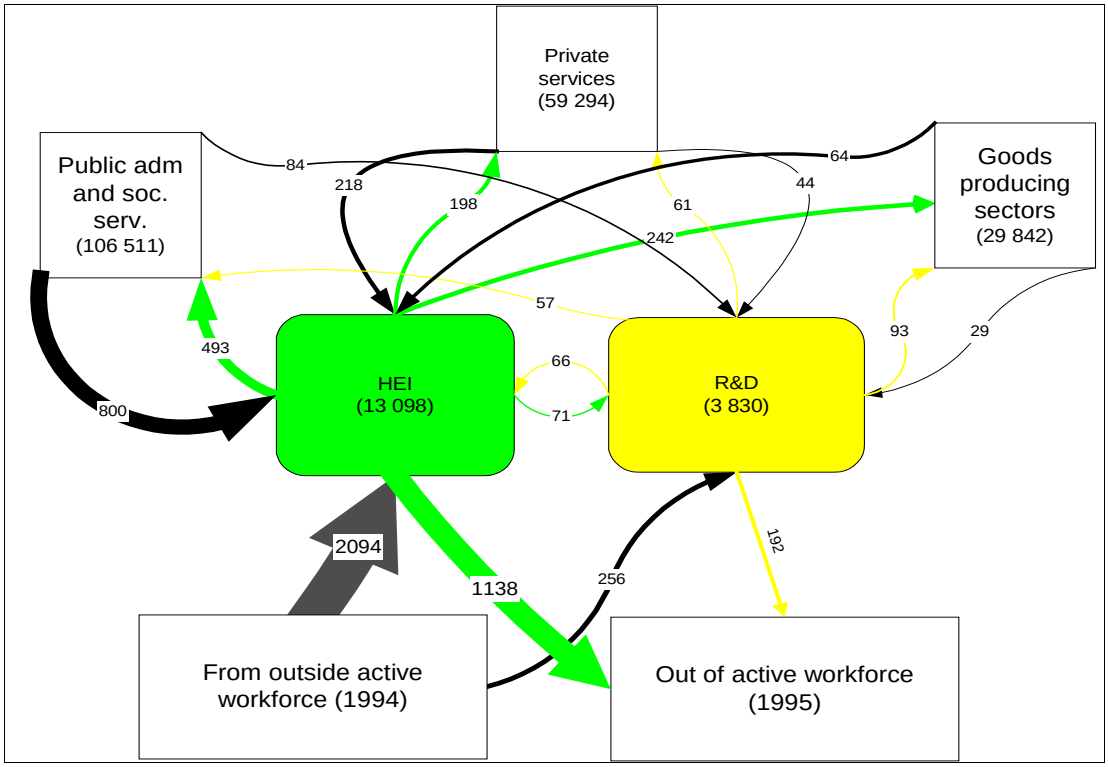


Table 4.9 Mobility of employees with higher education 1994-95 by delivering and receiving sectors. 11 sectors. Percent (delivering sectors 1994=100 %). Finland.

Delivering sectors → **Highly educated** **↓ Receiving sectors (1995)**	**Primary sectors. mining. oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence. health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. oil	17.0	0.3	0.4	0.5	0.2	0.1	0.5	1.5	0.1	0.1	0.6	1.0	377	2211	17.1 %
Manufacturing	5.8	56.8	11.4	11.7	5.4	2.3	10.7	9.9	5.3	1.2	5.4	14.7	8061	23576	34.2 %
Utilities and construction	0.3	1.5	34.5	0.7	1.5	0.2	1.9	0.5	0.1	0.1	0.3	2.0	888	2924	30.4 %
Trade. hotels. Restaurants	3.5	5.9	2.8	37.6	3.7	1.6	4.1	1.4	0.9	0.5	2.6	7.0	3357	11992	28.0 %
Transport. storage. Communic.	1.0	1.4	1.0	2.2	47.7	0.7	1.9	0.4	0.2	0.2	0.7	2.3	1244	4588	27.1 %
Financial services. Real estate	0.0	0.5	0.4	0.7	0.2	65.2	2.2	0.3	0.2	0.3	0.7	1.2	2087	6599	31.6 %
Business services	4.5	5.9	10.1	7.2	5.7	7.6	38.3	4.8	3.3	1.5	4.5	12.2	5777	20812	27.8 %
R&D institutes	0.6	0.4	0.1	0.2	0.1	0.2	0.5	39.2	1.6	0.3	0.3	1.3	794	3625	21.9 %
Higher education institutions	1.3	0.9	1.0	1.5	0.3	0.5	1.3	8.5	34.5	2.9	4.1	10.8	4787	11508	41.6 %
Public adm., health, social	6.7	5.1	5.5	6.5	4.1	2.9	7.5	7.3	11.4	67.2	14.9	38.0	28582	100638	28.4 %
Other non-public services	2.9	1.1	0.6	1.2	1.6	1.0	1.7	1.0	0.0	0.0	0.0	4.9	1184	11687	10.1 %
Out of active workforce	56.1	19.8	30.7	28.7	28.1	17.5	28.3	24.7	26.3	17.2	55.4	0.0	12229	19300	63.4 %
Total[1]	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**			
N persons moving (=100 %)	312	5944	690	2813	955	2416	4643	778	4327	27251	2447	19300			
N persons employed	2374	24395	3073	12838	4556	7012	21931	3830	13098	106511	12957	19300			
Mobility rate out	13.1 %	24.4 %	22.5 %	21.9 %	21.0 %	34.5 %	21.2 %	20.3 %	33.0 %	25.6 %	18.9 %	100.0 %			

[1]Total includes a residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1995. The value for this residual varies between 0.3% and 8.7% (Other non-public services) for each category represented in the table

4.2.3 Natural sciences and engineering

Having studied the mobility of all employees and those with higher education, we turn to a final sub-section of the workforce, those with higher education in the disciplines of science and engineering. The methodology is the same as above: the labour mobility of this group is presented in flowcharts where arrows are scaled to represent the number of persons changing jobs, and with the same sectors specified. In addition, we provide tables that cover the share of those moving out by receiving sectors and appendix tables with the corresponding absolute numbers.

Starting with Sweden, the patterns we are confronted with here are somewhat different from those pertaining to all personnel with higher education (see fig.4.14 and table 4.13. See also appendix table A26 for absolute number). The largest flows still go to and from the higher education institutions, but that is only due to its larger size. In relative terms, flows between R&D institutes and both goods producing sectors and private services dominate. The link with the public sector is less important, even for the higher education institutions.

Of those leaving higher education institutions, the lion's share move to R&D institutes (40 %). In the other direction the link is weaker; only 9 % of those leaving R&D institutes move to the higher education sector. For both types of NIS institutions, manufacturing industry is a more important recipient of personnel with higher degrees in the natural sciences and engineering than of all personnel with higher degrees. The share of those leaving R&D institutes for manufacturing is particularly high, at 33 %.

The stable flow pattern that indicates a net outflow of persons from NIS institutions to goods producing sectors and private services is confirmed also for this sub-group of higher educated personnel. For this group, however, the net direction of flow is away from the NIS institutions, even in the case of the link with the public sector.

Figure 4.14 Mobility of employees with higher education within the fields of natural sciences and engineering, by delivering and receiving sectors. Absolute numbers. Sweden 1994-95.

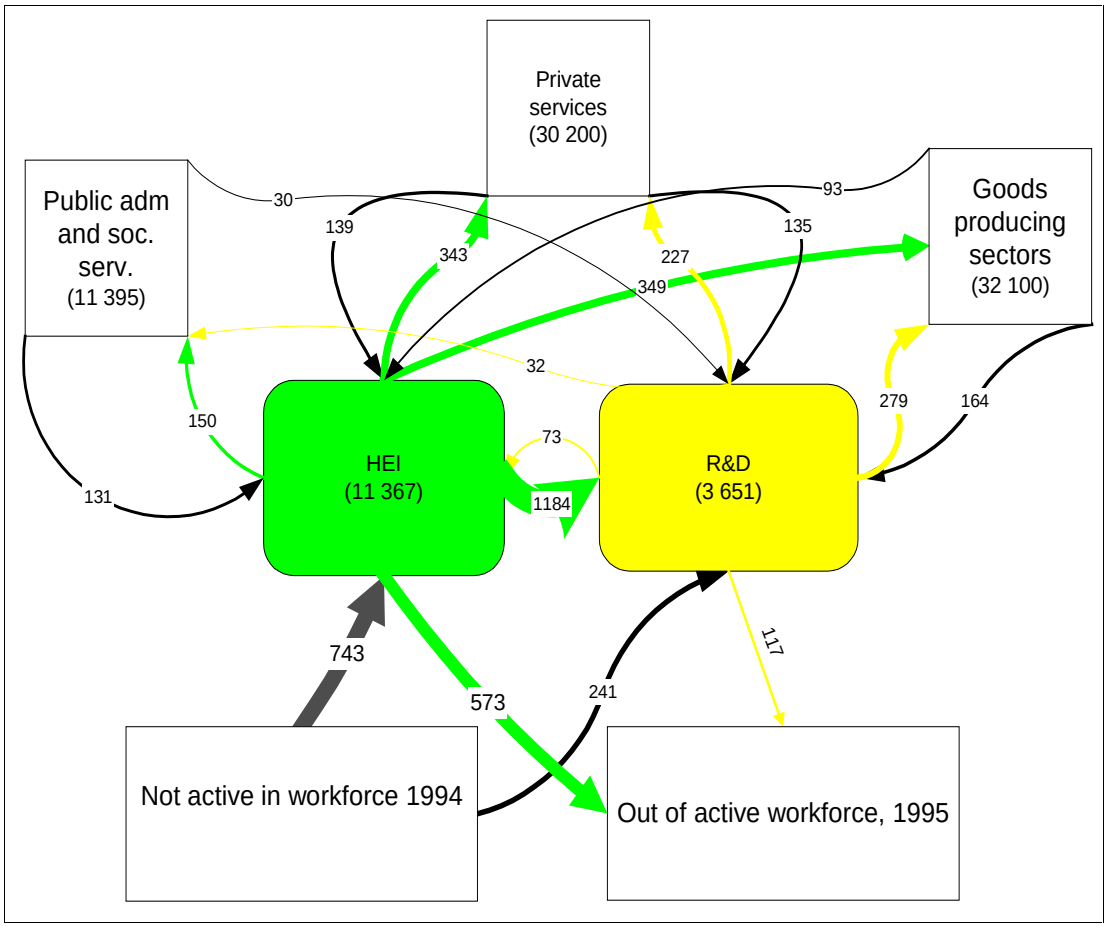


Table 4.13 Mobility of employees with higher technical and scientific education 1995-96 by delivering and receiving sectors. 11 sectors. Percent (delivering sectors 1994=100 %). Sweden.

Delivering sectors → **↓ Receiving sectors (1995)**	**Primary sectors, mining, oil**	**Manufac-turing**	**Utilities and construc-tion**	**Trade, hotels, restaurants**	**Transport, storage, communi-cation**	**Financial services, real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence, health and social work**	**Other non-public services**	**Out of active work force**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. mining. Oil	5.6	0.3	0.7	0.3	0.3	0.0	0.4	0.2	0.1	0.2	0.6	0.7	99	484	20.5 %
Manufacturing	11.1	45.4	11.7	20.3	21.8	12.3	21.7	33.0	10.9	8.3	11.9	27.0	5880	28216	20.8 %
Utilities and construction	2.8	1.4	13.1	1.3	1.8	0.4	3.9	1.4	0.8	3.4	2.4	4.0	700	4573	15.3 %
Trade. hotels. restaurants	3.7	5.7	7.5	16.9	3.8	6.4	5.6	4.0	1.2	2.2	3.6	6.8	1346	5210	25.8 %
Transport. storage. communic.	1.9	1.9	1.4	2.9	10.3	1.7	2.5	9.1	0.6	1.4	0.9	2.5	558	2594	21.5 %
Financial services. real estate	0.0	0.3	0.3	1.1	0.3	19.1	1.2	0.5	0.3	0.5	0.6	0.8	200	1070	18.7 %
Business services	27.8	19.1	24.2	25.6	22.3	30.6	27.9	14.2	8.8	15.8	14.2	22.1	4849	21182	22.9 %
R&D institutes	0.0	3.3	1.5	1.8	3.5	1.3	2.3	8.8	40.0	1.3	2.1	4.1	1828	4674	39.1 %
Higher education institutions	6.5	1.7	1.0	1.3	2.0	2.1	2.1	9.1	11.5	5.5	8.6	12.7	1530	9940	15.4 %
Public adm. health, social	7.4	1.6	9.7	4.3	5.0	3.0	5.4	4.0	5.1	20.7	11.6	12.7	1922	10917	17.6 %
Other non-public services	2.8	0.3	2.1	0.6	0.8	2.6	1.5	0.5	0.8	2.6	9.5	1.9	354	1334	26.5 %
Out of active work force	27.8	18.5	25.1	22.4	27.3	19.6	23.6	14.5	19.4	27.4	30.0	0.0	4001	4001	100.0 %
Total[1]	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**			
N persons moving (=100 %)	108	4680	718	1409	400	235	3736	805	2957	2400	337	5864			
N persons employed	493	27016	4591	5273	2436	1105	20069	3651	11367	11395	1317	5864			
Mobility rate out	21.9 %	17.3 %	15.6 %	26.7 %	16.4 %	21.3 %	18.6 %	22.0 %	26.0 %	21.1 %	25.6 %	100.0 %			

[1]Total includes a l residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1994. The value for this residual varies between 0,0% and 10,8%(Public administration), with an average of around 2% for each category represented in the table

In the Norwegian case, institutes of higher education and R&D institutes are practically the same size in terms of stocks of natural scientists and engineers (see fig. 4.15 and table 4.14. See also appendix table A27). Focusing on these employees, we find that flows are no longer concentrated around the higher education institutions, and further, that the role of the public sector is more marginal compared to the more aggregated flows of all higher educated employees. This is very similar to the Swedish case. A somewhat higher share of persons leaving the NIS institutions go to manufacturing than was the case with the total for the highly educated, but the difference is rather small. Rather, those leaving the R&D institutes particularly migrate to business services (25 %). A similar link is not found in the Swedish case.

