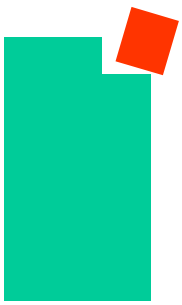
Svein Olav Nås, Tore Sandven, Tor Eriksson, Jan Andersson,
Björn Tegsjö, Olavi Lehtoranta and Markku Virtaharju

High-Tech Spin-Offs in the Nordic Countries

Main report



SINTEF

STEP REPORT 23-2003

TITLE

High-Tech Spin-Offs in the Nordic Countries
Main report

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CLIENT(S)
Nordic Industrial Fund

REPORT NO.	CLASSIFICATION	CLIENTS REF.	
STF38A03882		Project number 02010	
CLASS. THIS PAGE	ISBN	PROJECT NO.	NO. OF PAGES/APPENDICES
	82-14-03278-4	38811600	82
ELECTRONIC FILE CODE		PROJECT MANAGER (NAME, SIGN.)	CHECKED BY (NAME, SIGN.)
Spinoff_Final.doc		Svein Olav Nås	Nils Henrik Solum
FILE CODE	DATE	APPROVED BY (NAME, POSITION, SIGN.)	
	12.12.2003	Anders Ekeland, Research Director	

ABSTRACT

In this report we present the results from the project "High-tech spin-offs in the Nordic countries". The present report describes how it is possible to identify and classify changes in establishments and enterprises utilising administrative register data, and compares results across Sweden, Finland, Denmark and Norway. The work compares the occurrence of high-tech spin-off establishments with other new and existing firms, tracks their performance over time and tries to identify factors that seem to affect their performance.

The report is accompanied by two supplementary volumes, a Summary report and a Statistical annex. (STEP Reports 22-2003 and 24-2003). The annex includes detailed tables and breakdowns of the results in more detail than has been possible to include in the main report. It includes a brief sensitivity analysis for the methodology. The Summary report is intended to be a non-technical presentation of the approach, the main results and policy conclusions of the project.

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	Industrial Management	
GROUP 2	Innovation	
SELECTED BY AUTHOR	Spin-off, firm demography, high-tech	
	Industrial renewal	
	Researcher participation	

Foreword

The current project has its background in a request from the Nordic Industrial Fund (NI) to do a study on high-tech spin-offs. Having worked with the large datasets available in the Nordic countries matching employers and employees, I had an idea that it was possible to identify and classify spin-offs by tracking the background of the employees involved in new start-up firms. Such an approach would allow studying spin-offs within a much broader context than the common sample- and survey-based studies around. NI liked this idea and decided to support the project. The basic idea was coupled with ideas and experiences from earlier work in, in particular, Sweden and Finland that enriched and modified the original idea of the project. Valuable expertise was brought in also from Denmark. In sum it turned out to involve very interesting, but much work with many discussions and seemingly "endless" needs to recheck and rerun the data and analysis - an experience we have in common with much comparative work. Doing comparisons, on the other hand, always has a lot to give after all.

Reporting from the project is divided into a main report (the current volume), a statistical annex and a summary report. Within the research team responsibilities for writing up the texts have been as follows:
All tables according to agreed standards: Everybody
Main report:
Chapters 1, 2, 3, 4: Svein Olav Nås
Chapter 5.1 to 5.3: Jan Andersson and Björn Tegsjö
Chapter 5.4: Tore Sandven
Chapters 6 and 7: Tor Eriksson
Chapter 8: Svein Olav Nås
Over-all editing: Svein Olav Nås
Summary report: Svein Olav Nås

In addition to the above mentioned persons Olavi Lehtoranta and Markku Virtaharju have been our Finnish partners. In Sweden Gunnar Arvidson have helped compiling some of the figures, and in Norway Anders Ekeland has taken part in some meetings and discussions.

It has been an interesting and challenging work period with this project. I will take this opportunity to thank the partners for the cooperation and hope that we get a chance to carry on with this very promising approach.

We also had the great advantage of meeting with a reference group to discuss the contents and approach of the project. The group consisted of Richard B. Larsen, Danmarks Industri, Denmark Torsti Loikkanen, VTT, Finland and Paul Gunnar Larssen, SSB Norway We are grateful for the inputs and many good advices we were given. Unfortunately it has not been possible for us to follow all of them, and the reference group should not be held responsible for any of the results or conclusions presented in the final report.

Finally, and in particular, I would like to thank the Nordic Industrial Fund for financing the work, and hope that it meets at least some of their goals of contributing to developing a better Nordic innovation policy.

Oslo, 12.12.2003

Svein Olav Nås
Project leader

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Executive summary

Introduction

The project studies the creation and performance of new establishments and enterprises in the Nordic countries, utilising administrative register data compiled by the national statistical agencies on enterprises, establishments and employees. Among the many different aspects brought up during the study, the central theme concerns how one specific category of new establishments perform, namely those that can be identified as “high-tech spin-offs”.

Renewal is frequently pointed out as part of a solution to industrial challenges by policy makers. One question is, therefore, how much of the renewal that goes on within the frames of existing establishments and enterprises, and how important the newborn firms are in this process. In order for some kind of modernisation to take place, within this narrow category of changes, how large is the contribution of spin-offs that can be characterised as “high-tech”? Such quantitative comparisons have so far been difficult to carry out but have been assessed here utilising the register data.

Limited impact

A first point is that high-tech spin-offs in many respects seem to be a phenomenon of limited magnitude. The numbers of establishments involved and the numbers of employees in them are quite limited. The activity is to a large extent concentrated to particular parts of the business services industry, in many cases involving small consultancy firms that employ few others than the original members at the time of creation. In terms of industrial renewal this kind of change has very limited effect in quantitative terms, and other kinds of dynamics in the populations of business firms thus should be given greater attention. A more thorough analysis of the most influential types should be investigated utilising and building on the methodology presented here.

More spin-offs in high-tech

Spin-offs seem to be more important in some cases than others. In particular, spin-offs are more widespread in high-tech sectors than in other sectors, and they have a higher survival rate than other new start-ups.

Experience important for survival

Higher survival among spin-offs indicates that the experiences that the employees bring with them when spinning out are important, and more important in high-tech sectors than in other sectors. This could be an argument for considering how to foster spin-offs in the high-tech sectors if the goal is to expand the presence of such sectors in the economy.

Success factors hard to identify

It is difficult to identify the factors influencing the likeliness of success. In isolation this is an argument against getting involved with policy measures, simply because we have not sufficient knowledge about the decisive – or significant – factors. In particular the variables included that directly bears on policy, such as localisation and in particular being eligible for regional or structural support has no impact on the likeliness of success. Genuine uncertainty, omitted explanatory factors and limitations in the time horizon are considered main reasons for problems with explaining success factors.

Should low achievement be compensated?

Even if high-tech spin-offs are not found to be of any major importance so far, that does not necessarily imply that it should continue on the same track. One can contrary argue that the limited activity we have had so far accentuates the need to achieve better in this respect. A rational could be that high-tech spin-offs are presumed to be a mechanism for bringing advanced knowledge to use in new businesses. The present work has had no means of settling such an issue.

A functioning methodology

Methodologically the project has proven that spin-offs can be identified in a meaningful way by use of the matched employer-employee data. By use of reasonable criteria which we would argue resembles the basic idea of being a spin-off a substantial number of cases has been identified. The spin-offs are clearly distinguishable from other kinds of changes, and the relationship between the spin-offs and establishments with other kinds of changes, or with no observable change, seems to be rather robust both over time and between the countries.

Our definition of a spin-off requires, among other things, that a group of at least two persons move out from an existing establishment to create a new establishment/enterprise. We also require that it is not the whole of an existing establishment that is spun out, in which case we consider it a reorganisation of an existing establishment. This allows the integration of the study of corporate spin-offs with the study of research-based spin-offs, utilising the same criteria to identify the two kinds of cases, and thus to compare them. This is clearly different from the usual approaches where the two represent different strands in the literature, with huge variations in definitions within both.

1 Introduction

Spin-offs are often considered an important driving force in renewing industrial structures, as they add to or replace old establishments that decline or go out of business. In particular when combined with the birth of new firms that are considered "high-tech" in some sense, this process can be viewed as a process of modernising industry. Renewal is frequently pointed out as part of a solution to industrial challenges by policy makers. One question is, therefore, how much of the renewal that goes on within the frames of existing establishments and enterprises, and how important the newborn firms are in this process. To assess this, the size of the contribution from spin-off activities is important – compared to all the other kinds of restructuring that take place. And in order for some kind of modernisation to take place, within this narrow category of changes, how large is the contribution of spin-offs that can be characterised as "high-tech"? Such quantitative comparisons have so far been difficult to carry out.

