Summary Report of the Focus Group on Mobility of Human Resources in Nordic countries [1]

Svein Olav Nås and Anders Ekeland, STEP group, Norway
Christian Svanfeldt, NUTEK, Sweden
Mikael Åkerblom, Statistics Finland

Introduction

Indicators that involve human resources 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. In this chapter the results from the work of the focus group on skills and mobility of human resources is presented. The focus of the analysis is to investigate 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 R&D expenditures, the methodology allows for tracking of knowledge flows within the innovation systems. So far, however, such additional information has not been utilised.

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; various types of networks; 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. One should be aware therefore that this approach to mapping nodes and links in national innovation systems covers only one among many different aspects, which together constitutes the system. The patterns emerging from the study of human resources must be seen in conjunction with the other approaches presented in this book. In particular we will argue for the need to combine labour mobility data with other sources of information regarding knowledge creation and use, such as R&D statistics, innovation surveys and indicators for more embodied knowledge flows like investments in machinery and equipment.

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 whith many simililarities such as the Nordic countires. 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 comparative picture of the Nordic countries. At an overall level we find the same main structures in all three countries, but there naturally are also clear differences on a more detailed

[1] For full details of the work and results, see: Svein Olav Nås et al.: Formal cometencies in the innovation systems of the Nordic countries: An analysis based on register data. STEP report R-06/98. The report is available from the internet address http://www.sol.no/step/.

level. The chapter is organised as follows: Firstly we present some of the methodological problems and choices involved, including experiences from previous work. Secondly we present the main results from the analyses, and thirdly we highlight some of the policy issues brought forward by the work.

Previous work and methodological issues

This approach to establishing links in national innovation systems is a new one. Even though the importance of humans as vehicles for transferring knowledge has been recognised for a long time[2], suitable data - that is register data - has not been available until recently[3]. There have been carried out various studies in the fields of social mobility and labour marked studies that are partially relevant. But most of these studies have been based on specialised surveys. Consequently there are not much previous research to draw upon in this work..

Mobility of personnel to and from the research institute sector have been studied in Norway.[4] The mobility rates found were in the range of 6 – 8 %, i.e. considerably lower than the rates found in this study using register data. There are various plausible reasons for this discrepancy like different collection methods etc., which we will not go into here.

Recent work using the same register data in Norway shows 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.[5] Stock data also shows that the educational level in business services is on par with the public sector. A study of the employment of natural scientists and engineers in industry in Sweden 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-manufacturing sectors. [6] The same study concluded that PhD mobility seemed like a weak mechanism of knowledge transfer, at least in the period of 1990-1993. Another Swedish study 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.[7]

In Denmark there have been carried out studies of job creation and destruction that used some very interesting methods adressing problems related to "business demography" when using register data.

---

[2] This have been emphasised by many of the most influential writers on the issue of national innovation systems and related topics. See for instance Edquist, Charles (ed.): **Systems of innovation. Technologies, institutions and organizations**. Pinter, London and Washington 1997. Freeman, C. (1995), The 'National System of Innovation' in historical perspective. Cambridge Journal of Economics, Vol. 19: 5-24. Lundvall, Bengt-Åke (ed.): **National systems of innovation. Towards a theory of innovation and interactive learning**. Pinter Publishers, London 1992. Nelson, Richard (ed.): **National innovation systems. A comparative analysis**. Oxford University Press, New York, Oxford 1993. Nelson, Richard R. and Sydney Winter: **An evolutionary theory of economic change**. Harvard University Press, Cambridge, Massachusetts and London 1982. OECD (1992): **Technology and the economy: The key relationships**. OECD, Paris 1992.

[3] For an overview of data and related studies see: Mikael Rosengren, "An Inventory of National Priorities and Availability of data in OECD Countries to Quantify Science and Technology Personell Mobility Patterns"

[4] Results are documented in a series of STEP reports: Heidi Wiig og Vemund Riiser: "Forskermobilitet i instituttsektoren 1991" (11/92) [Researcher mobility in the Norwegian institute sector 1991], Heidi Wiig og Anders Ekeland, "Forskermobilitet i instituttsektoren i 1992" (8/94). The latter contains comparisons with similar studies in other countries. There was also studies of mobility of university personell: Heidi Wiig og Anders Ekeland, "Naturviternes kontakt med andre sektorer i samfunnet" (6/94) [Mobility of natural scientists in Norway]; As a part of this research there was written a theoretical paper: Johan Hauknes, "Modelling mobility of researchers" (9/94) exploring the use of various mathematical models in light of some empirical regularities. The Norwegian Institute for Studies of Research and Education (NIFU), as for many years collected data and conducted studies, but mainly on mobility between the different parts of the research system.