A limited number of people change jobs between the NIS institutions. The net direction of flow is from R&D institutes to institutes of higher education, and the relative rates are quite similar to what was found for all employees with higher education. Again this is different from the Swedish case, where net flows go from institutes of higher education to R&D institutes. The directions of net-flows are also in this case from the NIS institutions to goods producing sectors and private services. The influx from the public sector is, however, still greater than the outflow.

Figure 4.15 Mobility of employees with higher education in the fields of natural sciences and engineering, by delivering and receiving sectors. Absolute numbers. Norway 1995-96.

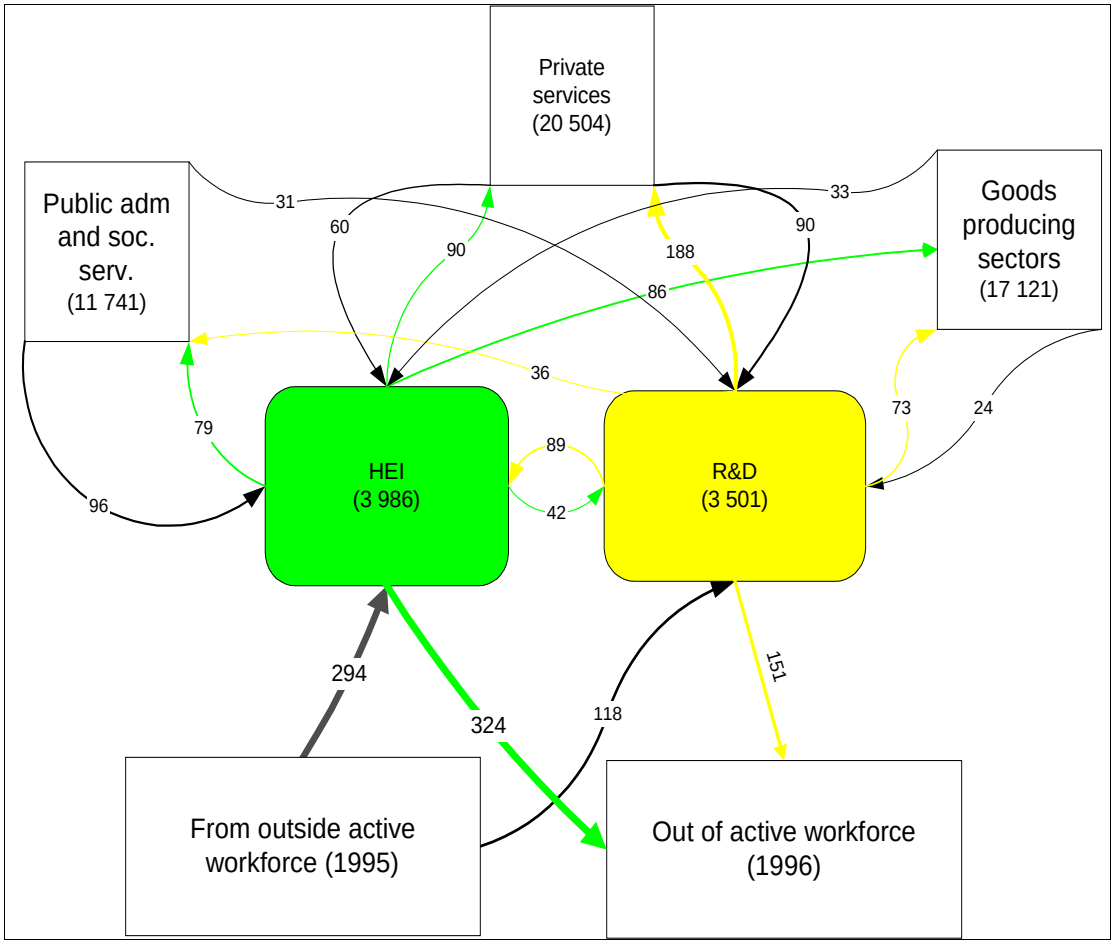


Table 4.14 Mobility of employees with higher education in the fields of natural sciences and engineering by delivering and receiving sectors. Percent (delivering sectors 1995=100 %). Norway 1995-96.

Delivering sectors → ↓ Receiving sectors (1996)	Primary sectors. mining. oil	Manufacturing	Utilities and construction	Trade. hotels. restaurants	Transport. storage. communication	Financial services. real estate	Business services	R&D institutes	Higher education institutions	Public adm. and defence. health and social work	Other non-public services	Out of active work force	N persons moving	N persons employed	Mobility rate in
Primary sectors. Mining. Oil	31,4 %	1,7 %	1,0 %	1,6 %	0,9 %	0,0 %	2,3 %	4,7 %	1,9 %	1,0 %	2,0 %	0,9 %	600	4061	14,8 %
Manufacturing	4,0 %	44,8 %	10,3 %	10,2 %	6,4 %	4,8 %	9,0 %	5,9 %	8,0 %	4,9 %	6,0 %	3,7 %	2054	9334	22,0 %
Utilities and construction	0,5 %	2,0 %	30,6 %	3,6 %	2,8 %	1,6 %	3,1 %	1,1 %	1,2 %	3,4 %	6,5 %	1,4 %	688	3749	18,4 %
Trade. hotels. Restaurants	23,9 %	6,0 %	4,1 %	27,6 %	5,3 %	6,5 %	5,8 %	3,1 %	2,1 %	3,9 %	5,0 %	2,4 %	1289	4532	28,4 %
Transport. storage. Communic.	3,6 %	4,7 %	2,4 %	2,4 %	36,6 %	4,0 %	4,6 %	0,5 %	0,6 %	1,8 %	3,0 %	1,1 %	680	2646	25,7 %
Financial services. Real estate	0,4 %	0,1 %	0,1 %	1,0 %	0,9 %	24,2 %	1,0 %	0,8 %	1,2 %	0,4 %	0,0 %	0,3 %	141	779	18,1 %
Business services	6,2 %	13,3 %	13,6 %	23,5 %	15,7 %	25,0 %	42,3 %	24,8 %	6,7 %	10,9 %	14,4 %	6,0 %	3133	12553	25,0 %
R&D institutes	0,7 %	0,8 %	0,4 %	0,7 %	0,7 %	0,0 %	1,2 %	12,7 %	5,4 %	1,6 %	1,5 %	0,9 %	341	3220	10,6 %
Higher education institutions	0,8 %	1,3 %	0,3 %	1,4 %	1,1 %	2,4 %	1,1 %	14,3 %	19,5 %	4,9 %	3,5 %	2,3 %	727	3940	18,5 %
Public adm. health, social	2,0 %	1,5 %	8,4 %	4,4 %	5,0 %	4,0 %	5,0 %	5,8 %	10,2 %	35,2 %	13,4 %	5,3 %	1835	11614	15,8 %
Other non-public services	0,0 %	0,3 %	0,7 %	0,7 %	1,8 %	0,8 %	0,7 %	1,1 %	1,0 %	1,3 %	14,9 %	0,6 %	197	935	21,1 %
Out of active work force	26,0 %	23,2 %	27,3 %	21,8 %	22,5 %	25,8 %	22,9 %	24,3 %	41,9 %	30,5 %	29,9 %	0,0 %	3010	3010	100,0 %
Total[1]	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**				
N persons moving (=100 %)	858	1897	677	1107	543	124	2524	622	773	1962	201	3231			
N persons employed	4319	9177	3738	4350	2509	762	11944	3501	3986	11741	939	3231			
Mobility rate out	19,9 %	20,7 %	18,1 %	25,4 %	21,6 %	16,3 %	21,1 %	17,8 %	19,4 %	16,7 %	21,4 %	100,0 %			

[1]Total includes a very small residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1995. The value for this residual varies between 0.05% and 0.9% for each category represented in the table

In Finland, the number of those holding higher degrees in the fields of natural sciences and engineering institutes is about twice as large for institutes of higher education than for R&D institutes (see fig. 4.16 and table 4.15. See also appendix table A28). A similarity between Finland and the other two countries is that the public sector is less important both as a recipient and deliverer of this grade of personnel than it was for all employees with higher education. Instead the goods producing sectors are more active. Fourteen percent of those leaving R&D institutes and 11 % of those leaving institutes of higher education move to the goods producing sectors. Meanwhile private services play a more marginal role here as they did in the Swedish but not in the Norwegian case.

In relative terms, mobility within each of the NIS institutions seems to be more important in the Finnish case than in the Norwegian and Swedish cases. 39 % of the employees who leave R&D institutes move to another R&D institute while 36 % of those who leave institutes of higher education go to another higher education institution. The comparable numbers for Norway are 13 % and 20 % respectively, down to 9 % and 12 % for Sweden.

Yet another difference compared to the other Nordic countries is the high number of people coming from what we have termed “outside the active workforce”. This difference exists for all the education types studied in this chapter. The inflow from outside the active work force is about two-and-a-half-times larger than the outflow.

On the other hand, outflows to all of the other sectors are larger than the inflows. This is, as we have seen, a stable pattern across countries and education types. Therefore one could say that the NIS institutions function in a sense as a gateway, with a net inflow of persons from outside the active work force, and a net outflow of persons to other sectors. This is particularly so in the Finnish case. The public sector is however an exception to this general rule, as more people move to higher education institutions from the public sector than out. This holds true for all three countries, but not in the case of natural scientists and engineers where there is a net outflow also to the public sector for Sweden and Finland.

Figure 4.16 Mobility of employees with higher education in the fields of natural sciences and engineering by delivering and receiving sectors. Absolute numbers. Finland 1994-95.

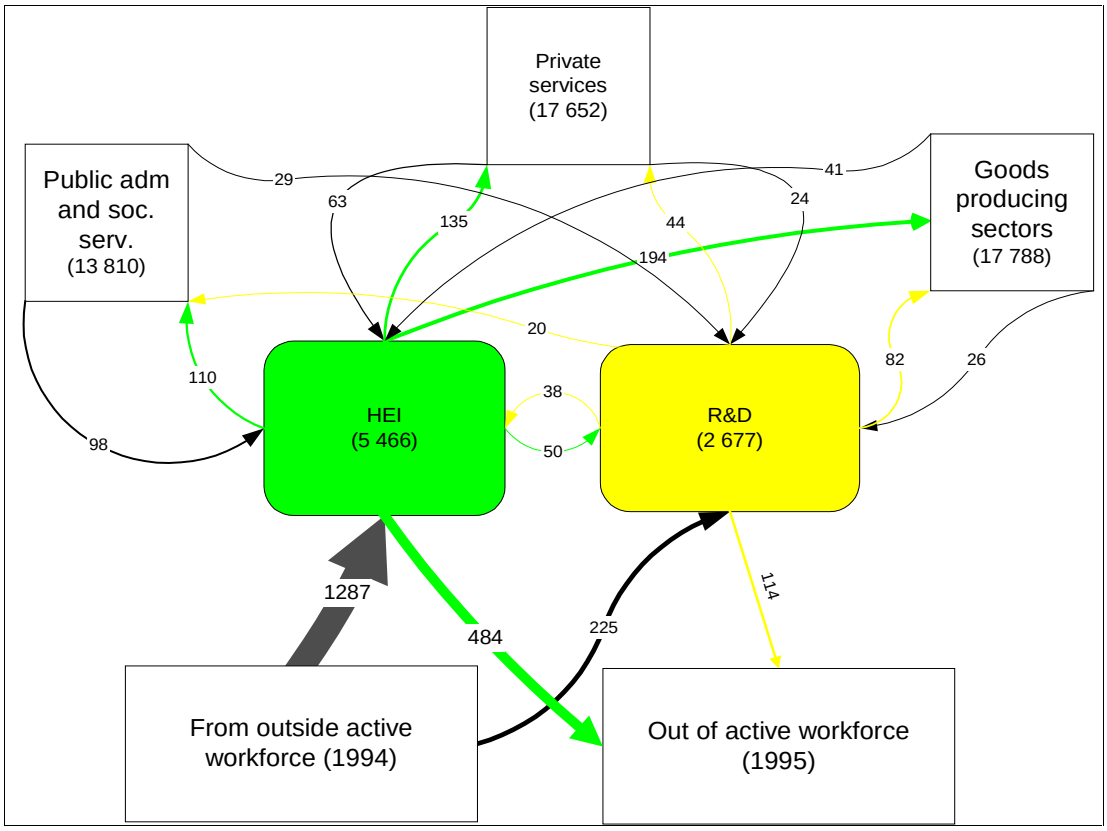


Table 4.15 Mobility of employees with higher education within natural sciences and engineering 1994-95 by delivering and receiving sectors. 11 sectors. Percent (delivering sectors 1994=100 %). Finland.