In this report the creation and performance of new establishments and enterprises in the Nordic countries is studied utilising administrative register data compiled by the national statistical agencies on enterprises, establishments and employees. Among the many different aspects brought up during the study, the central theme concerns how one specific category of new establishments perform, namely those that can be identified as "high-tech spin-offs". Both of these concepts, "high-tech" and "spin-offs", can be given different interpretations as is the case in the vast but not very coherent literature – and they both need clarification. The details will be discussed below, but in order to give a rough idea, high-tech sectors are basically identified by industry codes giving special attention to the research sectors. Spin-offs are defined as all new establishments/ enterprises where the employees make up certain shares in the new and the old establishment.

Among the many problems connected to studying and defining what different kinds of spin-offs are, the problem of access to proper data is frequently pointed out (Callan, 2001). Usually only data that partially cover the business sector have been available and in many cases collected from different agencies responsible for supporting spin-off activities. Such data are difficult to use to evaluate the importance of the activity related to the total economy, and in particular to compare between countries. Comparisons add significantly to our ability to identify key factors that seem to be associated with the more successful performance of industrial renewal.

Another problem is to track the performance over time of spin-offs that might be identified. Varying definitions of spin-offs in each country make comparisons difficult. In this project the same kinds of register based information for all the participating countries are utilised, so that the definitions are as comparable as possible. With the access to detailed register data in the Nordic countries, covering all establishments and their employees over time, it is also possible to do a more thorough investigation into the contributions to industrial renewal from spin-offs than has been possible before.

Knowledge of the industrial dynamics that are reshaping existing structures and altering competitiveness and future opportunities is deficient and scattered, even if these are among the most important processes in modern economies. Previous work has focused the problems partially, either by focusing on spin-offs or high-growth firms basically using survey data (an overview is found in Callan 2001, see also Chamanski and Waagø) or by studying aggregate

changes in firm populations without distinguishing between different processes (for a good overview, see Spilling 2001).

Exceptions do exist where register data are utilised, but usually with a limited focus (see for instance Møen 2002 for an analysis of Norwegian data, several contributions from Delmar on Swedish results). A particularly important predecessor of our work that utilises labour tracking to classify firm demography in Sweden is found in Svanfeldt and Ullstrøm 2001. Important experiences with utilising tracking of personnel mobility to follow knowledge transfer between firms are found in Nås et al 2001. None of these, however, combines a classification of firm demographic changes (such as spin-offs) with time series that allows tracking of results for the different kinds of firms identified. As far as we know the method of identifying spin-offs by means of labour tracking has not been tried before, and this approach thus opens new opportunities for studying this kind of changes.

The report is organised as follows: Firstly, chapter 2 discusses the different steps and criteria used to identify and classify spin-offs utilising register data, and how to track their performance and put them into perspective by comparing with other kinds of changes that takes place. Next, in chapter 3, the difficult concept of "high-tech" is discussed, as it forms an important part of expectations to the ability of renewing industrial structures. In chapter 4 the first layer of results are presented, comparing different kinds of changes as identified utilising formal identification numbers for the classification. Within one of the 9 categories introduced in chapter 4, the method of labour tracking is utilised in chapter 5 to further specify different kinds of changes that take place. This is where spin-offs are identified and described. The chapter also includes the special case of new establishments where a researcher has participated in its foundation. Chapter 6 describes some aspects related to identifying measures for performance for the different classes of changes. A part of this is to capture the effect of the continuing restructuring of the firms also after the initial identification of them as spin-offs. The last analytical chapter 7 utilises the information brought forward in the former chapters to identify and analyse what seems to be the factors most strongly associated with success or failure. To do this simple logit regression techniques are utilised. Finally, in chapter 8, the main conclusions and possible policy implications are brought forward and discussed.

2 Identifying spin-offs by register data – the methodology

In most studies of spin-offs the approach to identify the relevant cases is based upon survey results or information from institutions or programmes that are concerned with promoting spin-offs. As a consequence of differences in approaches the results are often not very comparable between countries or institutions, even though in each case the responsible data collector is free to identify exactly those cases that are of interest by utilising all available supplementary information (Callan 2001). Against this background we pursue a different approach in this study, by developing precisely defined characteristics for spin-offs and other firm demographic changes on the basis of administrative registers. The result is more explicit and comparable categories, but at the cost of risking to miss the target in some cases. By statistical means it is not possible to open up for all cases that could be considered spin-offs, or other interesting categories of change. This cost is similar to that of all forms of standardisation. It leaves room for supplementary work to follow up on borderline cases. We will argue, however, that defining a core group of cases is a useful starting point also when doing more case oriented work.

In this chapter we present the basic methodology in some detail. Firstly the main characteristics of the data that we utilise are presented, explaining how they are combined to construct the different categories that are used. Next the key practice of labour tracking is explained, including the categories it allows the identification of. Lastly different problems of sector coverage, firm sizes and register quality is discussed.

2.1 Formal ID numbers

The initial step in identifying spin-offs and classifying the different kinds of changes in the population of enterprises and establishments involves utilising their formal identification numbers.[1] Changes in identification numbers are being used as the first filter to identify the interesting classes of changes in the population of establishments and enterprises.

On the basis of this information it is possible to distinguish 9 different categories of events (see Figure 2-1 and Table 2-1 below). In chapter 4 all of these are described and compared across the countries in order to give an overview of the broad picture of firm demographic changes. One of the 9 categories is later selected for further analysis, consisting of establishments that have a completely new establishment number and at the same time a new enterprise number. It is within this category ("new-in-new") we will identify the spin-offs that are in focus. The process is illustrated in Figure 2-1below.

[1] An enterprise is the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more localities. An enterprise may be a sole legal unit. It may consist of one or many establishments. An establishment is an enterprise or part of an enterprise that is situated in a single location and in which only a single (non-ancillary) productive activity is carried out or in which the principal productive activity accounts for most of the value added. Sometimes the terms "firm" or "company" are used when the distinction is not of any importance – "firm may therefore refer to either an establishment or an enterprise. By an employee is meant a person that is employed to work more than 50 % of his/her time for an identified employer (establishment and enterprise) on an annual basis at the time of observation.

Figure 2-1 Steps in identifying high-tech spin-offs

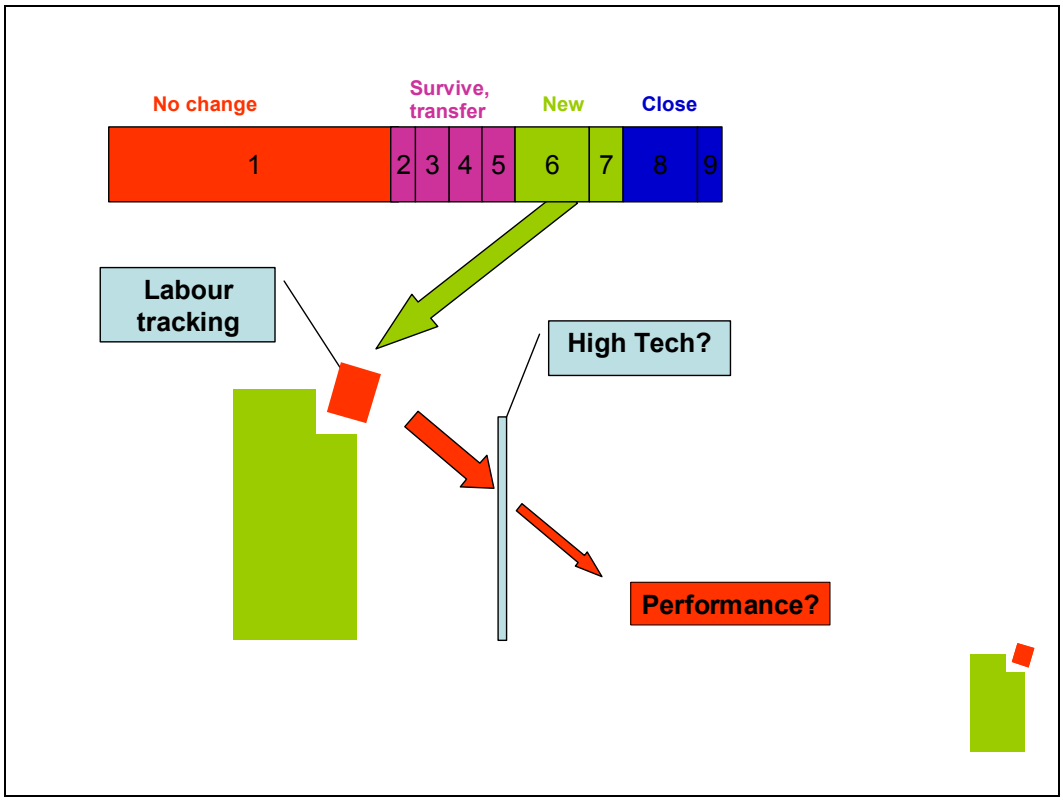


Table 2-1 Categories of change defined by ID numbers

Establishment:	No change	Survive but transferred				New		Close	
Delivering enterprise:	No change	Close	Close	Survive	Survive			Close	Survive
Receiving enterprise		New	Existing	Existing	New	**New**	Existing		
Change:	1	2	3	4	5	**6**	7	8	9
Label:	No Change	Trans-formation	Takeover	Move	Spin-out	New in New	New in Existing	Complete Closure	Closure in survivor

In the first phase only ID numbers are being utilised. There are two different ID numbers: One identifying the establishment (the smaller unit) and one identifying the enterprise that the establishment belongs to. In most cases there is only one establishment within each enterprise. When there are several establishments within one enterprise each is producing a different product or is localised in a separate geographical place. The enterprise level identifies the legal unit of the firm. In some of the countries even a group level identifier is available. Affiliation to a group is obviously of importance to innovation and structuring/restructuring of enterprises and establishments, and their relationships. Utilising this information is not a core part of the project but should be tested in future work.