[5] Nås, Svein Olav, Ekeland, Anders & Hauknes, Johan [1998]: "Formell kompetanse i norsk arbeidsliv 1986-1994" [Formal competencies in Norwegian labour markets 1986-1994]. *STEP Working paper A-05 1998.*

[6] 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.

[7] Euro QSE

Similiar techniques are now explored in other countries[8]. Business demography is one of the main methodological challenges for mobility and knowledge transfer studies.

A basic assumption underlying our work is that mobility of personnel between organisations or institutions indicates that there is also a knowledge transfer taking place. This is of course true to a varying degree. It depends – among other things - upon each person's ability and opportunity to learn from the organisation where he or she is employed. We expect that to depend upon the length of the employment and the education of the person – variables that are available for the analysis. In addition the exact position or occupation in the organisation will influence the learning that is taking place. Such information is, however, not available at present.

Several choices have had to be made regarding the level of detail, population, years studied, and what constitutes labour mobility. Firstly, 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 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 (NIS). 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. In addition come 9 industrial or public sectors.[9]

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. In follow up work the stability of mobility rates over time will be one of the main issues.

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 is has great advantages as a knowledge-indicator on a large scale, since indicators of other forms of knowledge would demand very elaborate means of data collection/collation. An altentive might be occupational classification, but not all OECD countries collect such data, and the classication differs[10]. Although highest achieved formal education has its clear limitations as a knowledge indicator, it is probably the best we have so far. 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. But one could use a combined indicator of education and characteristics of a person's occupational career.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 thery are only possible on a very basic level. Our work shows that even when comparing three countries that are so similar in many respects, there is work to be done to make comparisons analytical meaningfull. It is a limitation to our approach that we have not yet been able to take international mobility into account, not even between the Nordic

[8] For an overview see Per Vejrup Hansen, "Virksomhedsdemografi: overlevelse og vekst i nye virksomheder" [Business demography, survival and growht in new firms], Samfundsøkonomen 2, 1993

[9] The breakdown of sectors is important for how mobility patterns and –rates come out. In the main report 42 sectors are used at the most disaggregated level.

[10] See Peter Elias, "Occupational classification (ISCO-88): Concepts, method, reliability, validity and cross-national comparability", Labour marked and social policy – Occasional papers No 20, OECD, avialable on OLIS

countries[11]. This includes both permanent mobility between countries, and temporary exchange of personnel.

Mobility rates

Mobility of employees 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 (table 1). 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.

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 if everybody had the same propensity to change job. But, as we all know, there are large individual and group differences. There are "stayers" and "movers". In addition an important cause of mobility is 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 their identity number in the registers upon which we base our definition of mobility. To what extent this is "real" mobility depends on the definition of the "birth" and "death" of a firm, i.e on business demography.

Table 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.

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

[11] Although the Nordic countries has tried to make an inter-nordic labour marked there are various formal and practical obstacles still to be overcome. For an overview see Johan Roos: "Hinder för Nordisk forskarmobilitet" [Obstacles for inter-Nordic researcher mobility], Tema Nord, 1994:526

lot of knowledge is necessarily lost. Finding the correct balance between these two tendencies is a major challenge in human resource management in the firm. 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 (table 1)[12]. There are broad similarities on this aggregated level, but also many differences yet to be explained f.i. the variations between "narrow'' and "wide" mobility between fields of study and countries. Bringing in one extra year allow 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 (figure 1). 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 %.

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 2 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.

[12] Finland has to a certain degree corrected for "false" mobility. If a majority of the employees in an establishment in year T has changed employer collectivly in year T+1, they have considered the change of employer identification number as an statistical artefact. Overall this lowers their mobility rate by 2-3 percetage points. But since we do not have a "benchmark practice" on how "births" and "deaths" of firms are handeled in the business registers of the Nordic countries it is hard to tell which rates are the most comparable ones. The uncorrected rates or the corrected.

Figure 1 Permanent and mobile employees broken down by type of mobility. Norway 1992-1994. Percent.