Delivering sectors → **↓ Receiving sectors (1996)**	**Primary sectors, mining, oil**	**Manufac-turing**	**Utilities and construc-tion**	**Trade, hotels, restaurants**	**Transport, storage, communi-cation**	**Financial services, real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence, health and social work**	**Other non-public services**	**Out of active work force**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. mining. oil	15.6	0.3	0.4	0.6	0.4	0.0	0.5	1.8	0.1	0.2	1.1	1.2	167	452	36.9 %
Manufacturing	8.9	62.4	12.4	20.1	10.8	6.9	15.4	14.2	10.9	5.6	18.3	32.9	6202	14721	42.1 %
Utilities and construction	0.0	1.7	31.6	1.9	4.0	0.7	3.1	0.6	0.2	0.3	2.2	4.6	750	2221	33.8 %
Trade. hotels. restaurants	1.1	5.2	3.1	28.3	5.2	2.0	3.9	1.6	0.9	0.8	4.0	6.3	1122	2995	37.5 %
Transport. storage. communic.	3.3	0.6	1.0	4.1	34.8	2.0	1.6	0.6	0.2	0.4	1.5	2.5	435	1419	30.7 %
Financial services. real estate	0.0	0.1	0.0	0.7	0.0	51.6	1.2	0.0	0.2	0.5	1.1	0.5	259	967	26.8 %
Business services	7.8	6.1	11.8	11.8	6.8	21.1	34.0	6.3	6.0	3.7	10.3	18.5	3141	10093	31.1 %
R&D institutes	2.2	0.7	0.2	0.4	0.0	0.0	0.9	38.9	2.9	0.9	0.7	2.5	549	2534	21.7 %
Higher education institutions	1.1	1.0	1.2	1.6	0.8	0.7	1.7	7.7	36.2	3.1	4.0	14.5	2171	4602	47.2 %
Public adm. health, social	5.6	3.9	3.5	4.1	4.0	2.0	5.8	4.1	6.3	58.1	11.7	12.6	3554	13076	27.2 %
Other non-public services	2.2	0.5	0.4	1.0	1.6	1.0	0.9	0.4	0.5	0.9	14.3	1.6	279	1100	25.4 %
Out of active work force	51.1	17.2	33.1	24.4	29.6	12.2	29.8	23.1	27.8	20.8	29.3	0.0	3231	8876	36.4 %
Total*	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**			
N persons moving (=100 %)	90	3506	484	688	250	304	2156	493	1740	3187	273	8876			
N persons employed	496	14968	2324	3158	1336	1045	10865	2677	5466	13810	1248	8876			
Mobility rate out	18.1 %	23.4 %	20.8 %	21.8 %	18.7 %	29.1 %	19.8 %	18.4 %	31.8 %	23.1 %	21.9 %	100.0 %			

*Total includes a residual category consisting of members of the workforce that were active in unclassified NACE groupings in 1995. The value for this residual varies between 0 and 7.9% (an exception: “higher education institutions”)

4.3 Number of effective receiving sectors by delivering sectors

The mobility patterns are, as we have seen, complex even when focusing on just a few aggregated sectors. The analyses so far have revealed some more or less stable patterns of mobility flows between specified sectors, across types of education and countries. They have, of course, also uncovered clear differences between the countries and education types. In this section we apply a different approach to describing the mobility patterns. Here we disaggregate the data into 42 sectors to identify preferences in the way individual sectors draw labour from amongst the other sectors. That is, we are looking for a single numeric indicator that can tell us whether people moving out of one particular sector tend to end up in another sector or narrow group of sectors, or whether they spread themselves among a wider set of others sectors.

Why is this of interest? Our supposition is that the number of *user sectors* is indicative of whether the skills embodied in employees who leave a particular sector are of general or specific relevance for other activities. We expect for example that the number of user sectors is generally lower for higher educated personnel than for all employees, as a degree of specialisation is implied in pursuing a higher education. Further, if there were similarities in the behaviour of user-sectors across countries, this would point towards a more generally applicable tendency in the way skills are acquired by different sectors. If, on the other hand, the patterns are not the same across our sample countries, the interpretation becomes more difficult. Such a result could mean that national differences in how the labour markets work offsets the effects we are looking for. Alternately, it could indicate that our approach does not pick up what we are looking for.

To test for this we use the Herfindahl index based on the relative distribution of outflow on the receiving sectors - the same measure of variance that we used in section 3.4 above. The inverse of this index can be interpreted as the number of

"effective receiving sectors" with a value between 1 and the number of categories; in our case, the 42 sectors.[7]

The results are presented in table 4.11 for all employees independent of education and in table 4.12 for employees with higher education. The number of user sectors vary considerably between sectors, from almost 1 up to 15. For Sweden the number of effective user sectors seems to be higher than in the Norwegian and Finnish cases for most sectors. There is, however, no systematic correspondence regarding which sectors that score high or low compared to the Norwegian and Finnish results. For both Norway and Finland the numbers for all employees and the highly educated are strongly correlated. It is not, however, the case that the numbers are generally lower for the highly educated than for all employees. The number of effective user-sectors is higher for those with higher education for about half the sectors in both Norway and Finland, though in most cases, these differences are not found for the same sectors in the two countries. Comparing the two countries directly, the number of user-sectors is generally not correlated, neither using the absolute numbers nor their rank.

As a conclusion, we have not been able to confirm any of our hypotheses above. This may be due to the existence of some peculiarities, as the number of effective user-sectors in some cases are particularly low in one country and particularly high in the others, and vice versa. This may indicate that there are important differences in how the labour markets work, so that the national environment is the decisive factor. It seems to be the case, for instance, that the numbers of effective user sectors are generally higher in Sweden than in the other two countries, and higher in Norway than in Finland. Comparing Norway and Finland this is true for 30 of the 42 sectors when including all employees who change jobs, and for 28 of the sectors when looking at only the higher educated. Comparing Sweden and Norway, the Swedish numbers are the higher in 34 out of 41 sectors.

[7] The Herfindahl index is calculated as follows: $H_j = \sum_i s_{ji}^2$ where s_{ji} = share of total sum in sector i for sector j. In this case, i=1-42 and j=1-42, and the minimum possible value for the inverse of Hj (presented in the tables) is 1, the maximum is 42. For Sweden, i=1-41 and j=1-41.

Keeping our focus on the NIS institutions the results are rather similar in Norway and Finland for the higher education sector (around 4 effective user sectors) and for the social science institutes (6-7 sectors). For the industrially oriented institutes, however, eight sectors are on the receiving end in the Norwegian case while only three to four are recipients in the Finnish one. In the Swedish case the number of effective receiving sectors are considerably higher for personnel leaving NIS institutions; 8 for higher education, and 15 for R&D institutes.

*Table 4.11 Number of effective receiving sectors by delivering sectors, by country. All employees. Inverted Herfindahl indexes based on a 42*42 input-output matrix.*[1]

Delivering sectors	Sweden 1994-95	Norway 1995-96	Finland 1994-95
Agriculture, hunting and related service activities	10.4	9.5	5.1
Forestry, logging and related service activities	8.9	6.7	3.5
Fishing, oper. of fishing hatcheries and fish farms	10.8	7.0	8.3
Mining and quarrying	8.8	3.6	5.7
Food products, beverages and tobacco	4.3	4.7	3.1
Textiles and textile products	4.5	5.2	4.9
Wood and products of wood	7.3	6.6	6.1
Pulp, paper, paper products	3.2	14.2	4.3
Publishing, printing, repr. of recorded media	6.1	5.6	3.1
Coke, ref. petr. products, nuclear fuel [1]	6.8	4.5	5.0
Chemicals and chemical products [1]	..	12.5	4.7
Basic chemicals	2.8	9.5	3.0
Pharmaceutical preparations	11.8	3.0	5.8
Rubber and plastic products	8.9	5.1	9.6
Non-metallic mineral products	9.2	13.0	8.1
Basic metals	2.2	5.3	3.2
Fabricated metal products	8.9	8.6	6.5
Machinery and equipment n.e.c.	4.3	8.4	3.8
Office machinery and computers	7.5	1.5	4.2
Electrical machinery and apparatus n.e.c.	11.1	4.8	4.1
Radio, tv and communication equipment	14.9	10.5	1.6
Medical, precision and optical instruments	13.1	4.9	12.1
Transport equipment	10.8	3.1	3.1
Manufacturing n.e.c.	10.4	8.2	12.0
Electricity, gas, water supply	11.0	5.4	3.1
Construction	8.9	4.1	3.3
Wholesale and retail trade	4.8	5.1	2.5
Wholesale of machinery and equipment	10.1	3.6	7.7
Transport and storage	5.8	2.5	1.9
Post and telecommunications	12.2	5.4	1.7
Financial intermediation	5.7	4.3	1.4
Other, mainly private services	6.9	9.4	6.9
Computer and related services	6.6	3.9	3.7
Research institutes, technology	11.0	8.6	3.6
Research institutes, social sciences	13.6	7.4	7.3
Other business activities	11.8	7.5	5.5
Architectural and engineering activities	15.9	6.5	6.9
Technical testing and analysis	9.7	2.0	5.6
Public administration	3.7	1.7	1.6
Higher education	5.7	4.4	4.0
Other non-public services	7.2	5.0	4.7
Sector unknown	10.3	1.8	3.3

[1] In the Swedish case chemicals and chemical products are not separated out but reported as part of coke, ref. petr. products and nuclear fuel. The resulting matrix for Sweden is therefore 41*41.

*Table 4.12 Number of effective receiving sectors by delivering sectors, by country. Employees with higher education.. Inverted Herfindahl indexes based on a 42*42 input-output matrix.*[1]

Delivering sectors	Sweden 1994-95	Norway 1995-96	Finland 1994-95
Agriculture, hunting and related service activities	6.4	5.6	6.8
Forestry, logging and related service activities	7.9	2.2	3.2
Fishing, oper. of fishing hatcheries and fish farms	4.1	6.0	2.0
Mining and quarrying	12.6	3.0	7.3
Food products, beverages and tobacco	4.6	3.7	3.1
Textiles and textile products	6.4	6.3	4.9
Wood and products of wood	12.4	6.9	3.0
Pulp, paper, paper products	7.2	8.0	3.7
Publishing, printing, repr. of recorded media	7.1	6.7	2.6
Coke, ref. petr. products, nuclear fuel [1]	4.0	3.8	5.6
Chemicals and chemical products [1]	..	13.2	1.9
Basic chemicals	3.4	6.7	2.7
Pharmaceutical preparations	10.1	3.8	5.9
Rubber and plastic products	11.4	4.3	11.2
Non-metallic mineral products	20.5	12.0	6.0
Basic metals	6.0	5.4	4.4
Fabricated metal products	17.1	9.9	6.9
Machinery and equipment n.e.c.	8.8	8.6	3.0
Office machinery and computers	5.7	1.3	3.0
Electrical machinery and apparatus n.e.c.	16.1	7.6	4.5
Radio, tv and communication equipment	11.7	7.0	1.6
Medical, precision and optical instruments	10.6	4.1	8.7
Transport equipment	15.1	2.6	3.8
Manufacturing n.e.c.	12.7	8.8	14.0
Electricity, gas, water supply	12.5	4.2	3.6
Construction	9.0	6.0	3.9
Wholesale and retail trade	7.6	7.3	3.3
Wholesale of machinery and equipment	9.5	4.3	7.9
Transport and storage	5.6	3.7	2.7
Post and telecommunications	8.9	6.3	1.8
Financial intermediation	5.1	4.1	1.6
Other, mainly private services	7.3	9.5	6.0
Computer and related services	6.5	4.2	2.9
Research institutes, technology	8.3	8.5	3.2
Research institutes, social sciences	12.1	7.0	6.0
Other business activities	10.6	7.3	4.4
Architectural and engineering activities	17.9	5.7	5.4
Technical testing and analysis	9.4	1.7	6.0
Public administration	3.1	1.5	1.3
Higher education	5.4	4.2	2.9
Other non-public services	4.6	4.3	5.4
Sector unknown	6.0	1.5	2.2

[1] In the Swedish case chemicals and chemical products are not separated out but reported as part of coke, ref. petr. products and nuclear fuel. The resulting matrix for Sweden is therefore 41*41.

4.4 Main findings and experiences with the approach

In this chapter we have tracked employees who change jobs between two consecutive years. The complexity of these flows in terms of the various educational backgrounds of the employees, and the various types of employers, opens up a wide range of avenues for research. On the other hand it demands a high degree of selectivity in the analysis. Our focus has been two important kinds of institutions from a national innovation systems perspective: institutes of higher education and R&D institutes. The majority of the discussion concerns these. In addition we have been able to present a rich field of information covering a complete range of economic sectors at three different levels of aggregation: the 3+2 sectors in the flowcharts, the 11 sectors in the accompanying tables, and the 42 sectors in the most disaggregated tables. A great deal of this information has not been commented upon and utilised in this report, mainly owing to time and resource constraints. The information with which to complete the picture lays latent in this report. In particular the flows of people between different sectors other than the NIS institutions contains important information from a NIS perspective, since innovation systems involve to a large degree links between the companies themselves. What we have termed the NIS institutions do not necessarily play a prominent role at the interface with companies, though they are important in terms of framing and realising policy goals.

The results we believe to be reasonably comparable between the countries. There are - as in all cross-country comparisons - many possible pitfalls. Therefore the results should be interpreted with caution. There are, however, some rather clear results that we think are sufficiently robust to withstand the marginal adjustments and corrections of the data we know there is room for. These include:

The turnover of employees is generally high. Between two consecutive years about a quarter to a fifth of the staff is lost. Of these the larger share shift jobs, while the rest leave the active work force (permanently or for a period). The rate is more or less the same for the higher educated as for all employees, but with some national variation.

The inclusion of an extra year allows us to integrate new employees who enter firms into our calculations of mobility rates. Doing this reveals even higher mobility rates:

38 % of the employees in both Norway and Finland have entered the workplace since the previous year or have left by the following. The newcomers are more mobile than the “old” workers. The probability that a new entrant changes position in the next is more than twice that of an old workers leaving a position the subsequent year. Taking age into consideration, the share of stable workers increases with age and the share of mobile workers decreases almost linearly with increasing age.

The analysis of flows between different sectors is dominated by the larger size of the higher education institutions along side R&D institutes. Even if there are clear national differences, some common features emerge across countries: there is a strong link between the public sector and the higher education institutions, and the net direction of flows tends to move from the public sector to institutes of higher education. This is even true for the comprehensive group of the higher educated, albeit with an exception for the natural scientists and engineers. The general direction of net flows for the other sectors ---that is goods producing sectors and private services--- is from the NIS institutions to the goods producers and private services. The links between R&D institutes and the institutes of higher education is in general relatively weak, with the exception of Sweden where quite a lot of people move from HEIs to R&D institutes. For Norway and Finland the net direction of flows between the two are in the opposite direction.

Separating out one category of those with higher education, namely those with natural sciences and engineering degrees, revealed much of the same patterns as in the other cases. However the links with the goods producing sectors turned out to be stronger, and in the Norwegian case particularly strong with business services. The links with the public sector that had dominated flows for the other education types lost its dominating position for this education group.

Of course quite a few differences do exist between the countries. It seems for instance that there is somewhat more interaction between manufacturing and the NIS institutions in Sweden and Finland than in Norway. In the Norwegian case there are instead stronger links in terms of personnel transfers to private services – in particular business services. Comparing the “degree of openness” – the share of mobility out of the NIS sectors - of the two NIS institutions reveals that R&D institutes interact with other sectors to a higher degree than do higher education

institutions in Sweden and Norway. In Finland, institutes of higher education are more ‘open’, in particular because of a high level of mobility between different R&D institutes in Finland. Lastly, the influx of those that are not active in the work force the year before, and out of the active work force the following year, seem to be particularly high in Finland.