Establishments are, with our approach, classified according to a comparison of two adjacent years. If there is no change in any of the ID numbers, that is they both exist both years for the same unit, we consider that nothing has happened (change category 1 in Figure 2-1). The establishment ID may also disappear between the years (a closure, change categories 8 and 9), or a new establishment ID number my occur indicating the establishment of a new firm (change categories 6 and 7). When bringing in the enterprise level, more combinations become possible. A closure may involve both the establishment and the enterprise it belongs to (category 8), but it is possible that the enterprise lives on even if one establishment goes out of

business (category 9). Establishments may also survive even if an enterprise ceases to exist, by being transferred to a new enterprise. Such transfers can be grouped into four different categories according to what happens to the delivering and receiving enterprises (change categories 2, 3, 4 or 5). We have termed these changes Transformations, Takeovers, Moves, and Spin-outs. The latter occurs when an existing establishment leaves an existing enterprise to form a new (different) enterprise, leaving the delivering enterprise alive. If the delivering enterprise closes down we consider the case to be a Transformation.

To the study of spin-offs we have chosen to focus on those firms that are new in terms of their ID numbers, both at the establishment level and the enterprise level. To be a spin-off we additionally require that personnel move out of their existing enterprise, to form a new enterprise as an independent operation (we take no account of ownership or control over the new enterprise). Please note that we have ruled out the Spin-out cases where whole existing establishments are moved out. A new firm may also be a new establishment within an existing enterprise, as an expansion of that enterprise's activity (change category 7). We do not consider that a spin-off candidate neither. That leaves us with the last category where both the ID number of the establishment and the ID number of the enterprise are new (change category 6 termed "new-in-new"). To determine what personnel is involved in the new enterprise we must utilise the labour tracking method.

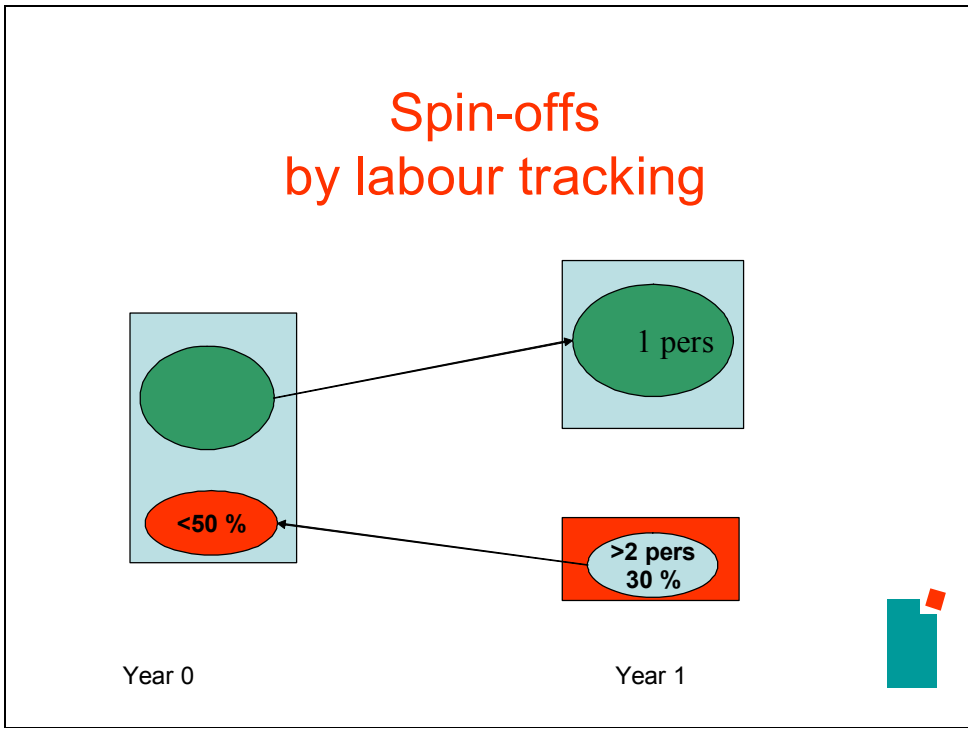
2.2 Labour tracking

Within the sub class of "new-in-new" (change category 6) there may be spin-offs, but other possibilities also exist. This is unknown to the observer at the time when a new enterprise/establishment is observed. In order to determine what has been going on it is necessary to bring in the employees. By tracking groups of employees back in time it is possible to create a link between the new firm and its "history" – see Figure 2-2 below for an illustration of the methodology. As an example, if all employees come from different enterprises, the new firm should be regarded as a Greenfield birth without any unique link to any particular delivering organisation. If, on the other hand, all or a major group of employees come from the same establishment, it could be considered a potential spin-off. Clearly some concrete rules are needed to differentiate between the different alternatives.

The rules used to distinguish spin-offs from other kinds of changes are the following:

1. The new unit (spin-off) must be a new establishment in a new enterprise
2. There must be at least 2 persons from the delivering establishment in the new establishment
3. The persons spinning off must make up at least 30 % of the employees in the new establishment year 1
4. The persons spinning off must be less than 50 % of the employment in the delivering establishment year 0
5. The delivering establishment must be alive with at least 1 employee year 1

Figure 2-2 Identifying spin-offs by labour tracking.



In addition to the core group of spin-offs we are studying it is necessary to identify particular classes of changes as a control group for comparisons. In particular those cases that are close to the border of being included as spin-offs should be separated and analysed. The cases to be considered include:

1. Greenfield births where no more than 1 employee comes from the same establishment
2. All other changes

The most important of these is the Greenfield birth category that is used as a basis for comparisons. The category of other changes is a residual that includes cases that fall between the extreme cases defined as Greenfields and Spin-offs. It may therefore contain cases that have much in common with the other two, and is the category that is affected when we vary the criteria – see part 2.4 on sensitivity below.

It should also be mentioned that checking for potential errors in the data is one of the aims when applying the labour tracking method. That is, errors according to our conception of a firm without any major changes, and not according to the formal status. The point is that ID numbers are allocated to the units according to somewhat differing practices in the countries under study.

The basic idea is to keep the ID of establishments as stable as possible, even if the unit is transferred to a new enterprise. Enterprises basically get new ID numbers when their legal status changes (see Grorud 2002 for a description of routines in the Norwegian case).

There exist new ID numbers where the activity they refer to is more or less unchanged. As an example we have found exactly the same persons working for an existing establishment year 0 as for an establishment with a new number year 1, on the same location and within the same industry. Such cases are clearly not spin-offs in our sense and should have kept their ID code. Since such cases occur, it is necessary to construct some rules for how to identify what we

consider to be errors. We have reclassified from being a new establishment to being a continuation in the cases where 80 % or more of the employees in the new establishment is found in another establishment the year before, or if 80 % or more of the employees in an existing establishment is found in a new establishment the following year.

With the particular focus on high-tech, special attention is given to identify start-ups with researcher participation. In such cases it is considered sufficient with 1 person participating. The method to identify the researchers rests on labour tracking. Researchers are defined as persons that have been employed in a research institute or a higher education institution the year before or over the previous three year period (alternative definitions). In addition it is required that the researcher has higher education in order to rule out the major part of ordinary job mobility among the more technical or administrative staff.

Ideally information on occupation would have helped in identifying the researchers, but such information is not available. Even if this method for identifying researchers no doubt is somewhat imperfect, the situation in the four countries is probably not very different so that comparisons would not be too much affected.

2.3 Sector coverage, firm types and micro firms

Having identified spin-offs and corrected for errors, it is necessary to apply the definitions of "high-tech" to isolate this class of spin-offs from the rest, as discussed in chapter 3. Again it is of interest to compare how important spin-off activity characterised as high-tech is compared to other kinds of spin-offs.