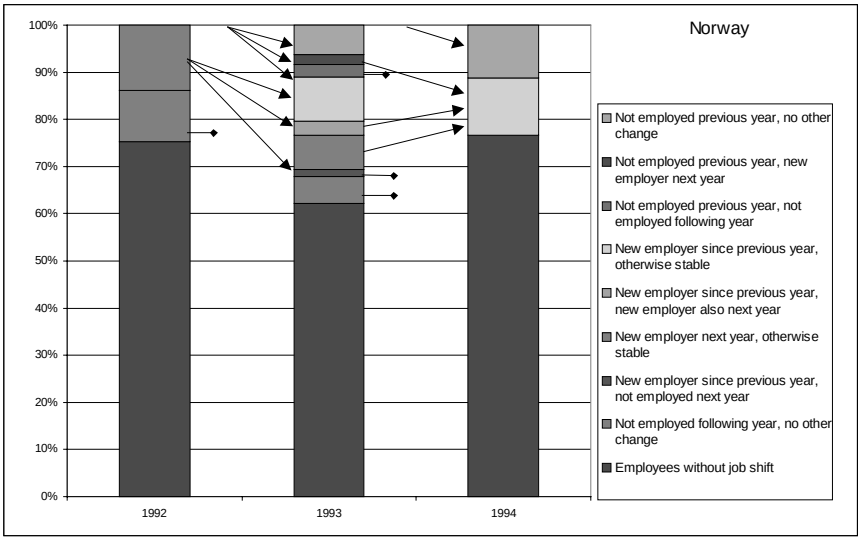
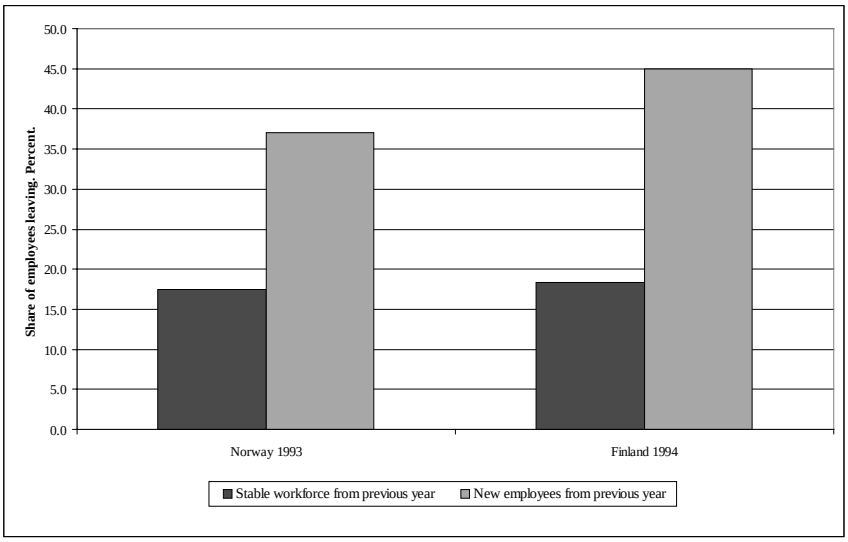


Figure 2. Mobility rates for "stable employees"(same employer previous year) and "new employees" (not same employer previous year), by country. Percent.



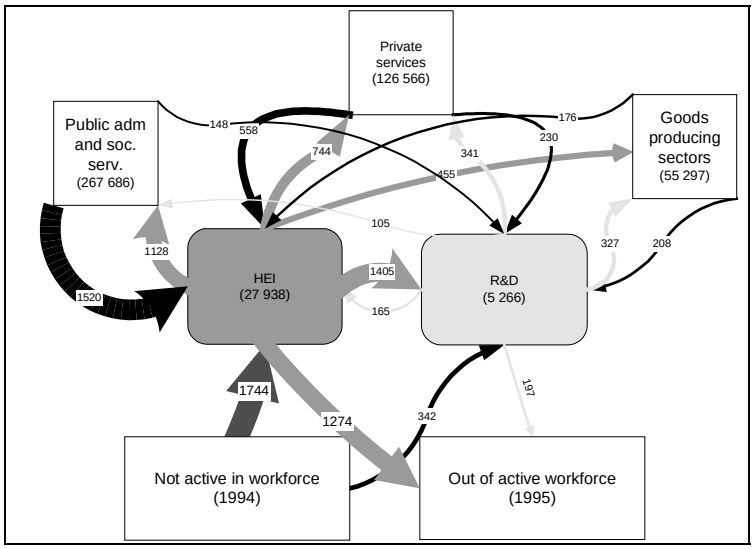
Sectoral flows

By bringing industrial and public sectors into the analysis it is possible to map knowledge flows in terms of labour mobility between the specified sectors. This is illustrated in figure 3 for higher educated personnel, where the presentation is focused around in- and outflows from two distinct types of NIS institutions; universities and other higher education, and research institutes. The patterns emerging show both similarities and differences between the countries. A more detailed breakdown for all the three countries are presented in table 2 below.