Our attempt to characterise the 42 sectors in our most disaggregated list by the number of effective *user-sectors* for personnel leaving resulted in a varied and somewhat confusing picture. The figures seem to be consistent within each country, but without any unambiguous differences between all employees and the higher educated. Sectoral variation seems to be rather large. The comparisons across countries showed no similarities that we could uncover. We therefore conclude that differences in how the labour markets function in each country is more important for this aspect of mobility patterns than are differences between sectors in skills/education, and applicability of these skills by other employers.

5. Concluding remarks

In this report we have attempted to describe the innovation systems of Finland, Norway and Sweden in terms of stocks and flows of human resources in the economies of the three countries. The level of analysis has been a 42-sector breakdown of each economy. Highlighted were the positions of the designated NIS categories, higher education institutions and the R&D sector. The latter of which was broken down into industrial research institutes and other R&D establishments. The object of analysis, human resources, was broken down according to broad categories corresponding to type/level of formal education. Human resources data is one type of indicator amongst many that can be used for such purposes. One element that makes this sort of data particularly attractive in analysis of national innovation systems is that it is available for the complete sets of national populations. Data availability in the Nordic countries combined with quality of the data open for mapping institutional frameworks in terms of the 'stocks' of employees that populate them and in terms of the flows of employee-competencies as they change positions within the framework.

Compared to R&D spending, data covering human resources provides a more comprehensive picture of the technological resources and links in the innovation system. There are however some drawbacks connected with using this quantitative approach. Knowledge stocks and flows can be assessed in terms of volume, and not really of quality, though breakdowns according to field and level of formal education do provide a rough qualitative indication. Another drawback is that other forms of knowledge flows, that do not involve the prolonged physical mobility (relocation to a new position) of human resources, are not visible in this data. In this work we have taken a broad approach, aiming at providing an overview of the three countries' innovation systems and comparing/contrasting their similarities and differences. Our intention has been to illustrate the possibilities to be found in this data source. Subjects of more detailed research - such as into the stocks and flows of a highly specialised subgroup of the human resources for which a more detailed breakdown of NIS categories is used - can provide correspondingly more detailed information about common knowledge bases, competence clusters and so forth. Arguably, the

possibilities for the data are endless, especially when coupled to other types of indicators and other, more qualitative, approaches.

5.1 Main findings

On the whole, Finland, Norway and Sweden are quite similar in terms of stocks and flows of human resources. The Norwegian economy has for instance not experienced the kind of economic difficulties as the Swedish and particularly the Finnish economies have. The mobility rates of the latter two countries are naturally affected, especially where regards the flows in and out of the active workforce. Another major difference involves different institutional orientations. In the Swedish research infrastructure, a great deal of industrial research takes place in universities. In Norway and Finland, however, the industrial research infrastructure is concentrated around large industrial research institutes (in particular SINTEF and VTT respectively). Such differences also leave their mark on the flows between the R&D sector, institutes of higher education and industry in the three countries. Meanwhile, historical differences mark the national systems of higher education, in terms of academic orientation and duration of degree, which has affected relative proportions of, for ex., PhDs in the three countries. However, these differences seem to lessen over time as all three countries are adapting their education-regimes to suit international standards.

Looking at the industrial structures of the three countries, it is evident that the manufacturing sectors in Sweden and Finland are relatively larger than their Norwegian counterparts. Primary sectors in Norway are relatively larger (due to its oil industry being classified there), as is the trade, hotels and restaurants sector. Norway and Sweden also have considerably larger public sectors than Finland. The mobility data indicates that there have been substantial lay-offs from the Finnish public sector.

In terms of educational level and specialisation in different sectors the three countries show very similar patterns when looking at the eleven sector level. The only major difference is that there is a higher share of highly educated within the primary sectors

in Norway, which is due to the Norwegian petroleum industry. Looking at the how natural scientists and engineers are absorbed by "user sectors", Sweden shows a wider distribution of sectors which recruit such employees, which in turn reflects Sweden's relatively larger manufacturing sector.

A closer look at three specific sectors (the ICT sector, pulp and paper, and the public sector) indicates that the relative proportion and distribution of highly educated regarding fields are very similar, despite the fact that the total numbers of employees are much higher in Sweden and Finland in the pulp and paper sector than in Norway. The ICT sectors shows remarkably similar figures for the three countries when related to the sizes of populations, whilst public administration is larger in Norway in relative terms than in Sweden and Finland.

We have looked at mobility rates at different levels of sectoral breakdown. We have also looked at the proportion of different types of changes in job. Around 20-25 per cent of the employed population either change jobs or leave the active work force within the course of two consecutive years, independent of the level of education. Adding an extra year to take account of both inflows and outflows simultaneously brings the stable work force down to only around 60 per cent. From earlier studies in Sweden (1986-93) we know that that proportion of the workforce will be down to about 20 % in as little as seven years. The Norwegian experience shows a somewhat higher degree of stability with about 30 % of the employees remaining with the same employer after 8 years (1986-94).

Studying mobility patterns of more than two years in a row also permits us to see that the mobility rate is significantly higher (about twice the size) for those who are new within the system or have just changed jobs from the previous year, compared to the stable workers since last year. This kind of analysis also showed the existence of two groups of particularly mobile workers. We have termed them the "inexperienced nomads", persons who were out of the active work force last year and changing job again the following year, and the "experienced nomads", persons shifting job both since previous year and again next year. In follow up work we will treat the experienced nomads in particular to see what kinds of formal skills they possess and what kind of employments they move between.

Age is also a significant variable for the rates of mobility. The results are clear cut; the probability that one will change job sinks with age, and the pattern is very similar in the different countries.

Even though a large number of persons are shifting jobs or moving in and out of the active work force, not all establishments are equally affected by these changes. Much remains to be done with respect to how many, and which, firms or establishments deliver and receive mobile employees. With our perspective of national innovation systems in mind we have investigated such involvement by the firm units in a very strict and narrow sense, looking at the share of firms having received any personnel from HEI or R&D institutes since the previous year. The results show that well below 1 % of the units were involved, but with some sectoral variation. The patterns, however, were very similar for the two countries included in this comparison, Finland and Norway.

Going through the mobility rates and the number of effective delivering and receiving sectors by our 42-sector classification, a great disparity becomes evident between the three countries. Here we can clearly see that although the three countries are basically very similar, there are differences between the functioning of the labour markets, the industry recruitment patterns and the interaction between industry and the R&D infrastructure. Overall it seems like national circumstances play a decisive role for mobility at such a disaggregated level.

When studying the mobility flows between the higher education institutions (HEI), the R&D sector, the public sector, private services and the goods producing sectors, the differences in research infrastructures and the roles of the HEI and R&D sectors become evident. The HEI and R&D sectors of Norway and Finland are roughly comparable in size, whilst the Swedish R&D sector is slightly smaller in absolute numbers. This is compensated for by a larger HEI sector compared to the other countries.

Whether we study flows of the entire workforce, the highly educated or only the highly educated within natural science and engineering, the relative importance of flows remains fairly stable. Both the Swedish HEI and R&D sector display greater interaction with the manufacturing sector than do their counterparts in Finland and

Norway. The Swedish institutes of higher education also show relatively larger flows to the public sector. The net directions of flows are however in all countries from the public sector to institutes of higher education. This is even true for the comprehensive group of the higher educated, albeit with an exception for the natural scientists and engineers. The general direction of net flows for the other sectors - that is goods producing sectors and private services - is from the NIS institutions to the goods producers and private services.

There are greater flows out of the active workforce from the Finnish HEI and R&D sectors and the interactions between the R&D sector and the service sector seem weaker compared to Norway and Sweden. Norway's R&D sector seems better geared for the service sectors, partly due to its relatively larger size than in the other countries. The flows from HEI to R&D is much stronger in Sweden than in the other countries, whilst the reverse flows are very weak. The flows from R&D to HEI in Norway are by comparison bigger than in the other two countries in relative terms.

5.2 Relations to overall mapping of innovation systems

Human resources based indicators are among the best types of indicators for mapping of the dynamics and knowledge resources of national innovation systems. Ideally though these indicators should be coupled both to other types of indicators, and a further development of the categorisation of national innovation systems. We have based our sectoral breakdown on the NACE classification, with only two specially selected NIS institutions. A more thorough study would include the building up of NIS categories from hand picked organisations. Such time consuming work has not been possible within the constraints of this work, but is arguably a good investment for the future, especially if the categories can be maintained over time.

As mobility of personnel is but one of many forms of interactions taking part in innovation systems, a more complete picture of the systems can only be obtained by integrating the results from several approaches to identifying and describing nodes and links. Results from the work of other focus groups, such as the cluster analysis based on input-output data, analysis of inter-firm collaboration and the institutional mapping of the most important actors in the innovation systems will add significantly to this and probably reveal links that are not particularly outstanding from a

personnel mobility perspective. It remains to be seen whether combining approaches will serve to strengthen the links and structures identified by each of them, or whether the patterns will change.

5.3 Applicability of the indicator when register data is not available

The Nordic countries are unique in their access to labour-registry data. Other countries do not yet have access to such registers as far as we know. Some studies are clearly not possible without such data, but a wide range of issues can be dealt with using other, less complete sources. In such cases we hope that our more complete data can contribute benchmark results to make evaluation of results easier when using other data sources.

Survey data can be used both as a substitute and as an important complement to register data. There are a number of available sources (e.g., salary levels and recruitment patterns from trade organisations, unions, universities, etc.) that provide data that is relevant to specific questions. A combination of these sources with surveys could provide good coverage of larger innovation systems. Qualitative data might also provide analysis that can be boiled down to generally applicable insights. The OECD blue sky mobility indicator project aims at finding alternative data sources for mobility indicators. The most common sources are the labour force surveys.

5.4 Needs, opportunities and plans for further work

In this work the focus has been set on the flows in the labour market, i.e., the flows concerning the employed population. Only one type of mobility has been studied. We have looked solely at the stocks and flows of individuals, ignoring the stocks of firms or organisations, and in most cases the number of organisations affected by mobility. Further work would include more detailed studies and categorisation of the population outside the labour market (e.g., newly graduated, unemployed, immigrants, emigrants, etc). It would also include more NIS categories and include studies of the impact of mobility of organisations. Yet another aspect includes mobility of persons between countries, in particular of a temporary kind for instance within large multinational firms. Such work would be a natural continuation and

development of the work presented in this report. It is hoped that a continuation of this work will be undertaken by this group, hopefully with the inclusion of Denmark.

Mobility of human resources between different firms, sectors or NIS institutions indicates both the existence of knowledge flows and that there is a common knowledge base between the above categories. It can be argued that the dissemination of knowledge through human mobility is vital to the dynamics and innovative capacity of a sector or a whole economy. It can also be argued that mobility rates that are overly high are detrimental to the employer, precipitating losses of key skills and imposing costs in the form of training of new staff. All sectors may not benefit equally from the same mobility rates, depending on the generic nature of the knowledge base and degree of specialisation. It is obviously not possible to suggest an optimal mobility rate, but it can be argued that there are healthy levels of mobility, both for individual organisations, as well as for sectors or NIS institutions. An extension of the work would be to relate mobility to other factors in an effort to better assess the economic impacts of mobility. Characterisation of organisations with above average, average and below average mobility would be one such aspect. Possible studies would be:

- the innovativeness of organisations or sectors related to mobility rates;
- a comparison of money flows and mobility in institutional mappings;
- a comparison of high growth firms with a control population concerning mobility;
- a comparison of KIBS with a control population concerning mobility;
- a comparison of incomes with mobility rates;
- a study of the mobility of recently graduated in new specialised fields (e.g., biotech, environmental , etc.);

Labour mobility is also only one of many vehicles for knowledge transfer and we have studied only one type of mobility (change of establishment). There are some phenomena that must be assessed, in order to understand the relative importance of the indicator presented in this work, both in terms of the importance of our indicator of mobility, and in terms of the importance of human mobility *vis-à-vis* other forms of knowledge transfers. Such phenomena include: mobility through organisational change and changes in firm structures (e.g., spin-offs and spin- ins); mobility within

organisation (e.g., regional, national and international flows; flows between different functions and professions); temporary mobility (national and international, as well as between different types of actors, etc). They also include other forms of knowledge transfers, such as (R&D) co-operations, buyer-supplier relationships, training schemes, consultancy work, etc.

We can conclude that the human resources data we have used provides a solid description of important aspects of each country's innovation systems. The differences that have been found have not been overly surprising, and the data can be said to have confirmed our presuppositions. Nevertheless, our data have shed new light on the three countries in relation to one another and, perhaps most important, have raised new and more focused questions for how to utilise this data source in future analyses of innovation systems and related topics.

Appendix: Tables

Table A1. Basic data for figures 3.1 and 3.2. Number of employees by level of education and country.

Level of education	Sweden	Norway	Finland
Secondary education or below	2794864	1319513	1558640
ISCED 5 (12-15 years)	548647	203285	144791
ISCED 6+	469875	258084	213915
Licenciates	10769		5821
PhD	18333	6519	8384
Total	3842488	1787401	1931551

Table A2. Basic data for figures 3.3 and 3.4. Number of employees with higher education by Scientific field and country.