Some sectors are less well covered by the register data, or they are characterised by a mix of firm types that in practice makes the kinds of analyses we do here very difficult. This includes agriculture and to some extent forestry, where in some cases the unit is organised as an enterprise, in others as a self employed farmer. It turns out to be much turbulence in these sectors that is difficult to handle, as they influence the totals significantly. Since these industries are not in the core target group for high-tech spin-offs they have been left out of the study on the results side.[2]

In addition we have left out public administration and defence[3] as a target industry, since we are aiming at studying the dynamics in the business enterprise sector. However, public administration is kept as a potential supplier industry (from which new enterprises may spin off). Also in other industries publicly owned or operated firms or organisations can be found. In many of these cases it is difficult to leave them out because the ownership structure varies between similar units, and between the countries. Examples are schools and medical services. These are included in the study.

In subsequent chapters some results are presented according to industry. The grouping of industries is defined in Table 2-2.

[2] This includes NACE 01 and 02.
[3] NACE 75.

Table 2-2 NACE codes defining the industries in breakdowns by industry

Industry	NACE Code
Fishing	05
Mining etc	10+12+13+14
Oil and gas extraction	11
Food, beverages, tobacco	15+16
Textiles, leather	17+18+19
Wood and wood products	20
Pulp and paper	21
Printing and publishing	22
Chemicals and refining	23+24 (-244)
Pharmaceuticals	244
Rubber and plastic products	25
Mineral products (non-met)	26
Basic metals	27
Metal products	28
Machinery and equipment nec	29
Office m. radio, tele, instruments	30+32+33
Eelectrical machinery and app.	31
Transport equipment ex air tr.	34+35 (-353)
Air transport	353
Furniture and manuf nec	36
Recycling	37
Utilities (electricity, water, gas)	40+41
Construction	45
Trade, hotels, restaurants	50+51+52+55
Transport and postal services	60--63+641
Telecommunications	642
Financial services, real estate, renting of machinery	65--67+70+71
Computer and related activities	72
Research and development	73
Other business services	74
Education	80 (-803)
Higher education	803
Health	85
Other services, extraterr. org	90+
Unknown	

Another source of difficulty with the data involves the smaller units. Turbulence is particularly high among this group of firms, as many of them are rather short-lived Sometimes employment drops below the threshold of 0,5 employees so that it disappears and maybe later re-enters the registers. There may be arbitrary reasons for choosing different formal statuses for the firms, sometimes organised as firms with limited liability or personally owned firms, in other cases a similar activity is undertaken by a self employed person.

In practice our definition of a spin-off, utilising labour tracking and requiring at least two persons coming from the same supplier establishment, rules out the smaller establishments on the results side. In order to have comparable groups of firms also among all the other categories of change included in the study, we have chosen to leave out both the self employed and establishments with less than two persons employed. Apart from the fact that this is necessary in order to actually identify a spin-off, it also helps removing a lot of statistical noise that would have hampered the results and required a lot of resource demanding manual checking.

On the other hand we most certainly leave out interesting cases of both spin-offs and other forms of new firm formation when we leave out the self employed and the 1 person firms. In many cases such small scale activity may be the beginning of something that eventually grows

into a success. It may even be that it is a very common way of starting something new, even spinning off, to operate a small scale activity for a period to gain experience. With the present data and methodology such micro processes cannot be identified, so this kind of close-up study of the initial period of new firms must be left aside for future research.

However, micro firms will be captured by our methodology at the point when they start to grow. Most probably they will then be classified as a totally new firm, and not a spin-off. Therefore these cases may be a source of errors in the analysis.

Exceptions to the rule of leaving out the 1 person establishments include two cases.

The first involves firms with 2 or more employees year 1 but with only 1 employee year 0. These establishments will be recorded as new units if we do not take into consideration that they already exist year 0 with 1 employee. We have treated these cases as "no change" and left those 1-person establishments in the analysis.

The second exception involves the parallel problem of establishments with only 1 employee year 1, but with 2 or more employees year 0. Leaving those out in year 1 would result in a classification of them as closures, whereas we know they still exist but with a reduced size. We have chosen to leave also these firms in the category of no change.

As a result of the exceptions mentioned above, the numbers of units (establishments or employees) is not exactly the same when comparing year 1 from one pair of years to year 0 of the following pair of years. The difference is accounted for by establishments growing out of or declining into a size of 1 employee. In addition changes in employment in existing establishments will influence the comparability. This discrepancy is explainable and the inconvenience of such differences in numbers is outweighed by a better consistency of the analysis and less noise in the data.

Another case where 1 person start-ups are treated differently concerns new units where a researcher has participated in the start-up, as mentioned above. Start-ups with researchers involved are considered to be especially interesting as a form of potentially high-tech spin-off from the research sector. Since these cases are quite rare, and since there often seems to be a very modest size of such start-ups, at least the first years, justifies in our view to include them in the analysis as a special case.

In sum our basic population has been reduced with the following cases:
- Enterprises/establishments ruled by self-employed without any employees
- One-person establishments
- Establishments within the sector of public services
- Establishments within agriculture and forestry
- Establishments within non-profit sector

In addition comes some problems with the data in particular countries. In Finland the number of spin-offs is probably somewhat underestimated in relation to other countries. One reason for this is matching problem between the person-level data and the imputed (interpolated) establishment level data. Of this reason one should not put too much emphasis on the differences in levels, and rather focus differences in structures between the countries.

In the Norwegian case a particularly high number of new establishments are identified for the years 1995-1996. In 1995 a new system for ID numbers were put in place, and we suspect that

problems of capacity or other kinds of administrative problems have affected this number. We would therefore not put too much emphasis on this cohort.

2.4 Sensitivity

In order to investigate the sensitivity of our results from varying definitions we have included a separate analysis of the Norwegian data. The parameters are not chosen arbitrarily, as is argued above - there is reasoning behind the choice of borderlines which relates to how we understand spin-offs and other changes. Therefore it is unproblematic with some variations in the results around the chosen values, as long as they are not so big that they completely changes the picture at given breakpoints. In addition it is useful to know how much variation that occurs around the selected values. All in all the results are satisfactory showing that there are no dramatic changes in the results from varying the borderlines we have chosen. The following criteria has been tested:

Firstly, the error correction procedure affects only the category of "other new" and not spin-offs or Greenfields. The number of corrections is clearly increased when changing the stability requirement from 80 % down to 50 % and 30 %. These are, however, extremely strong requirements in our opinion.[4]

If we change the requirement that the delivering establishment shall be alive with at least 1 employee, to a stronger requirement that the delivering establishment is of at least equal size as the new one after the spin-off has occurred, the number of spin-offs is reduced from 905 to 826.[5]

Another requirement is that the new unit should be smaller than the delivering one before the spin-off. Moderating this to the stronger requirement of being smaller than 30 % reduces the number of spin-offs from 905 to 708, whereas loosening to require that the new is less than 70 % of the old returns 1077 spin-offs.[6]

Lastly, we have required that the personnel spinning off make up a significant share of the employment in the new establishment – in our specification at least 30 %. Varying this share from 10 % (less strict) to 50 % (more strict) results in a change in number of spin-offs from the original 905 to 975 and 812 respectively.[7]

[4] Corrections increase from 108 cases to 360 and 628 respectively, see statistical appendix, sensitivity analysis, tables 1-6, 1-7 and 1-8.
[5] See statistical appendix, sensitivity analysis, table 1-9.
[6] See statistical appendix, sensitivity analysis, table 1-10.
[7] See statistical appendix, sensitivity analysis, table 1-11.

3 The concept of "high-tech"

This project explicitly addresses spin-off activities that can be considered "high-tech" in some sense. The concept refers to the contents of different technologies, and is usually understood to describe technologies that are considered very advanced or complicated, or even particularly costly to bring about. One could also think of it as technologies that are aimed at solving difficult or "advanced" problems. A common association includes technologies such as information- and communication technology, biotechnology, pharmaceuticals, nano technology etc. Another common way of thinking about "high-tech" when it comes to the establishment of new firms involves the participation of or linkage to (any kind of) research (see Callan 2002). One particular approach associates high-tech activity with firms that perform R&D (for instance Møen 2002).

Rarely discussions of "high-tech" activities consider how the advanced knowledge is being developed, transferred, stored or utilised – nor how that interrelates with other activities necessary for successful innovation. The point here is that many industries and firms may access and utilise advanced technologies developed elsewhere, given that they have the necessary absorptive capacity or that the technology exist in such a form that it can be easily adopted and used. One such possibility is technology embedded in machinery and equipment which may be extremely advanced and "high-tech", but where the user industry may not necessarily be classified as very advanced according to the usual criteria (see below). This poses challenges when trying to study "high-tech" spin-offs, and should at least remind us that existing – and available – classification criteria at the best are partial and approximations to what we really should be looking for. On the other hand, the world is complex and the ways firm operate and innovate are so different that we must be open to include a variety of indicators along with the variety of behavioural patterns that we can observe.