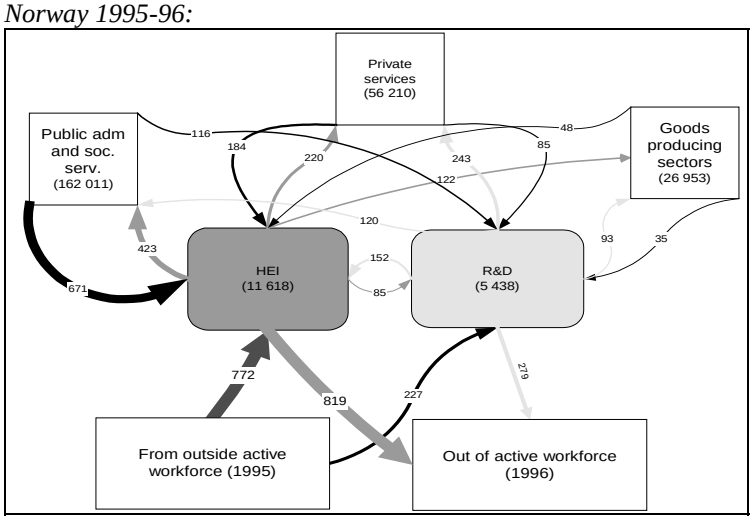
In the Swedish case, the basic pattern of mobility for personnel with higher education is very much the same as for the flow of all employees. Internal flows are important for all sectors. Flows concentrate around the higher education sector (HEI), due to its larger size compared to the R&D institutes. 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.

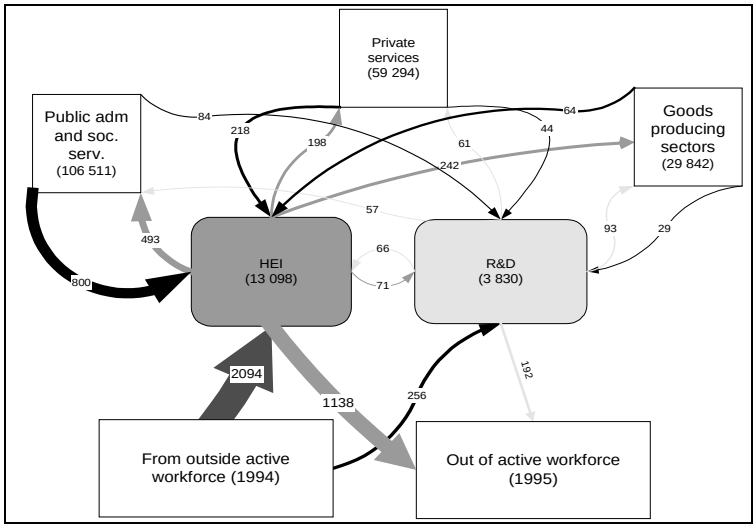
Figure 3. Mobility of employees with higher education by delivering and receiving sectors. Absolute numbers. Sweden 1994-95:



Norway 1995-96:



Finland 1994-95:



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 instituitions 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 larger part 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 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.

In the Norwegian case 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. Higher education institutions 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[13].

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.

[13] But the mobility in the HEI-sector is dependent on the classification of that sector . It is not obvious which organisational level that corresponds to "establishment" in this sector, and statistical practice is different in the different countries.

Table 2. Mobility of employees with higher education by delivering and receiving sectors

Delivering sectors (1994) → **Sweden** ↓ 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.

Delivering sectors (1995) → **Norway** ↓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.

Delivering sectors (1994) → **Finland** ↓ 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

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 – as expected - 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 %. Why this is so is not obvious. Our hypothesis is that this is because there are more temporary employees at the higher education institutions in terms of visiting scholars, assistants leaving to study abroad, to do military service etc. etc.

As for Sweden and Norway, the basic structure of mobility of higher educated personnel in Finland 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 %.

Policy issues and future work

The results of this study 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 future adjustments and corrections. 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. But the causes for job-shifts might be different. The higher educated might be seeking better pay and/or new challenges, whereas the influence of the business cycle (job creation and destruction) may be more important for other educational groups.

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 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.

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.

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.

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.

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.

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.

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, as 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 and Island.

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.