Disciplines	Sweden	Norway	Finland
Natural sciences and engineering	91468	57776	63565
Medical and health related disciplines	61274	40965	24800
Social sciences, humanities and other disciplines	347077	165862	139755
Total	499819	264603	228120

Table A3. Basic data for figures 3.4, 3.5 and 3.6. Number of employees with higher education by scientific field, age and country

	Sweden			Norway			Finland		
Age 1995	Natural sciences & eng.	Medical & health rel. disc.	Social sci., human. and other	Natural sciences & engineer.	Medical and health rel. discip.	Social sci., hum. and other	Natural sciences & engin.	Medical and health rel.discip.	Social sci., humanities and other
20	1	0	4	0	0	23	0	0	0
21	0	36	66	1	0	100	3	1	3
22	18	161	212	8	3	262	16	41	129
23	133	286	982	280	25	792	141	101	375
24	539	344	1945	607	260	1797	629	164	846
25	1028	402	2740	1178	722	2851	1334	270	1524
26	1639	515	3774	2004	1269	4108	1971	432	2210
27	2281	645	4837	2511	1526	4989	2640	573	3075
28	3084	780	6114	2868	1580	5226	2854	653	3634
29	3328	881	6939	2995	1667	5376	2921	692	4088
30	3381	1069	7285	2775	1807	5432	2747	690	4118
31	3512	1213	8014	2673	1909	5408	2478	752	4480
32	3387	1299	7630	2382	2016	4991	2126	824	4573
33	3119	1380	7519	2211	2058	4940	2011	845	4303
34	3134	1548	7851	2035	2136	4962	2022	848	4306
35	3115	1702	7658	1842	2072	4937	1931	920	4465
36	3035	1884	8209	1773	2114	4976	1898	903	4430
37	2927	2117	8556	1727	1820	5056	1973	886	4305
38	2934	2328	8866	1652	1569	4996	2023	937	4556
39	3014	2473	9065	1715	1411	5193	2128	969	4862
40	2825	2532	9425	1652	1271	5567	2198	928	4835
41	2594	2404	9686	1570	1117	5549	2165	907	4926
42	2779	2492	10455	1536	1096	5766	2060	947	4950
43	2649	2252	11056	1406	944	5872	2042	797	4988
44	2490	2069	11680	1323	897	5637	1986	768	4865
45	2649	2017	12918	1244	874	5524	1944	750	4623
46	2457	2401	13752	1214	815	5419	1869	711	4981
47	2607	2410	14362	1161	778	5285	1967	716	5232
48	2547	2317	14278	1262	743	5324	1853	724	5205
49	2564	2147	14247	1310	777	5380	1788	710	5101
50	2610	2092	13693	1181	624	4650	1603	691	4590
51	2465	1926	13384	1170	637	4645	1157	587	3750
52	2309	1677	12610	1054	545	3890	1223	587	3559
53	1881	1441	10621	893	512	3367	873	493	2639
54	1518	1235	8682	691	334	2691	1142	580	3264
55	1354	1057	7410	706	389	2571	672	328	2082
56	1316	1109	7182	692	357	2301	660	393	2179
57	1273	1012	6456	644	335	2039	622	318	1930
58	1075	944	5766	586	302	1712	526	273	1557
59	927	754	5474	489	287	1557	427	257	1311
60	823	630	4592	428	216	1256	302	214	942
61	625	559	3885	396	199	1129	235	166	686
62	594	460	3537	418	220	988	185	134	550
63	526	437	2871	367	167	981	99	74	271
64	473	379	2361	342	125	729	63	87	187
65	446	342	2270	239	86	663	16	48	80
66	287	222	1105	186	95	427	16	25	46
67	249	191	977	109	50	322	2	22	39
68	159	153	740	79	45	171	2	15	26
69	150	137	620	52	45	147	7	8	20
70	154	102	588	34	24	86	6	13	18
71	114	79	502	36	19	54	1	3	13
72	88	70	418	20	13	51	2	8	13
73	61	45	282	23	4	33	4	8	7
74	80	44	298	8	9	20	2	9	8

Table A4. Basic data for figure 3.8. Number of employees by sector and country

Sector	Sweden	Norway	Finland
Primary sectors, mining, oil	97110	118445	139065
Manufacturing	754400	279664	393160
Utilities and construction	252892	134675	115872
Trade, hotels, restaurants	543968	347554	279665
Transport, storage, communication	260148	149634	144485
Financial services	82369	46021	48238
Business services	322925	129452	153613
R-D institutes	12267	10801	8633
Higher education institutions	44434	20369	24099
Public adm. and defence, health and social work	1204930	591718	490988
Other non-public services	166397	63366	92006
Sector unknown	100648	54253	41727
Total	3842488	1945952	1931551

Table A5. Basic data for figure 3.9. Number of employees by sector and level of education. Sweden.

Sector	Secondary education or below	ISCED 5 (12-15 years)	ISCED 6+	Licenci-ates	PhD
Primary sectors, mining, oil	88218	6307	2469	59	57
Manufacturing	631382	74906	44897	1243	1972
Utilities and construction	226978	18355	7398	91	70
Trade, hotels, restaurants	468950	52920	21597	238	263
Transport, storage, communication	225685	21600	12682	110	71
Financial services	57726	11604	12838	100	101
Business services	211447	54529	55179	907	863
R-D institutes	3786	2329	4049	812	1291
Higher education institutes	9860	6659	16809	3480	7626
Public adm. and defence, health and social work	674973	264965	256599	3007	5386
Other non-public services	118884	22074	24566	458	415
Sector unknown	76975	12399	10792	264	218
Total	2794864	548647	469875	10769	18333

Table A5B. Basic data for figure 3.9, by 42 sectors. Number of employees by sector and level of education. Sweden.

Sector	Secondary education or below	ISCED 5 (12-15 years)	ISCED 6+	Licenciates	PhD	Sum
Agriculture, hunting and related service activities	63077	3579	1524	31	29	**68240**
Forestry, logging and related service activities	16125	2131	611	16	12	**18895**
Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	811	82	23	1	1	**918**
Mining and quarrying	8205	515	311	11	15	**9057**
Food products; beverages and tobacco	63565	4569	2457	33	43	**70667**
Textiles and textile products	16170	947	392	7	4	**17520**
Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	37196	1996	628	7	3	**39830**
Pulp, paper and paper products	41028	3925	2080	68	46	**47147**
Publishing, printing and reproduction of recorded media	47216	7827	4522	119	76	**59760**
Coke, refined petroleum products, nuclear fuel, chemicals and chemical products	9177	1444	904	43	38	**11606**
Chemicals and chemical products [1]	N/A	N/A	N/A	N/A	N/A	**N/A**
Basic chemicals	10166	1764	1526	69	75	**13600**
Pharmaceutical preparations	7084	3036	3042	218	905	**14285**
Rubber and plastic products	23074	1981	769	18	13	**25855**
Other non-metallic mineral products	16988	1283	665	15	9	**18960**
Mnufacture of basic metals	32703	2396	1264	41	47	**36451**
Fabricated metal products, except machinery and equipment	72909	4793	1556	29	37	**79324**
Machinery and equipment n.e.c.	85577	11511	6089	130	162	**103469**
Office machinery and computers	3288	937	923	28	31	**5207**
Electrical machinery and apparatus n.e.c.	20392	2961	1570	55	75	**25053**
Radio, television and communication equipment and apparatus	23993	7040	6155	144	169	**37501**
Medical, precision and optical instruments, watches and clocks	16765	4224	3531	91	132	**24743**
Transport equipment	76342	10803	6338	123	105	**93711**
Manufacturing n.e.c.	27749	1469	486	5	2	**29711**
Electricity, gas and water supply	21974	4758	2609	52	44	**29437**
Construction	205004	13597	4789	39	26	**223455**
Wholesale on a fee or contract basis, wholesale of machinery, equipment and supplies	41554	11791	6115	71	64	**59595**
Wholesale and retail trade; repairs	427396	41129	15482	167	199	**484373**
Transport and storage	154593	12786	8363	48	24	**175814**
Post and telecommunications	71092	8814	4319	62	47	**84334**
Financial intermediation	57726	11604	12838	100	101	**82369**
Real estate, renting and business activities	62565	6227	4861	44	28	**73725**
Computer and related activities	15936	12179	11999	156	136	**40406**
Research and development	3786	2329	4049	812	1291	**12267**
Research institutes, social sciences	0					
Other business activities	104266	22387	26126	317	291	**153387**
Architectural and engineering activities and related technical consultancy	24732	12487	11382	328	346	**49275**
Technical testing and analysis	3948	1249	811	62	62	**6132**
Public adm & defence; compulsory social security	674973	264965	256599	3007	5386	**1204930**
Higher education	9860	6659	16809	3480	7626	**44434**
Other community, social & personal services	118884	22074	24566	458	415	**166397**
Unknown	76975	12399	10792	264	218	**100648**
Sum	**2794864**	**548647**	**469875**	**10769**	**18333**	**3842488**

[1] Chemicals and chemical products included with coke, petr. ref. and nuclear fuel.

Table A6. Basic data for figure 3.10. Number of employees by sector and level of education. Norway.

Sector	Secondary education or below	ISCED 5 (12-15 years)	ISCED 6+	Licenciates[1]	PhD
Primary sectors, mining, oil	49546	5504	6248		268
Manufacturing	238372	19860	15246		346
Utilities and construction	104296	7442	5056		33
Trade, hotels, restaurants	290939	27264	12755		129
Transport, storage, communication	119629	15835	6027		54
Financial services	32621	7306	6046		46
Business services	77833	21409	22198		348
R-D institutes	3830	1531	4419		1019
Higher education institutes	5807	2944	9432		2186
Public adm. and defence, health and social work	339147	84143	160097		1914
Other non-public services	40200	7850	8499		108
Sector unknown	17293	2197	2061		68
Total	1319513	203285	258084	0	6519

[1] For Norway, licentiates are included with the group ISCED 6+.

Table A6B. Basic data for figure 3.9. Number of employees by sector and level of education: Norway.

Sector	Secondary education or below	ISCED 5 (12-15 years)	ISCED 6+[8]	PhD	Sum
Agriculture, hunting and related service activities	47628	1457	1066	10	**50161**
Forestry, logging and related service activities	4785	232	265	1	**5283**
Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	9608	343	216	3	**10170**
Mining and quarrying	17214	3925	5009	254	**26402**
Food products; beverages and tobacco	50226	2030	1540	23	**53819**
Textiles and textile products	8809	361	217	3	**9390**
Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	15147	595	367	3	**16112**
Pulp, paper and paper products	5625	356	255	8	**6244**
Publishing, printing and reproduction of recorded media	25603	3882	2452	17	**31954**
Coke, refined petroleum products, nuclear fuel,	1241	199	161	3	**1604**
Chemicals and chemical products	7340	1044	948	39	**9371**
Basic chemicals	2591	416	366	10	**3383**
Pharmaceutical preparations	1673	426	625	87	**2811**
Rubber and plastic products	6155	413	229	4	**6801**
Other non-metallic mineral products	8449	658	415	7	**9529**
Mnufacture of basic metals	12225	885	767	46	**13923**
Fabricated metal products, except machinery and equipment	16094	905	449	4	**17452**
Machinery and equipment n.e.c.	19260	2128	1623	25	**23036**
Office machinery and computers	652	104	138	2	**896**
Electrical machinery and apparatus n.e.c.	7886	1165	856	16	**9923**
Radio, television and communication equipment and apparatus	3012	745	997	12	**4766**
Medical, precision and optical instruments, watches and clocks	3367	664	734	23	**4788**
Transport equipment	35341	2570	1971	16	**39898**
Manufacturing n.e.c.	12970	615	378	1	**13964**
Electricity, gas and water supply	15387	2065	1598	11	**19061**
Construction	106194	5795	3602	23	**115614**
Wholesale on a fee or contract basis, wholesale of machinery, equipment and supplies	42432	1991	643	1	**45067**
Wholesale and retail trade; repairs	263473	26167	12713	134	**302487**
Transport and storage	86501	12107	3751	25	**102384**
Post and telecommunications	41091	3824	2305	30	**47250**
Financial intermediation	32623	7306	6046	46	**46021**
Real estate, renting and business activities	13113	2304	1271	8	**16696**
Computer and related activities	5620	3045	3702	44	**12411**
Research and development	2883	1049	2952	711	**7595**
Research institutes, social sciences	948	482	1468	308	**3206**
Other business activities	38414	6403	3568	28	**48413**
Architectural and engineering activities and related technical consultancy	22368	9994	16007	228	**48597**
Technical testing and analysis	1532	712	1036	55	**3335**
Public adm & defence; compulsory social security	343558	86250	164607	2000	**596415**
Higher education	5807	2944	9432	2186	**20369**
Other community, social & personal services	42374	7695	8495	105	**58669**
Unknown	68706	6723	5115	137	**80681**
Sum	**1455925**	**212974**	**270355**	**6697**	**1945951**

[8] Licenciates are included with ISCED 6+ for Norway

Table A7. Basic data for figure 3.11. Number of employees by sector and level of education. Finland

Sector	Secondary education or below	ISCED 5 (12-15 years)	ISCED 6+	Licenciates	PhD
Primary sectors, mining, oil	130540	6023	2439	34	29
Manufacturing	343803	21785	26505	622	445
Utilities and construction	105859	6582	3360	55	16
Trade, hotels, restaurants	251556	14251	13649	121	88
Transport, storage, communication	135511	3760	5153	50	11
Financial services	40010	1286	6795	95	52
Business services	115916	13920	23058	445	274
R-D institutes	4165	497	2742	479	750
Higher education institutes	9299	737	8590	1907	3566
Public adm. and defence, health and social work	313674	67437	105558	1635	2684
Other non-public services	73779	5309	12396	289	233
Sector unknown	34528	3204	3670	89	236
Total	**1558640**	**144791**	**213915**	**5821**	**8384**

Table A8. Basic data for figures 3.12, 3.13 and 3.14. Number of employees with higher education by sector, scientific field and country.

	Sweden			Norway	Finland				
Sector	Natural sciences and engineering	Medical and health related disciplines	Social sciences, humanities and other disciplines	Natural sciences and engineering	Medical and health related disciplines	Social sciences, humanities and other disciplines	Natural sciences and engineering	Medical and health related disciplines	Social sciences, humanities and other disciplines
Primary sectors, mining, oil	484	175	1202	4319	125	2072	556	44	1902
Manufacturing	28209	1458	18005	9177	402	6013	17645	547	9380
Utilities and construction	4571	34	2886	3738	36	1315	2633	17	781
Trade, hotels, restaurants	5208	1672	14861	4350	1031	7503	3550	3043	7265
Transport, storage, communication	2594	152	10069	2509	123	3449	1642	24	3548
Financial services	1070	91	11794	762	33	5297	1011	47	5884
Business services	21118	520	34616	11944	326	10276	11737	220	11820
R-D institutes	4232	371	1400	3501	308	1629	2759	228	984
Higher education institutes	9933	2821	14252	3986	1121	6511	5889	1293	6881
Public adm. and defence, health and social work	11409	52413	199896	11741	37144	113126	14198	18653	77026
Other non-public services	1318	272	23669	939	203	7465	1240	255	11423
Sector unknown	1181	1222	8738	810	113	1206	705	429	2861
Total	**91327**	**61201**	**341388**	**57776**	**40965**	**165862**	**63565**	**24800**	**139755**

Table A8B. Basic data for figures 3.12, 3.13 and 3.14 by 42 sectors. Number of employees with higher education by sector, scientific field and country.