We are generally not able to obtain information directly on the contents or characteristics of technologies that are adapted or utilised by different firms or groups of firms. Therefore we must create indicators that we think are related to the characteristics that we really want to identify. One option is to use information about the industry each establishment operates within as an indicator for the technological level or type of the operations. The most common, and most easily adapted, is the OECD classification of industries according to the R&D intensity (average level of R&D expenditure as a share of value added). Industries are classified as "high-tech" when the R&D intensity is 4 % or above. The classification has traditionally been adapted to manufacturing only and includes eight broad industries. Later three service industries have been added, all with R&D intensities above the magic 4 % border.

The classification of each industry as "high-tech" using this method is dependent on how industries are grouped. For example are pharmaceuticals classified as high tech because it is separated out from the broader group of chemical industries – which is not high tech according to the OECD classification. Similarly there are other industries grouped along with "low tech" activities that would have been high-tech if they were grouped independently.

Since the R&D intensity in different industries varies between countries, one option is to allow for national specifications of particular industries that should be counted as "high-tech". This should take place at a more disaggregated level like 4 digit NACE code. Such an approach would allow a better-targeted identification of the "real high-tech" sectors in each country, but at the cost of differences in the groups to be compared between the countries. These will,

however, reflect real differences. That requires that all the relevant sub sectors be specified in comparisons between the countries.

The original OECD classification does not include service industries. This is increasingly problematic since such industries grow in importance, and many of them are very advanced operations. Particular services should therefore be added to the OECD list of high tech industries to explore. Those presently on the list all are above the 4% limit. In addition it has been proposed to include other service industries with a high share of personnel with higher education.

It is possible to think of the high-tech component in both the delivering and the receiving industry when we focus spin-offs. To decide whether a particular establishment is a high tech spin-off or not we can distinguish between cases where the new firm is “high-tech”, the firm it spins out from is “high-tech”, or if both are.

The last possible classification criterion with the information available to the project will be the educational background of the employees taking part in a start-up or spin-off. This classification method requires information on the single employees in each establishment or enterprise. It is necessary to aggregate this information into groups such as the share of persons with higher education, or the share of persons with particular kinds of education (for instance engineering or natural sciences). If one is interested in particular technologies, such as biotech or nano tech, a more detailed specification of formal competences could add a valuable indication of the type of knowledge involved.

The identification of high-tech can be of any kind described above (OECD-type NACE-code, researcher participation, education of employees). Unfortunately it is not possible to classify according to the particular technology involved, since such information is not available.

As the basic approach, and as a reference to previous work and widespread use, the project will apply the OECD high tech industries classification for the *target* industry. This information is available for establishments. In addition the project will classify according to delivering industry in those cases where it is possible to identify the delivering industry. We will underscore that the solution is not completely satisfying, and in practice is reduced to using the well-known OECD high-tech sectors. It facilitates comparisons with other results, but should in future research be complemented with a more sophisticated concept of high-tech activity.

It will also be classified according to the occupational background of employees in the cases where at least one of the employees has background from the research system (spin-off with researcher participation). It requires information on the career and education of each employee in order to identify those that previously worked in the research sector, and in addition information about which research institution.

4 Spin-offs and enterprise dynamics – the broad picture

4.1 Introduction

The aim of this chapter is to present the first basic results and put the different kinds of changes in the establishments and enterprises in relation to each other. As described in chapter 2 we have separated 9 different states of change for the establishments, of which we consider that spin-offs will be part of essentially one of them. It is the category where the establishment is new and at the same time it belongs to a new enterprise.

Here we focus this new-in-new category to investigate its importance compared to the other 8 categories, and in addition investigates its development over time, the distribution between industries and size classes. All of this is carried out for all the countries so that the results can be compared. This way the chapter presents the basic picture within which we go into more detail about the new-in-new category in the following chapters.

Initially we compare the breakdown into the 9 categories between the countries for the latest common years (1999-2000). As with all following breakdowns we first compare the number of establishments and next the number of employees they represent. Next we include overviews of the development over time to see if the patterns we observe vary much or if they seem to be stable and robust. Then we focus on the distribution of the change categories between industries, and finally different size classes of establishments where the different kinds of changes have occurred are compared.

4.2 A first comparative look at the most recent period

The first approach is simply to compare the different kinds of changes across the countries for the latest available common pair of years. In Figure 4-1 we firstly illustrate the number of units included in the analysis with details to be found in Table 4-1 below. The numbers are exclusive of establishments with only 1 employee both years in the comparison. In addition only the private business sector is included.

The selection criteria returns a number of establishments in Norway and Denmark around 100 000, in Finland around 85 000, and in Sweden around 170 000. This broadly reflects the differences in sizes between the countries, but with a slightly higher number than expected in Denmark and Norway when comparing to Sweden and Finland. Some reasons for such discrepancies are taken up in chapter 2 above. As a consequence of the differences in levels we try to focus composition of types and developments over time rather than levels when doing comparisons between the countries.

Figure 4-1 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Number of establishments

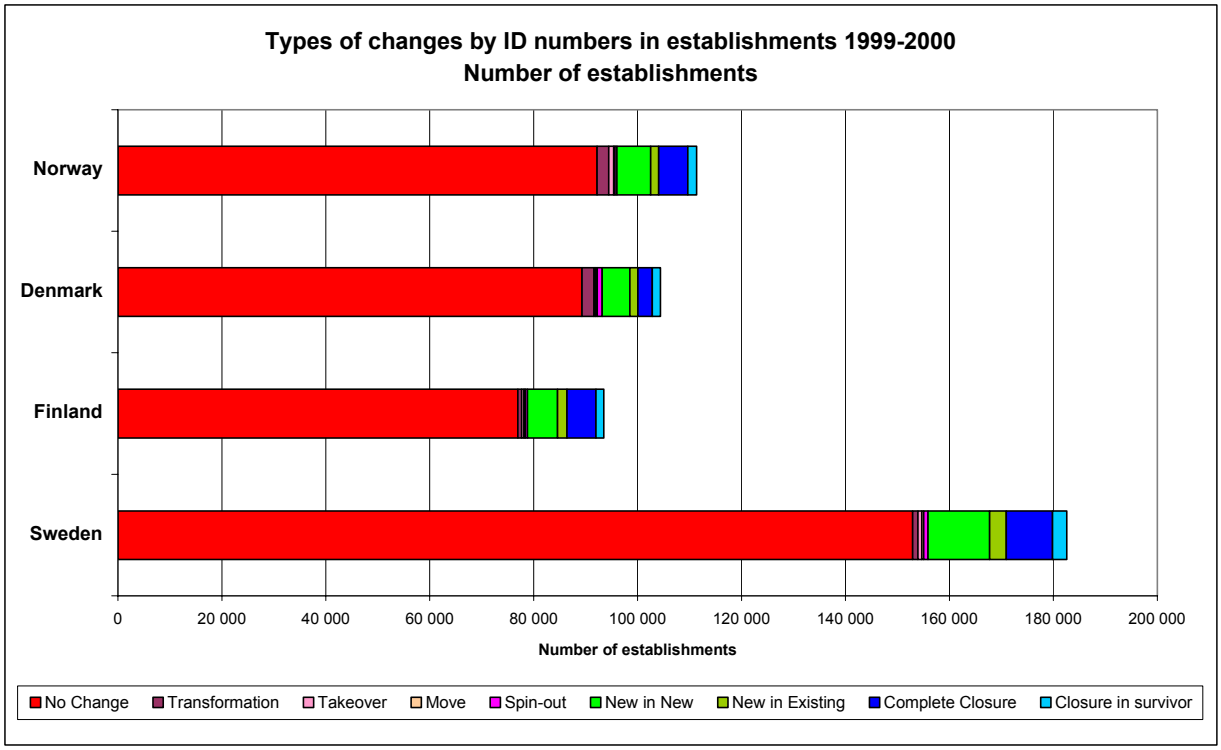
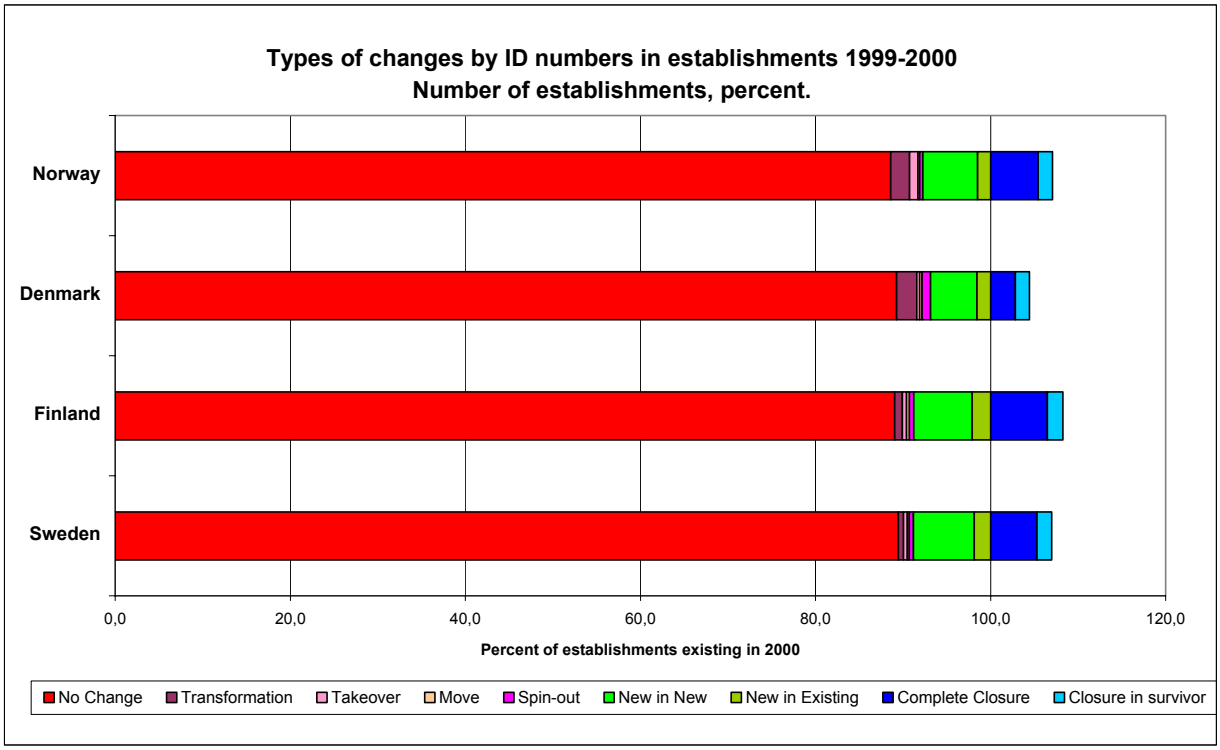