	Sweden			Norway			Finland		
Sector	Natural sciences and engineering	Medical and health related disciplines	Social sciences, hum. and other disciplines	Natural sciences and engineering	Medical and health related disciplines	sciences, hum., other disciplines	Natural sciences and engineering	Medical and health related disciplines	sciences, humanities and other disc.
Agriculture, hunting and related service activities	197	160	829	115	24	494	312	40	1328
Forestry, logging and related service activities	49	11	258	35	1	137	87	2	512
Fishing, oper. of fishing hatcheries and fish farms	14	0	11	95	3	108	21	0	10
Mining and quarrying	224	4	104	3961	80	1219	136	2	52
Food products, bewerages and tobacco	826	57	1521	623	35	898	474	20	1161
Textiles and textile products	120	5	277	42	3	144	164	6	291
Wood and products of wood	170	4	385	147	10	192	471	8	317
Pulp, paper, paper products	1147	29	974	188	5	70	1170	33	661
Publishing, printing, repr. of recorded media	480	45	4158	344	25	2005	439	25	2671
Coke, ref. petr. products, nuclear fuel[1]	636	9	332	128	4	31	391	3	139
Chemicals and chemical products[1]				638	16	332	358	40	193
Basic chemicals	1187	13	458	217	15	144	761	8	253
Pharmaceutical preparations	2272	1017	849	408	169	134	473	323	198
Rubber and plastic products	377	7	412	131	2	99	324	4	260
Non-metallic mineral products	329	2	353	257	6	139	347	1	204
Basic metals	990	10	348	553	20	240	642	11	209
Fabricated metal products	756	19	840	275	3	167	792	3	255
Machinery and equipment n.e.c.	4334	34	1967	1337	5	302	3264	13	962
Office machinery and computers	798	0	183	112	2	26	207	5	58
Electrical machinery and apparatus n.e.c.	1215	3	480	691	9	164	1130	3	273
Radio, tv and communication equipment	4979	18	1461	890	3	113	4244	9	586
Medical, precision and optical instruments	2961	138	647	581	48	125	1243	24	254
Transport equipment	4509	40	2001	1493	16	477	538	5	196
Manufacturing N.E.C.l	123	8	359	122	6	211	213	3	239
Electricity, gas, water supply	1576	8	1114	1108	6	495	1145	11	352
Construction	2995	26	1772	2630	30	820	1488	6	429
Wholesale and retail trade	2760	46	3384	172	12	447	1623	3022	5255
Wholesale of machinery and equipment	2448	1626	11477	4178	1019	7056	1927	21	2010
Transport and storage	855	73	7473	1136	87	2524	733	19	2779
Post and telecommunications	1739	79	2596	1373	36	925	909	5	769
Financial intermediation	1070	91	11794	762	33	5297	1011	47	5884
Real estate, renting and business activities'	1459	83	3324	366	25	867	772	19	971
Computer and related services	6314	62	5875	2598	17	1091	2914	8	1083
Research institutes, technology	4232	371	1400	2510	242	911	2747	228	739
Research institutes, social sciences				991	66	718	12	0	245
Other business activities	2712	304	23435	7462	85	5530	1637	102	8808
Architectural and engineering activities	9901	47	1816	834	100	146	5888	6	788
Technical testing and analysis	732	24	166	684	99	2642	526	85	170
Public administration	11409	52413	199896	11919	37146	113180	14198	18653	77026
Higher education	9933	2821	14252	3986	1121	6511	5889	1293	6881
Other community, social and personal service activities	1318	272	23669	761	201	7411	1240	255	11423
NACE unknown	1181	1222	8738	923	130	1320	705	429	2861
Total	91327	61201	341388	70603	51208	208023	63565	24800	139755

1 For Sweden the two sectors coke refining, petroleum products and nuclear fuel, and chemicals and chemical products have not been separated.

Table A9. Basic data for figure 3.15. Number of employees with higher education by scientific field and country. Information and communication technology sector (NACE 30 + 32 + 64.2 + 72. 64.2 not included for Sweden).

Information- and communication technology	Sweden	Norway	Finland
Natural sciences and engineering	12091	4851	7365
Medical and health related disciplines	80	41	22
Social sciences, humanities and other disciplines	7519	2091	1727
Education less than ISCED 6	63061	23475	30410
Total	**82751**	**30458**	**39524**

Table A10. Basic data for figure 3.16. Number of employees with higher education by scientific field and country. Pulp and paper sector (NACE 21).

Pulp and paper	Sweden	Norway	Finland
Natural sciences and engineering	1147	188	1170
Medical and health related disciplines	29	5	33
Social sciences, humanities and other disciplines	974	133	661
Education less than ISCED 6	44997	5915	31835
Total	**47147**	**6241**	**33699**

Table A11. Basic data for figure 3.17. Number of employees with higher education by scientific field and country. Public administration sector (NACE 75).

Public administration	Sweden	Norway	Finland
Natural sciences and engineering	5600	6003	3964
Medical and health related disciplines	1524	2039	582
Social sciences, humanities and other disciplines	46810	32923	21906
Education less than ISCED 6	160115	119516	97967
Total	**214049**	**160481**	**124419**

Table A12. Basic data for figure 3.18. Number of effective user sectors by scientific field and country. Inverted Herfindahl indexes on the basis of 42 specified user sectors.

	Sweden	Norway	Finland
Natural sciences and engineering	16.4	12.1	11.8
Medical and health related disciplines	1.4	1.2	1.7
Social sciences, humanities and other disciplines	2.8	2.4	3.1

Table A13. Basic data for figure 4.1. Share of employees with and without job shift between two years by level of education and country. Percent.

	Sweden		Norway		Finland	
	All employees	Higher ed.	All employees	Higher ed.	All employees	Higher ed.
Emloyees without job shift	84.0	85.0	79.9	81.4	76.7	76.1
Employees with job shift	16.0	15.0	12.4	12.8	11.5	17.9
Employees leaving active work force			7.7	5.8	11.8	6.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table A14. Basic data for figure 4.2. Number of employees with and without job shift between three years by type of job shift. Norway

	1992	1993	1994
Total number of employees	1680529	1692782	1718019
New employer next year, otherwise stable	231797	123990	0
Not employed previous year, new employer next year	0	36713	0
New employer since previous year, otherwise stable	0	157708	210251
New employer since previous year, not employed next year	0	24541	0
New employer since previous year, new employer also next year	0	49548	0
Employees without job shift	1265486	1051464	1315634
Not employed following year, no other change	183246	97531	0
Not employed previous year, no other change	0	106462	192134
Not employed previous year, not employed following year	0	44825	0

Table A15. Basic data for figure 4.3. Number of employees with and without job shift between three years by type of job shift. Finland

	1993	1994	1995
Total number of employees	1876428	1915824	1931552
New employer next year, otherwise stable	203044	157480	0
Not employed previous year, new employer next year	0	41520	0
New employer since previous year, otherwise stable	0	134896	246149
New employer since previous year, not employed next year	0	20999	0
New employer since previous year, new employer also next year	0	47149	0
Employees without job shift	1460977	1193163	1443675
Not employed following year, no other change	212407	110334	0
Not employed previous year, no other change	0	115616	241727
Not employed previous year, not employed following year	0	94667	0

Table A16. Basic data for figure 4.4. Mobility rates for "stable employees" and "new employees". Number of persons and percent.

	Norway 1993			Finland 1994		
	Number of persons 1993	Persons having left next year	Mobility rate %	Number of persons 1994	Persons having left next year	Mobility rate %
Stable workforce from previous year	1272985	221521	17.4	1460977	267814	18.3
New employees from previous year	419797	155627	37.1	454847	204335	44.9
Total (mob rate to next year)	1692782	377148	22.3	1915824	472149	24.6

Table A17. Basic data for figure 4.5. Number of employees by type of job shift and age. Sweden.

Age 1995	Emloyees without job shift	Employees with job shift	Employees leaving active work force	Total employment 1994	Total population 1995
74	1812	306	1205	3323	81470
73	2029	352	1372	3753	78189
72	2470	452	1615	4537	79671
71	2737	587	1821	5145	79748
70	3282	601	1879	5762	80312
69	3687	684	1919	6290	79244
68	4051	823	2142	7016	78434
67	4712	1148	2789	8649	80946
66	5348	1639	5906	12893	78905
65	17416	2255	5700	25371	81662
64	21230	2328	7130	30688	80614
63	26813	2781	8465	38059	80986
62	32509	3573	5879	41961	78258
61	37307	4228	6856	48391	79917
60	43637	4947	6328	54912	81914
59	49654	6019	4759	60432	85627
58	53679	6582	4237	64498	88031
57	57997	7519	4287	69803	92395
56	62009	8045	4341	74395	96455
55	63201	8801	3981	75983	95715
54	67732	9845	2459	80036	100729
53	75524	11138	258	86920	113474
52	86389	12914	3589	102892	124133
51	92091	14386	3823	110300	132308
50	93312	14994	3900	112206	134233
49	93686	15438	4054	113178	135384
48	91911	15545	4038	111494	133389
47	90647	15851	3967	110465	132099
46	86705	15430	3972	106107	127488
45	82562	15132	3872	101566	122793
44	78278	14499	3691	96468	117398
43	77927	14970	3893	96790	118270
42	77864	15166	3882	96912	118881
41	73935	14796	4002	92733	115611
40	74341	15369	4200	93910	117769
39	74300	15828	4393	94521	119215
38	72511	15684	4632	92827	118439
37	69994	15807	4964	90765	116780
36	68827	15683	4988	89498	116713
35	65865	15512	5326	86703	115241
34	65230	16179	5807	87216	116794
33	65336	16827	6077	88240	119965
32	67207	17990	6569	91766	125294
31	70427	19306	7608	97341	134562
30	68754	19623	7642	96019	134130
29	66545	19374	7863	93782	133161
28	63142	19265	7975	90382	131110
27	55905	17672	7835	81412	123228
26	49639	16126	7830	73595	116387
25	45759	16730	9730	72219	116991
24	41665	16962	9908	68535	120132
23	34994	15406	9895	60295	118498
22	28228	13796	9481	51505	115621
21	21318	11294	9422	42034	116178
20	15138	10228	13577	38943	109742
Total	**2849268**	**604435**	**287733**	**3741436**	**5920633**

Table A18. Basic data for figure 4.6. Number of employees by type of job shift and age. Norway.

Age 1995	Emloyees without job shift	Employees with job shift	Employees leaving active work force	Total employment 1995	Total population 1995
74	656	19	1378	2053	36878
73	813	21	1288	2122	37811
72	954	26	1161	2141	37384
71	1094	38	1181	2313	36335
70	1395	57	1315	2767	37245
69	1938	61	1192	3191	35751
68	2869	124	1998	4991	36281
67	4390	192	3399	7981	36064
66	7904	332	2094	10330	36975
65	9236	427	3047	12710	36294
64	12146	588	3138	15872	36455
63	14042	650	1572	16264	34386
62	15257	743	1652	17652	34446
61	16501	934	1583	19018	34543
60	18515	1065	1689	21269	36080
59	20273	1258	1371	22902	37482
58	22183	1386	1338	24907	39330
57	23718	1625	1350	26693	40852
56	25065	1743	1390	28198	42071
55	24761	1756	1335	27852	40824
54	29041	2093	1408	32542	46468
53	32240	2543	1555	36338	50636
52	36563	3065	1707	41335	56991
51	38096	3345	1851	43292	59272
50	42713	3764	1955	48432	66202
49	41049	3818	1981	46848	63651
48	40127	3877	1976	45980	62025
47	39420	3948	1878	45246	60674
46	38793	4192	1953	44938	60363
45	38074	4167	1943	44184	58973
44	39280	4570	1962	45812	61247
43	39646	4621	2012	46279	61941
42	39341	4788	2238	46367	62084
41	39742	5062	2291	47095	63159
40	39429	5343	2504	47276	64175
39	38504	5489	2584	46577	63291
38	38368	5580	2804	46752	63845
37	37999	5773	2911	46683	64145
36	36626	5910	3080	45616	63423
35	36736	6060	3326	46122	63943
34	36177	6200	3566	45943	64305
33	36201	6890	3704	46795	65489
32	37021	7239	3955	48215	67753
31	36445	7715	4276	48436	68336
30	35894	8146	4515	48555	69125
29	34730	8412	4639	47781	68447
28	33970	8856	4882	47708	69701
27	32370	9181	4986	46537	69860
26	28422	9028	4844	42294	66674
25	26197	9419	5013	40629	67244
24	23518	8876	5064	37458	66111
23	20471	8017	5005	33493	62978
22	17742	7615	5186	30543	61538
21	14097	6275	5051	25423	58062
20	11495	5108	4823	21426	0
Total	**1410247**	**218030**	**147899**	**1776176**	**2885618**

Table A19. Basic data for figure 4.7. Number of employees by type of job shift and age. Finland.

Age 1995	Emloyees without job shift	Employees with job shift	Employees leaving active work force	Total employment 1994	Total population 1994
74	184	15	100	299	35741
73	209	10	109	328	36505
72	211	9	147	367	40107
71	259	17	154	430	40723
70	261	13	176	450	43331
69	281	13	201	495	44318
68	367	23	257	647	44951
67	404	34	318	756	47850
66	532	39	741	1312	48844
65	937	93	3974	5004	49906
64	4214	195	1741	6150	48844
63	4858	313	3794	8965	47834
62	7253	556	2187	9996	45550
61	9054	665	3257	12976	48217
60	11672	1048	5108	17828	50505
59	15614	1430	3774	20818	50379
58	18647	1828	4869	25344	52948
57	22954	2380	4818	30152	56423
56	26575	2821	5318	34714	58205
55	25567	2841	4450	32858	49912
54	39012	4576	5325	48913	69936
53	28096	3316	3361	34773	48148
52	36409	4378	3269	44056	59957
51	38341	4862	3356	46559	62999
50	48367	6235	4099	58701	78071
49	54309	6858	4579	65746	87141
48	55532	7348	4682	67562	89033
47	55460	7323	4542	67325	89010
46	53859	7448	4459	65766	87086
45	51679	7415	4300	63394	84179
44	49746	7060	4142	60948	80824
43	50727	7383	4373	62483	83173
42	48570	7336	4178	60084	79961
41	48164	7574	4300	60038	80363
40	47416	7543	4266	59225	79911
39	47478	7658	4451	59587	80401
38	44974	7535	4507	57016	77801
37	42486	7429	4391	54306	74195
36	42809	7761	4527	55097	76157
35	41751	7797	4843	54391	76188
34	40480	8046	5058	53584	76188
33	39651	8241	5214	53106	76337
32	38599	8411	5518	52528	77144
31	37081	8456	5710	51247	76021
30	34527	8297	5736	48560	74297
29	32408	8362	5864	46634	73958
28	30021	8226	6055	44302	73202
27	26596	7689	6077	40362	70703
26	21959	6682	5969	34610	65519
25	18280	6085	6196	30561	63749
24	14704	5112	5855	25671	61371
23	11195	3980	5541	20716	59073
22	8492	3145	5630	17267	56865
21	5684	2535	5365	13584	62344
20	3808	1773	6880	12461	65398
Total	**1438723**	**244218**	**218111**	**1901052**	**3517796**

Table A20. Basic data for figure 4.8 and table 4.3. Overall mobility independent of education by delivering and receiving sectors. Number of employees. Sweden 1994-95.