Table 4-1 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Number of establishments.

Change:	1	2	3	4	5	6	7	8	9			
Country	No Change	Trans-formation	Take-over	Move	Spin-out	New in New	New in Existing	Complete Closure	Closure in survivor	Total Year 0	Total Year 1	Net effect Y1-Y0
Sweden	152 940	1004	743	358	813	**11 857**	3 209	8 908	2 773	167 539	170 924	3 385
Finland	76 939	743	422	280	436	**5 763**	1 809	5 589	1 502	85 911	86 392	481
Denmark	89 308	2 326	308	279	964	**5 316**	1 554	2 757	1 577	97 519	100 055	2 536
Norway	92 194	2 235	975	224	376	**6 501**	1 548	5 591	1 706	103 301	104 053	752

The structures of relationships between the different categories seem to have much in common across the countries (Figure 4-2 and Table 4-2). Unchanged establishments make up the large majorities accounting for about 90 % of the establishments in all counties. The other two large categories are complete closure (establishment and enterprise) accounting for around 3 - 6 % of the establishments that existed year 0, and the totally new establishments (new-in-new) which is the focus here and accounting for around 5 - 7 % of the number of establishments year 1. The share of new-in-new is the lowest in Denmark and the highest for Sweden, but differences are small. It is a considerable number of units that are involved totalling some 11 000 new-in-new units in Sweden and around 5 000-6 000 in each of the other countries. Of the different establishments that has survived but been transferred the numbers of cases are clearly lower in all the countries (change categories 2-5).

Figure 4-2 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Percent of number of establishments



Percentage shares of closures are calculated according to the number of units year 0.
Percentages for surviving or new units are calculated on the basis of the number of units year 1.

Table 4-2 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Percent of number of establishments.

Change:	1	2	3	4	5	6	7	8	9		
	No Change	Trans-formation	Take-over	Move	Spin-out	New in New	New in Existing	Complete Closure	Closure in survivor	Total Year 0	Total Year 1 (=100 %)
Sweden	89,5	0,6	0,4	0,2	0,5	**6,9**	1,9	5,3	1,7	167539	170924
Finland	89,1	0,9	0,5	0,3	0,5	**6,7**	2,1	6,5	1,7	85911	86392
Denmark	89,3	2,3	0,3	0,3	1,0	**5,3**	1,6	2,8	1,6	97519	100055
Norway	88,6	2,1	0,9	0,2	0,4	**6,2**	1,5	5,4	1,7	103301	104053

Percentage shares of closures are calculated according to the number of units year 0.
Percentages for surviving or new units are calculated on the basis of the number of units year 1.

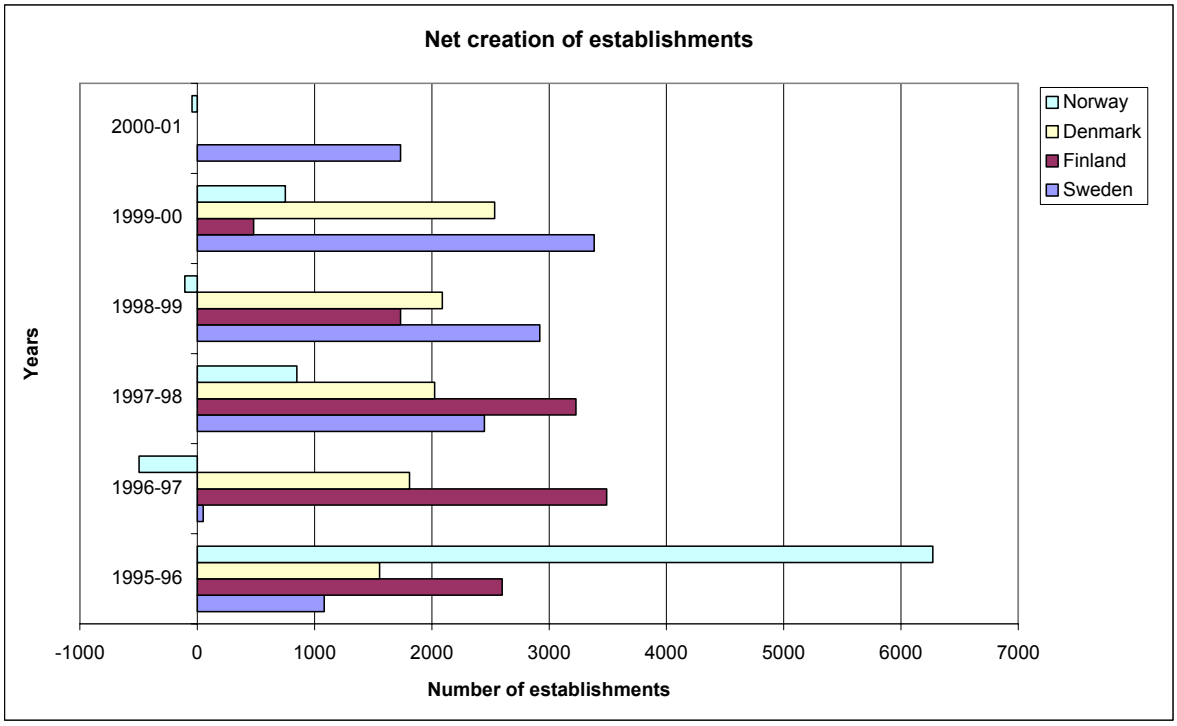
The different types of transfers of establishments between enterprises are clearly more marginal in all the countries than the other kinds of changes. However, the type termed "transformation" (change category 2) involves some 2 200-2 300 units in Norway and Sweden for 1999-2000 (Table 4-1). This kind of change involves a shift in enterprise identity for an existing establishment, with the old enterprise identity disappearing. This kind of shift may involve changes that in some cases can be considered to be very similar to spin-offs. We have chosen to interpret this as a shift, or transformation, of something that already exists as an activity within an existing organisation. In line with this it is kept out of our spin-off definition.

A similar case involves establishments that shift from being part of one enterprise to becoming (part of) a new enterprise, but in this case with the old enterprise surviving. This type we have termed "spin-out" since it is an existing activity that forms the basis of a new legal entity (the enterprise). For some purposes this could be regarded as a kind of spin-off in the sense that it involves the creation of a new independent entity leaving the mother enterprise alive and

functioning. However we think that in many cases this type of change is merely a reorganisation of an activity that is already existing and even organised as a separate organisation (the establishment). We have no means with our data to decide what the real background to the change is. That is partly why we have left also this group out of the core group under study, and reserved the spin-off concept to the cases where a group of persons start something completely new of their own without having formally existed as a separate unit beforehand. The number of cases of spin-outs is around 400 in Norway and Finland, and around 800-900 in Sweden and Denmark for the period 1999-2000 (Table 4-1). This amounts to a share of total numbers of establishments of about 0,5 percent in Sweden, Finland and Norway, and 1 percent in Denmark. The levels and shares of spin-outs are by and large the same over time within each country, but with Norway tilting to the lower levels all the time (see *statistical annex, tables A4.1 to A4.16*).

When closures and the creation of new establishments do not balance each other out, we get a net growth or decline in the number of establishments. This balance varies over time in all the countries, among other things influenced by the business cycle (see Figure 4-3 below and *annex tables A4.1 to A4.16*). For the year pair 1999-2000 in Table 4-1 there is a net growth in number of establishments for all the countries, but the growth is in a different order of magnitude for Sweden and Denmark (around 3 300 and 2 500 respectively) compared to around 500 to 750 in Finland and Norway. For Finland this is not representative, as for the other years Finland is even higher than Denmark and Sweden. Norway is the different country with the balance hovering around 0 with a negative net effect every second year. There is a large positive growth in Norway for the first pair of years but we suspect this to be caused by errors due to changes in register routines in that period.[8]

Figure 4-3 Net effects of changes in establishments and enterprises 1995-2001. Sweden, Finland, Denmark, Norway. Number of establishments



[8] The problems resulting from a shift in the use of ID numbers in Norway in 1994-1995 is taken up in chapter 2.

Below the different categories of changes are weighted by the numbers of employees in each of the establishments involved. This way we can indicate how large proportions of the total employment in the groups of firms that we study which are affected by the different kinds of changes. In doing so the number of employees in year 1 is used, that is in year 2000 for the pair 1999-2000. For closures employment in year 0 is used. One should be cautious when interpreting the net effect on employment by the changes (Table 4-3). The number for net employment effect gives the net difference between establishments closing down and those starting up.[9] This results in a net increase of around 20 000 employees in all countries except Norway where there is a slight negative effect of around 1000 employees between 1999 and 2000.

To take into account changes in employment also in existing and surviving establishments we have added this information for Norway and Sweden in Table 4-4 (and related to employment in each group in Table 4-5). The two countries differ sharply both when it comes to the direction of change and the size of the changes. In particular employment in establishments without change in Sweden increases with some 90 000, almost four times higher than the net effect from new establishments and closures. In the Norwegian case it is a reduction of about 4 000 employees among the unchanged establishments. Such effects will normally fluctuate over time, and these differences should be checked over time and for all the countries.

Table 4-3 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Number of employees.

Change:	1	2	3	4	5	6	7	8	9			
	No Change	Trans-formation	Take-over	Move	Spin-out	New in New	New in Existing	Complete Closure	Closure in survivor	Total Year 0	Total Year 1	Net effect[1]
Sweden	2 059 005	41274	19522	15917	41867	**72 500**	51 237	57 431	43 098	2 278 114	2 301 322	23 208
Finland	1 054 652	9 761	8 848	7 088	14 182	**31 275**	18 000	17 680	13 475	1 125 686	1 143 806	18 120
Denmark	1 327 775	58 395	8948	13277	13 870	**40 860**	18 834	22 309	16 288	1 460 862	1 481 959	21 097
Norway	1 145 206	36 714	22 320	6 029	9 699	**41 938**	18 795	38 086	23 925	1 281 979	1 280 701	-1 278

[1] Net effect on employment is the difference between the number of employees in new establishments and in closed establishments. Changes in employment in existing establishments are not included. They are reported according to employment year 1.

Table 4-4 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Net effect on number of employees

Change:	1	2	3	4	5	6+7-8-9	
	2000-1999	2000-1999	2000-1999	2000-1999	2000-1999	2000-1999	
	No Change	Trans-formation	Takeover	Move	Spin-out	Net New- close	Total change
Sweden	89 549	-1 017	-859	523	2 934	23 208	114 338
Norway	-3 876	1 275	195	-172	-1 531	-1 278	-5 387

[9] The way it is presented here the net employment effect does not include changes in employment in all the existing establishments, since these are all counted in year 1. This procedure is repeated for every year pair. Doing so the effect of growth or decline in existing establishments will affect the numbers for total employment each year. That is the main reason why the numbers of employees the last year of the first pair is different from the numbers of employees of the first year in the following period (see annex tables A4.1 to A4.16). That difference is therefore the result of both a difference in net entry-exit of establishments and a change in employment in surviving establishments.

Table 4-5 Changes in establishments and enterprises identified by ID numbers 1999-2000. Sweden, Finland, Denmark, Norway. Net change in number of employees as a percentage of employment 1999

Change:	1	2	3	4	5
	% av 1999	% av 1999	% av 1999	% av 1999	% av 1999
	No Change	Transformation	Takeover	Move	Spin-out
Sweden	4,5	-2,4	-4,2	3,4	7,5
Norway	-0,3	3,6	0,9	-2,8	-13,6

In terms of numbers of employees involved, the category of establishments with no change dominates equally much as for the numbers of establishments (see Figure 4-4 and Figure 4-5, and Table 4-3 and Table 4-6 for details). Around 90 % of the employees belong to the no change type of establishments. All the categories where existing establishments are transferred increases in relative importance, whereas the cases with new establishments and closed establishments get a smaller relative importance. This is caused by the fact that the new and the closed establishments on average are smaller than those that survive in some fashion. The category of new-in-new which is our focus is reduced in relative importance to about 3 % in all the countries.

All in all, even if the category where we expect to find spin-offs is of limited magnitude compared to the group with no change, it does account for a considerable number of establishments and a considerable number of employees. All in all around 70 000 employees worked in new in new establishments in Sweden in 2000, with around 30 000 in Denmark and around 40 000 in Finland and Norway. These are the employees we will follow by labour tracking in chapter 5 below to identify the real spin-offs according to our definition.

Figure 4-4 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Number of employees

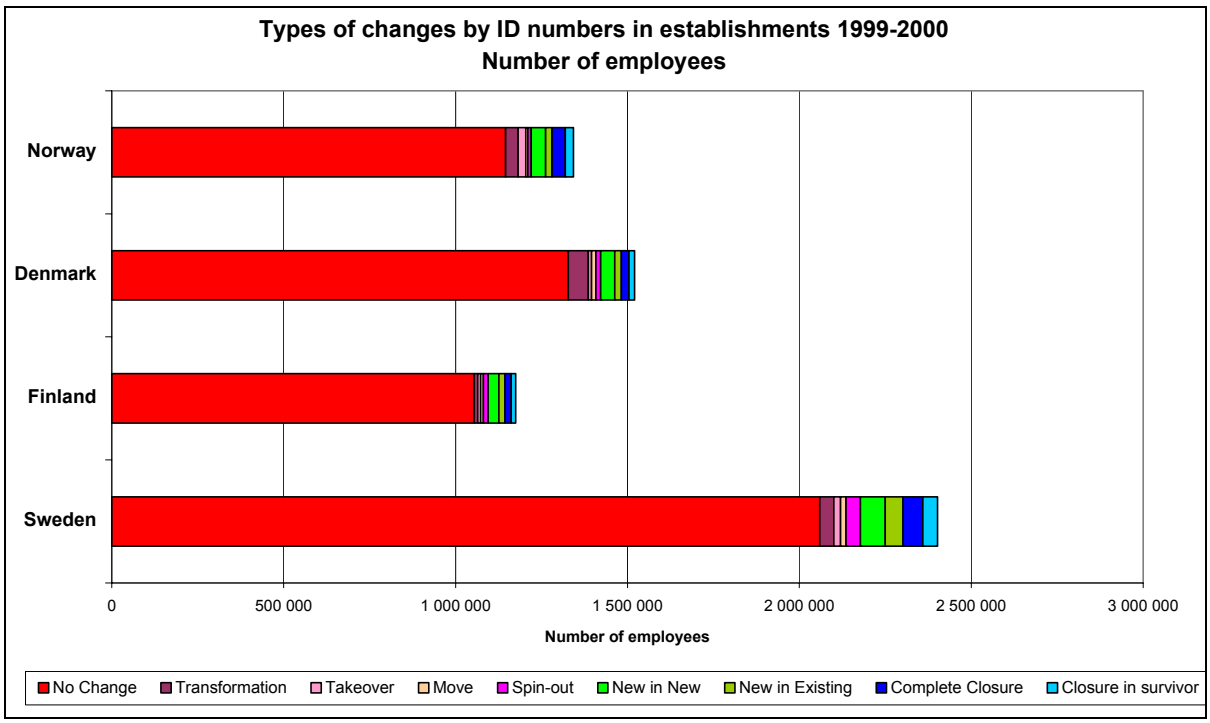
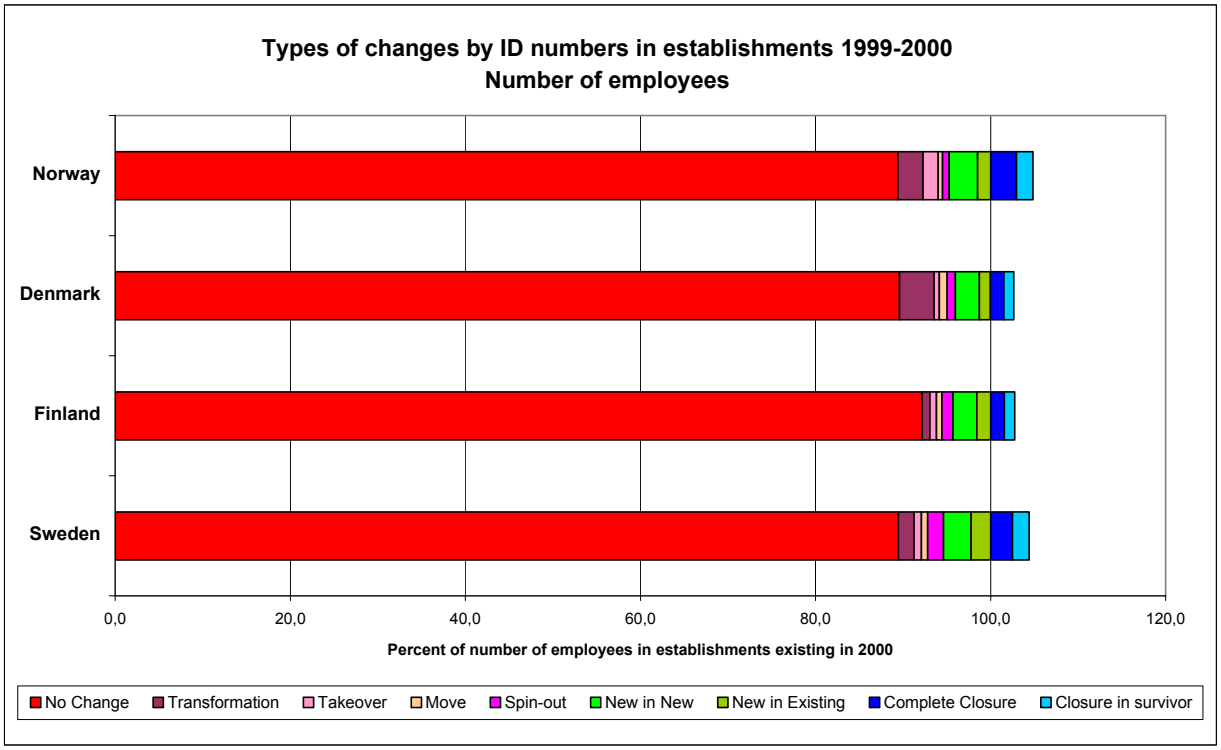