Delivering sectors (1994) → / ↓ Receiving sectors (1995)	Primary sectors, mining, oil	Manufacturing	Utilities and construction	Trade, hotels, restaurants	Transport, storage, communication	Financial services, real estate	Business services	R&D institutes	Higher education institutions	Public adm. And defence, health and social work	Other non-public services	From Outside active workforce	N persons moving	N persons employed	Mobility rate in
Primary sectors. Mining. oil	2393	1159	762	794	465	103	672	32	51	1515	425	9137	18572	97105	19.1%
Manufacturing	1607	51176	4567	11157	2760	415	7545	575	619	6734	1969	68511	159477	754374	21.1%
Utilities and construction	884	3110	7411	2377	1206	92	4289	20	42	2844	784	22648	46590	252892	18.4%
Trade. hotels. restaurants	902	9303	3175	32152	3495	723	6879	176	202	7527	2344	71017	140845	543948	25.9%
Transport. storage. communication	571	2934	1285	3822	7320	402	4481	180	79	2552	1028	22282	47784	260138	18.4%
Financial services. real estate	133	272	143	804	263	2615	1311	17	48	665	190	3920	10512	82369	12.8%
Business services	718	7591	4479	8177	2693	1687	15571	306	615	9300	2235	37235	92436	322996	28.6%
R&D institutes	11	447	36	144	43	25	320	363	2024	293	66	1097	4889	12816	38.1%
Higher education institutions	49	282	42	213	64	57	395	199	1725	2099	336	3963	9529	44434	21.4%
Public adm. and defence. health and social work	1623	3363	2046	6878	2048	679	6271	178	1635	57871	5087	83632	173301	1204250	14.4%
Other non-public services	602	1 464	858	2289	1013	220	2365	37	303	5917	4373	18200	38894	166433	23.4%
Out of active workforce	10744	45347	20209	58633	18544	4977	29714	638	2780	99800	18012		315936	315936	100.0%
Nace Unknown	1115	1310	1082	2321	730	207	1862	30	191	29623	1470	21694	61635	85927	71.7%
N persons moving (=100)	21352	127758	46095	129761	40644	12202	81675	2751	10314	226740	38319	363336			
N persons employed	99885	722655	252397	532864	252998	84059	312235	10678	45219	1257689	165858	363336			
Mobility rate out	21.4%	17.7%	18.3%	24.4%	16.1%	14.5%	26.2%	25.8%	22.8%	18.0%	23.1%	100.0%			

Table A21. Basic data for figure 4.9 and table 4.4. Overall mobility independent of education by delivering and receiving sectors. Number of employees. Norway 1995-96.

Delivering sectors (1995) → **↓ Receiving sectors (1996)**	**Primary sectors, mining, oil**	**Manufacturing**	**Utilities and construction**	**Trade, hotels, restaurants**	**Transport, storage, communication**	**Financial services, real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. And defence, health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. oil	2449	909	362	709	274	28	591	51	45	592	144	5658	12155	56892	21.4 %
Manufacturing	1161	16162	2093	4737	1323	107	2261	86	165	2425	709	23285	55570	280817	19.8 %
Utilities and construction	582	1710	6528	1555	694	54	816	20	25	1524	258	11519	26082	121620	21.4 %
Trade. hotels. restaurants	1494	4195	1360	26113	2344	244	3808	60	86	4588	941	40972	88678	342722	25.9 %
Transport. storage. communication	505	1346	589	2307	11200	93	1284	17	35	1422	304	13587	33221	143583	23.1 %
Financial services. real estate	58	150	49	383	144	1314	535	17	29	275	52	1787	4899	45707	10.7 %
Business services	570	2474	858	5571	1555	696	8223	277	196	2994	647	17894	42773	133082	32.1 %
R&D institutes	27	46	8	58	23	14	83	266	103	194	28	666	1552	10567	14.7 %
Higher education institutions	41	70	30	143	61	22	133	201	721	992	98	2440	4975	21426	23.2 %
Public adm. and defence. health and social work	889	1916	1043	6478	1546	264	2546	183	706	45078	1698	51980	115146	598457	19.2 %
Other non-public services	121	415	190	1030	338	46	534	18	95	1549	2496	6935	14054	58329	24.1 %
Out of active workforce	5358	18979	8037	27525	11558	2286	10455	580	1702	40056	4962	1242089	1376952	1376952	100.0 %
Nace Unknown	78	205	142	434	123	43	210	8	10	301	45	2334	4269	18393	23.2 %
N persons moving (=100 %)	13333	48577	21289	77043	31183	5211	31479	1784	3918	101990	12382	1421146			
N persons employed	58070	273824	116827	331087	141545	46019	121788	10799	20369	585301	56657	1421146			
Mobility rate out	23.0 %	17.7 %	18.2 %	23.3 %	22.0 %	11.3 %	25.8 %	16.5 %	19.2 %	17.4 %	21.9 %	100.0 %			

Table A22. Basic data for figure 4.10 and table 4.5. Overall mobility independent of education by delivering and receiving sectors. Number of employees. Finland 1995-96.

Delivering sectors (1994) → **↓ Receiving sectors (1995)**	**Primary sectors. mining. oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence. health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	1684	525	375	331	279	47	139	26	11	281	121	8726	12897	130339	9,9 %
Manufacturing	484	23379	2076	3780	837	195	2366	123	377	1658	731	40451	77517	352709	22,0 %
Utilities and construction	187	1617	6541	509	487	35	759	10	20	369	331	17661	29233	98211	29,8 %
Trade. hotels. Restaurants	201	3024	563	19222	733	287	1875	32	89	1730	795	38244	67953	241421	28,1 %
Transport. Storage. Communication	139	1202	438	1183	11667	158	719	13	43	493	255	11693	28403	132793	21,4 %
Financial services. Real estate	10	80	20	179	29	9069	318	3	18	192	67	1631	11667	46607	25,0 %
Business services	96	1763	968	2097	632	718	8340	59	261	2229	711	22416	41266	131197	31,5 %
R&D institutes	14	56	7	30	10	4	54	552	94	156	22	1022	2044	7612	26,9 %
Higher education institutions	17	120	21	129	24	18	153	102	2070	1060	171	5276	9284	18823	49,3 %
Public adm. And defence. Health and social work	294	1475	432	1982	428	213	2084	182	754	54569	1474	63242	133266	427746	31,2 %
Other non-public services	93	476	256	717	180	81	615	23	135	1280	3519	12018	19925	79988	24,9 %
Out of active workforce	18292	34079	17166	32905	11867	4581	18537	995	3496	51976	11805	0	225975	241727	93,5 %
Nace unknown	288	392	327	563	259	38	535	14	1134	4898	326	19348	28143	22379	125,8 %
N persons moving (=100 %)	21799	68188	29190	63627	27432	15444	36494	2134	8502	120891	20328	241727			
N persons employed	148348	383967	115457	276019	142735	51813	146496	9087	23326	479263	92287	241727			
Mobility rate out	14,7 %	17,8 %	25,3 %	23,1 %	19,2 %	29,8 %	24,9 %	23,5 %	36,4 %	25,2 %	22,0 %	100,0 %			

Table A23. Basic data for figure 4.11 and table 4.7. Mobility of employees with higher education by delivering and receiving sectors. Number of employees. Sweden 1995-96.

Delivering sectors (1994) → **↓ Receiving sectors (1995)**	**Primary sectors. mining. Oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence. health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	44	35	5	16	2	8	41	2	7	105	30	163	475	1867	25.4 %
Manufacturing	45	3437	132	716	172	94	1356	314	421	753	182	3008	10750	47715	22.5 %
Utilities and construction	7	105	161	51	30	11	268	11	27	217	21	397	1328	7500	17.7 %
Trade. hotels. Restaurants	13	609	116	1274	101	91	738	54	81	593	137	1893	5822	21758	26.8 %
Transport. Storage. Communication	9	177	26	169	474	70	373	95	34	245	70	874	2657	12819	20.7 %
Financial services. Real estate	2	79	13	106	40	663	445	9	32	196	25	539	2179	12962	16.8 %
Business services	60	1445	310	1020	377	509	2904	166	406	2037	345	3831	13756	56365	24.4 %
R&D institutes	0	194	14	44	18	13	122	185	1405	148	33	342	2527	6457	39.1 %
Higher education institutions	15	149	12	80	25	34	222	165	1035	1520	197	1744	5256	27029	19.4 %
Public adm. And defence. Health and social work	86	478	237	752	275	242	1415	105	1128	13030	1181	12048	31472	263358	12.0 %
Other non-public services	53	164	29	147	76	51	466	17	191	1316	1000	1673	5407	25334	21.3 %
Out of active workforce	133	1867	323	1513	725	479	2691	197	1274	10874	1592		22220	22220	
Nace unknown	27	108	49	118	62	41	338	16	124	4766	268	1718	7635	10032	76.1 %
N persons moving (=100 %)	494	8847	1427	6006	2377	2306	11379	1336	6165	35800	5081	28230			
N persons employed	1886	45812	7599	21942	12539	13089	53988	5266	27938	267686	25008	28230			
Mobility rate out	26.2 %	19.3 %	18.8 %	27.4 %	19.0 %	17.6 %	21.1 %	25.4 %	22.1 %	13.4 %	20.3 %	100.0 %			

Table A24. Basic data for figure 4.12 and table 4.8. Mobility of employees with higher education by delivering and receiving sectors. Number of employees. Norway 1995-96.

Delivering sectors (1995) → **Highly educated/norw** **↓ Receiving sectors (1996)**	**Primary sectors. mining. Oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence. health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	345	50	11	40	9	7	91	33	22	99	12	224	963	5977	16,1 %
Manufacturing	47	1242	88	234	61	32	346	50	90	333	56	896	3551	15911	22,3 %
Utilities and construction	6	60	273	53	24	15	109	9	10	160	21	274	1050	5181	20,3 %
Trade. hotels. Restaurants	249	235	43	981	79	35	361	32	32	509	52	958	3655	13127	27,8 %
Transport. Storage. Communication	38	122	19	95	423	18	213	6	9	174	18	429	1580	6280	25,2 %
Financial services. Real estate	7	23	12	58	20	308	116	14	21	85	12	226	930	6050	15,4 %
Business services	75	390	113	507	150	142	1909	179	98	700	115	1814	6355	23669	26,8 %
R&D institutes	12	20	3	17	7	4	38	145	82	116	19	227	710	5110	13,9 %
Higher education institutions	7	35	6	38	17	15	55	152	482	671	59	772	2318	11781	19,7 %
Public adm. And defence. Health and social work	87	135	113	426	173	52	449	120	423	14999	394	7678	25165	160168	15,7 %
Other non-public services	6	42	12	55	24	10	91	12	60	442	384	641	1804	8663	20,8 %
Out of active workforce	372	858	259	886	382	321	1399	279	819	8635	597	50923	65949	65949	200,0 %
Nace unknown	7	20	6	22	12	13	55	7	7	85	9	169	438	1968	22,3 %
N persons moving (=100 %)	1258	3232	958	3412	1381	972	5232	1038	2155	27008	1748	65231			
N persons employed	6272	15592	5089	12884	6081	6092	22546	5438	11618	162011	8607	65231			
Mobility rate out	20,1 %	20,7 %	18,8 %	26,5 %	22,7 %	16,0 %	23,2 %	19,1 %	18,5 %	16,7 %	20,3 %	100,0 %			

Table A25. Basic data for figure 4.13 and table 4.9. Mobility of employees with higher education by delivering and receiving sectors. Number of employees. Finland 1995-96.

Delivering sectors (1994) → **Highly educated** **↓ Receiving sectors (1995)**	**Primary sectors. mining. Oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. and defence. health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	53	20	3	15	2	3	22	12	5	28	14	194	377	2211	17.1 %
Manufacturing	18	3378	79	329	52	56	498	77	231	339	131	2840	8061	23576	34.2 %
Utilities and construction	1	87	238	20	14	6	88	4	6	25	7	379	888	2924	30.4 %
Trade. hotels. Restaurants	11	351	19	1057	35	38	191	11	41	148	64	1351	3357	11992	28.0 %
Transport. Storage. Communication	3	83	7	62	456	18	86	3	7	56	16	436	1244	4588	27.1 %
Financial services. Real estate	0	31	3	19	2	1576	102	2	9	93	18	227	2087	6599	31.6 %
Business services	14	351	70	202	54	184	1779	37	141	401	109	2347	5777	20812	27.8 %
R&D institutes	2	26	1	7	1	4	24	305	71	84	8	256	794	3625	21.9 %
Higher education institutions	4	53	7	41	3	12	62	66	1493	800	100	2094	4787	11508	41.6 %
Public adm. And defence. Health and social work	21	302	38	183	39	69	349	57	493	18311	364	7329	28582	100638	28.4 %
Other non-public services	9	64	4	35	15	24	79	8				946	1184	11687	10.1 %
Out of active workforce	175	1175	212	808	268	424	1312	192	1138	4688	1355	0	12229	19300	63.4 %
NACE unknown	1	23	9	35	14	2	51	4	221	961	214	901			
N persons moving (=100 %)	312	5944	690	2813	955	2416	4643	778	4327	27251	2447	19300			
N persons employed	2374	24395	3073	12838	4556	7012	21931	3830	13098	106511	12957	19300			
Mobility rate out	13.1 %	24.4 %	22.5 %	21.9 %	21.0 %	34.5 %	21.2 %	20.3 %	33.0 %	25.6 %	18.9 %	100.0 %			

Table A26. Basic data for figure 4.14 and table 4.13. Mobility of employees with higher education within natural sciences and engineering by delivering and receiving sectors. Number of employees. Sweden 1994-95.

Delivering sectors (1994) → **↓ Receiving sectors (1995)**	**Primary sectors. mining. Oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. And defence. health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	6	14	5	4	1	0	15	2	3	5	2	39	99	484	20.5 %
Manufacturing	12	2124	84	286	87	29	809	266	323	200	40	1585	5880	28216	20.8 %
Utilities and construction	3	67	94	18	7	1	144	11	23	82	8	236	700	4573	15.3 %
Trade. Hotels. Restaurants	4	266	54	238	15	15	209	32	35	52	12	398	1346	5210	25.8 %
Transport. Storage. Communication	2	88	10	41	41	4	92	73	17	33	3	148	558	2594	21.5 %
Financial services. Real estate	0	16	2	15	1	45	45	4	9	13	2	45	200	1070	18.7 %
Business services	30	893	174	361	89	72	1043	114	259	379	48	1297	4849	21182	22.9 %
R&D institutes	0	153	11	25	14	3	86	71	1184	30	7	241	1828	4674	39.1 %
Higher education institutions	7	79	7	19	8	5	78	73	339	131	29	743	1530	9940	15.4 %
Public adm. And defence. Health and social work	8	76	70	60	20	7	202	32	150	497	39	746	1922	10917	17.6 %
Other non-public services	3	16	15	8	3	6	57	4	23	63	32	110	354	1334	26.5 %
Out of active workforce	30	866	180	315	109	46	883	117	573	657	101		4001	4001	100.0 %
Nace unknown	3	22	12	19	5	2	73	6	19	258	14	276	709	1014	69.9 %
N persons moving (=100 %)	108	4680	718	1409	400	235	3736	805	2957	2400	337	5864			
N persons employed	493	27016	4591	5273	2436	1105	20069	3651	11367	11395	1317	5864			
Mobility rate out	21.9 %	17.3 %	15.6 %	26.7 %	16.4 %	21.3 %	18.6 %	22.0 %	26.0 %	21.1 %	25.6 %	100.0 %			

Table A27. Basic data for figure 4.15 and table 4.14. Mobility of employees with higher education within natural sciences and engineering by delivering and receiving sectors. Number of employees. Norway 1995-96.

Delivering sectors (1995) → **↓ Receiving sectors (1996)**	**Primary sectors. mining. Oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. And defence. health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	264	32	7	18	5		58	29	15	20	4	118	585	3950	14,8 %
Manufacturing	34	849	70	113	35	6	227	37	62	96	12	473	2054	9334	22,0 %
Utilities and construction	4	37	207	40	15	2	77	7	9	67	13	185	688	3749	18,4 %
Trade. Hotels. Restaurants	201	114	28	305	29	8	147	19	16	76	10	310	1289	4532	28,4 %
Transport. Storage. Communication	30	89	16	27	199	5	117	3	5	35	6	140	680	2646	25,7 %
Financial services. Real estate	3	2	1	11	5	30	24	5	9	7		41	141	779	18,1 %
Business services	52	252	92	260	85	31	1068	154	52	213	29	773	3133	12553	25,0 %
R&D institutes	6	15	3	8	4		31	79	42	31	3	118	341	3220	10,6 %
Higher education institutions	7	24	2	16	6	3	28	89	151	96	7	294	727	3940	18,5 %
Public adm. And defence. Health & soc. work	17	29	57	49	27	5	127	36	79	690	27	678	1835	11614	15,8 %
Other non-public services		6	5	8	10	1	18	7	8	25	30	77	197	935	21,1 %
Out of active workforce	219	440	185	241	122	32	579	151	324	598	60	9596	12606	12606	100,0 %
Nace unknown	4	8	4	11	1	1	23	6	1	8		24	93	745	12,5 %
N persons moving (=100 %)	841	1897	677	1107	543	124	2524	622	773	1962	201	12827			
N persons employed	4206	9177	3738	4350	2509	762	11944	3501	3986	11741	939	12827			
Mobility rate out	20,0 %	20,7 %	18,1 %	25,4 %	21,6 %	16,3 %	21,1 %	17,8 %	19,4 %	16,7 %	21,4 %	100,0 %			

Table A28. Basic data for figure 4.16 and table 4.15. Mobility of employees with higher education within natural sciences and engineering by delivering and receiving sectors. Number of employees. Finland 1994-95.

Delivering sectors → **↓ Receiving sectors (1995)**	**Primary sectors. mining. Oil**	**Manufacturing**	**Utilities and construction**	**Trade. hotels. restaurants**	**Transport. storage. communication**	**Financial services. real estate**	**Business services**	**R&D institutes**	**Higher education institutions**	**Public adm. And defence. health and social work**	**Other non-public services**	**From Outside active workforce**	**N persons moving**	**N persons employed**	**Mobility rate in**
Primary sectors. Mining. Oil	14	9	2	4	1	0	11	9	1	6	3	104	167	452	36,9 %
Manufacturing	8	2188	60	138	27	21	332	70	189	180	50	2924	6202	14721	42,1 %
Utilities and construction	0	60	153	13	10	2	67	3	4	10	6	412	750	2221	33,8 %
Trade. Hotels. Restaurants	1	184	15	195	13	6	84	8	15	25	11	555	1122	2995	37,5 %
Transport. Storage. Communication	3	22	5	28	87	6	34	3	3	13	4	223	435	1419	30,7 %
Financial services. Real estate	0	5	0	5	0	157	26	0	3	16	3	44	259	967	26,8 %
Business services	7	215	57	81	17	64	734	31	105	119	28	1644	3141	10093	31,1 %
R&D institutes	2	23	1	3	0	0	19	192	50	29	2	225	549	2534	21,7 %
Higher education institutions	1	34	6	11	2	2	37	38	630	98	11	1287	2171	4602	47,2 %
Public adm. And defence. Health and social work	5	136	17	28	10	6	124	20	110	1852	32	1122	3554	13076	27,2 %
Other non-public services	2	17	2	7	4	3	20	2	9	30	39	140	279	1100	25,4 %
Out of active workforce	46	602	160	168	74	37	643	114	484	662	80	0	3231	8876	36,4 %
Nace unknown	1	11	6	7	5		25	3	137	147	4	196	542	509	106,5%
N persons moving (=100 %)	90	3506	484	688	250	304	2156	493	1740	3187	273	8876			
N persons employed	496	14968	2324	3158	1336	1045	10865	2677	5466	13810	1248	8876			
Mobility rate out	18,1 %	23,4 %	20,8 %	21,8 %	18,7 %	29,1 %	19,8 %	18,4 %	31,8 %	23,1 %	21,9 %	100,0 %			

STEP rapporter / reports

ISSN 0804-8185

1994

1/94
Keith Smith
New directions in research and technology policy: Identifying the key issues

2/94
Svein Olav Nås og Vemund Riiser
FoU i norsk næringsliv 1985-1991

3/94
Erik S. Reinert
Competitiveness and its predecessors – a 500-year cross-national perspective

4/94
Svein Olav Nås, Tore Sandven og Keith Smith
Innovasjon og ny teknologi i norsk industri: En oversikt

5/94
Anders Ekeland
Forskermobilitet i næringslivet i 1992

6/94
Heidi Wiig og Anders Ekeland
Naturviternes kontakt med andre sektorer i samfunnet

7/94
Svein Olav Nås
Forsknings- og teknologisamarbeid i norsk industri

8/94
Heidi Wiig og Anders Ekeland
Forskermobilitet i instituttsektoren i 1992

9/94
Johan Hauknes
Modelling the mobility of researchers

10/94
Keith Smith
Interactions in knowledge systems: Foundations, policy implications and empirical methods

11/94
Erik S. Reinert
Tjenestesektoren i det økonomiske helhetsbildet

12/94
Erik S. Reinert and Vemund Riiser
Recent trends in economic theory – implications for development geography

13/94
Johan Hauknes
Tjenesteytende næringer – økonomi og teknologi

14/94
Johan Hauknes
Teknologipolitikk i det norske statsbudsjettet

15/94
Erik S. Reinert
A Schumpeterian theory of underdevelopment – a contradiction in terms?

16/94
Tore Sandven
Understanding R&D performance: A note on a new OECD indicator

17/94
Olav Wicken
Norsk fiskeriteknologi – politiske mål i møte med regionale kulturer

18/94
Bjørn Asheim
Regionale innovasjonssystem: Teknologipolitikk som regionalpolitikk

19/94
Erik S. Reinert
Hvorfor er økonomisk vekst geografisk ujevnt fordelt?

20/94
William Lazonick
Creating and extracting value: Corporate investment behaviour and economic performance

21/94
Olav Wicken
Entreprenørskap i Møre og Romsdal. Et historisk perspektiv

22/94
Espen Dietrichs og Keith Smith
Fiskerinæringens teknologi og dens regionale forankring

23/94
William Lazonick and Mary O'Sullivan
Skill formation in wealthy nations: Organizational evolution and economic consequences

1995

1/95
Heidi Wiig and Michelle Wood
What comprises a regional innovation system? An empirical study

2/95
Espen Dietrichs
Adopting a 'high-tech' policy in a 'low-tech' industry. The case of aquaculture

3/95
Bjørn Asheim
Industrial Districts as 'learning regions'. A condition for prosperity

4/95
Arne Isaksen
Mot en regional innovasjonspolitikk for Norge

1996

1/96
Arne Isaksen m. fl.
Nyskapning og teknologiutvikling i Nord-Norge. Evaluering av NT programmet

2/96
Svein Olav Nås
How innovative is Norwegian industry? An international comparison

3/96
Arne Isaksen
Location and innovation. Geographical variations in innovative activity in Norwegian manufacturing industry

4/96
Tore Sandven
Typologies of innovation in small and medium sized enterprises in Norway

5/96
Tore Sandven
Innovation outputs in the Norwegian economy: How innovative are small firms and medium sized enterprises in Norway

6/96
Johan Hauknes and Ian Miles
Services in European Innovation Systems: A review of issues

7/96
Johan Hauknes
Innovation in the Service Economy

8/96
Terje Nord og Trond Einar Pedersen
Endring i telekommunikasjon - utfordringer for Norge

9/96
Heidi Wiig
An empirical study of the innovation system in Finmark

10/96
Tore Sandven
Technology acquisition by SME's in Norway

11/96
Mette Christiansen, Kim Møller Jørgensen and Keith Smith
Innovation Policies for SMEs in Norway

12/96
Eva Næss Karlsen, Keith Smith and Nils Henrik Solum
Design and Innovation in Norwegian Industry

13/96
Bjørn T. Asheim and Arne Isaksen
Location, agglomeration and innovation: Towards regional innovation systems in Norway?

14/96
William Lazonick and Mary O'Sullivan
Sustained Economic Development

15/96
Eric Iversen og Trond Einar Pedersen
Postens stilling i det globale informasjonsamfunnet: et eksplorativt studium

16/96
Arne Isaksen
Regional Clusters and Competitiveness: the Norwegian Case

1997

1/97
Svein Olav Nås and Ari Leppãlahti
Innovation, firm profitability and growth

2/97
Arne Isaksen and Keith Smith
Innovation policies for SMEs in Norway: Analytical framework and policy options

3/97
Arne Isaksen
Regional innovasjon: En ny strategi i tiltaksarbeid og regionalpolitikk

4/97
Errko Autio, Espen Dietrichs, Karl Führer and Keith Smith
Innovation Activities in Pulp, Paper and Paper Products in Europe

5/97
Rinaldo Evangelista, Tore Sandven, Georgio Sirilli and Keith Smith
Innovation Expenditures in European Industry

1998

R-01/1998
Arne Isaksen
Regionalisation and regional clusters as development strategies in a global economy

R-02/1998
Heidi Wiig and Arne Isaksen
Innovation in ultra-peripheral regions: The case of Finnmark and rural areas in Norway

R-03/1998
William Lazonick and Mary O'Sullivan
Corporate Governance and the Innovative Economy: Policy implications

R-04/1998
Rajneesh Narula
Strategic technology alliances by European firms since 1980: questioning integration?

R-05/1998
Rajneesh Narula
Innovation through strategic alliances: moving towards international partnerships and contractual agreements

R-06/1998
Svein Olav Nås et al.
Formal competencies in the innovation systems of the Nordic countries: An analysis based on register data

Storgaten 1, N-0155 Oslo, Norway
Telephone +47 2247 7310
Fax: +47 2242 9533
Web: http://www.sol.no/step/

STEP group

STEP-gruppen ble etablert i 1991 for å forsyne beslutningstakere med forskning knyttet til alle sider ved innovasjon og teknologisk endring, med særlig vekt på forholdet mellom innovasjon, økonomisk vekst og de samfunnsmessige omgivelser. Basis for gruppens arbeid er erkjennelsen av at utviklingen innen vitenskap og teknologi er fundamental for økonomisk vekst. Det gjenstår likevel mange uløste problemer omkring hvordan prosessen med vitenskapelig og teknologisk endring forløper, og hvordan denne prosessen får samfunnsmessige og økonomiske konsekvenser. Forståelse av denne prosessen er av stor betydning for utformingen og iverksettelsen av forsknings-, teknologi- og innovasjonspolitikken. Forskningen i STEP-gruppen er derfor sentrert omkring historiske, økonomiske, sosiologiske og organisatoriske spørsmål som er relevante for de brede feltene innovasjonspolitikk og økonomisk vekst.

The STEP-group was established in 1991 to support policy-makers with research on all aspects of innovation and technological change, with particular emphasis on the relationships between innovation, economic growth and the social context. The basis of the group's work is the recognition that science, technology and innovation are fundamental to economic growth; yet there remain many unresolved problems about how the processes of scientific and technological change actually occur, and about how they have social and economic impacts. Resolving such problems is central to the formation and implementation of science, technology and innovation policy. The research of the STEP group centres on historical, economic, social and organisational issues relevant for broad fields of innovation policy and economic growth.