Figure 4-5 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Percent of number of employees



Percentage share of closures are calculated according to the number of units year 0.
Percentages for surviving or new units are calculated on the basis of the number of units year 1.

Table 4-6 Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Percent of number of employees.

Change:	1	2	3	4	5	6	7	8	9		
Receiving enterprise	No Change	Trans-formation	Take-over	Move	Spin-out	New in New	New in Existing	Complete Closure	Closure in survivor	Total Year 0	Total Year 1
Sweden	89,5	1,8	0,8	0,7	1,8	3,2	2,2	2,5	1,9	2 278 114	2 301 322
Finland	92,2	0,9	0,8	0,6	1,2	2,7	1,6	1,6	1,2	1 125 686	1 143 806
Denmark	89,6	3,9	0,6	0,9	0,9	2,8	1,3	1,5	1,1	1 460 862	1 481 959
Norway	89,4	2,9	1,7	0,5	0,8	3,3	1,5	3,0	1,9	1 281 979	1 280 701

Percentage share of closures are calculated according to the number of units year 0.
Percentages for surviving or new units are calculated on the basis of the number of units year 1.

4.3 How stable are the patterns over time?

Observing only one year as we mostly did in the previous part may give biased results because the chosen year may not be representative in some way. For our purposes, stages in the business cycle will normally affect the results. In this and the following section we focus the category of firms labelled new-in-new. Further details about changes over time in the other kinds of changes are collected in *the statistical annex, tables A4.1 to A4.16*. The development over time will also be the focus when we track performance in chapters 6 and 7 below.

When investigating development over time we find that there are some variations. As a general rule, however, the basic structures in the data seems to be quite robust in terms of the relationship between the categories and the countries (see Table 4-7 and Table 4-8). We do expect parts of the variation over time to be related to the business cycle. In addition, we suspect that they are partly related to changes in classification systems and administrative routines in the registers, in particular for the first couple of years included here. To the degree

that such errors exist, they will to some extent be identified when we utilise labour tracking in the next chapter.

The number of new-in-new establishments in Sweden is rather stable around 11 000 over the period. Stability in the numbers is also found in Finland at around 6 000 establishments. For Norway and Denmark the evidence is more mixed, but there seems to be a downward trend for Norway and an upward trend for Denmark both ending more or less at par with the Finish order of magnitude. As regards the shares that new-in-new make up of the total it is in the interval of 6-8 percent for Sweden, Finland and Norway with a slight downward trend. Denmark is the exception with shares 4-5 percent but rising so that all the countries are at more or less the same level in 2000.

Table 4-7 New establishments within new enterprises 1995-2001. Sweden, Finland, Denmark, Norway. Number of establishments and percents of total number of establishments year 1.

	Sweden	Finland	Denmark	Norway	Sweden	Finland	Denmark	Norway
Years 0-years 1	N	N	N	N	Percent	Percent	Percent	Percent
1995-1996	**9 154**	**5854**	3818	10781	5,8	7,6	4,1	10,6
1996-1997	**11 282**	**6548**	4028	8920	7,1	8,1	4,3	8,6
1997-1998	**10 773**	**6690**	4200	7132	6,6	8,0	4,4	7,0
1998-1999	**10 753**	**6028**	5106	6375	6,4	7,0	5,3	6,2
1999-2000	**11 857**	**5763**	5316	6501	6,9	6,7	5,3	6,2
2000-2001	**10 294**			5790	6,0			5,5

The differences between the countries are repeated when it comes to the share personnel in new-in-new establishments make up of the total employment (Table 4-8). As was pointed out above these shares are much lower than the respective shares for numbers of establishments. They are by and large stable over time in Finland and Sweden, somewhat rising in Denmark and decreasing in Norway. Regarding the actual numbers of employees there seems to be a downward trend for Norway over time, stability in Finland and Sweden, and an increase for Denmark.

Table 4-8 New establishments within new enterprises 1995-2000. Sweden, Finland, Denmark, Norway. Number of employees and percents of total number of employees year1.

	Sweden	Finland	Denmark	Norway	Sweden	Finland	Denmark	Norway
Years 0-years 1	N	N	N	N	Percent	Percent	Percent	Percent
1995-1996	**41 817**	**25 974**	22559	54856	2,1	2,8	1,7	4,6
1996-1997	**59 247**	**27 646**	24252	56781	2,9	2,8	1,8	4,6
1997-1998	**63 981**	**29 222**	27683	45277	3,0	2,7	2,0	3,6
1998-1999	**66 910**	**28 695**	36578	38152	3,1	2,6	2,5	3,0
1999-2000	**72 500**	**31 275**	40860	41938	3,2	2,7	2,8	3,3
2000-2001	**61 440**			35558	2,6			2,8

In *annex tables A4.1 to A4.4* we look into the details of the development in each of the different categories over time for Sweden. Similar breakdowns are included for Finland (*annex tables A4.5 to A4.8*), Denmark (*annex tables A4.9 to A4.12*) and Norway (*annex tables A4.13 to A4.16*). What these tables basically show is that the relationships between the categories are more or less the same over time across the countries and between each other. That is, for all the years, in all the countries, unchanged establishments account for around 90 percent of the

establishments and about 90 percent of the employees. New-in-new establishments account for 5 - 8 percent of the units and around 2-4 percent of employment.

4.4 Which size classes are the more dynamic?

As was pointed out above, new-in-new establishments are generally smaller than the ones that experience no changes in our sense. This is also illustrated in this section where the establishments are distributed into size categories according to their numbers of employees. The small size groups include a large number of units, indicating that establishment of new-in-new firms clearly is a small firm activity (see Table 4-9). In Sweden, for instance, only around 1400 out of 12 000 new establishments have more than 9 employees. Similar biases are found also in the other countries.

Bringing the number of employees into the picture clearly outweighs much of the small unit bias (see Table 4-10). Even if smaller in number of units, the larger establishments to a major degree balance out the numbers of employees in the small establishments. The situation is very similar in all the Nordic countries as is also illustrated in Figure 4-6 and Figure 4-7 below.

Details for all the countries on all the change categories related to size classes are found in *annex tables A4.17to A4.32*.

Figure 4-6 New establishments within new enterprises by size classes.

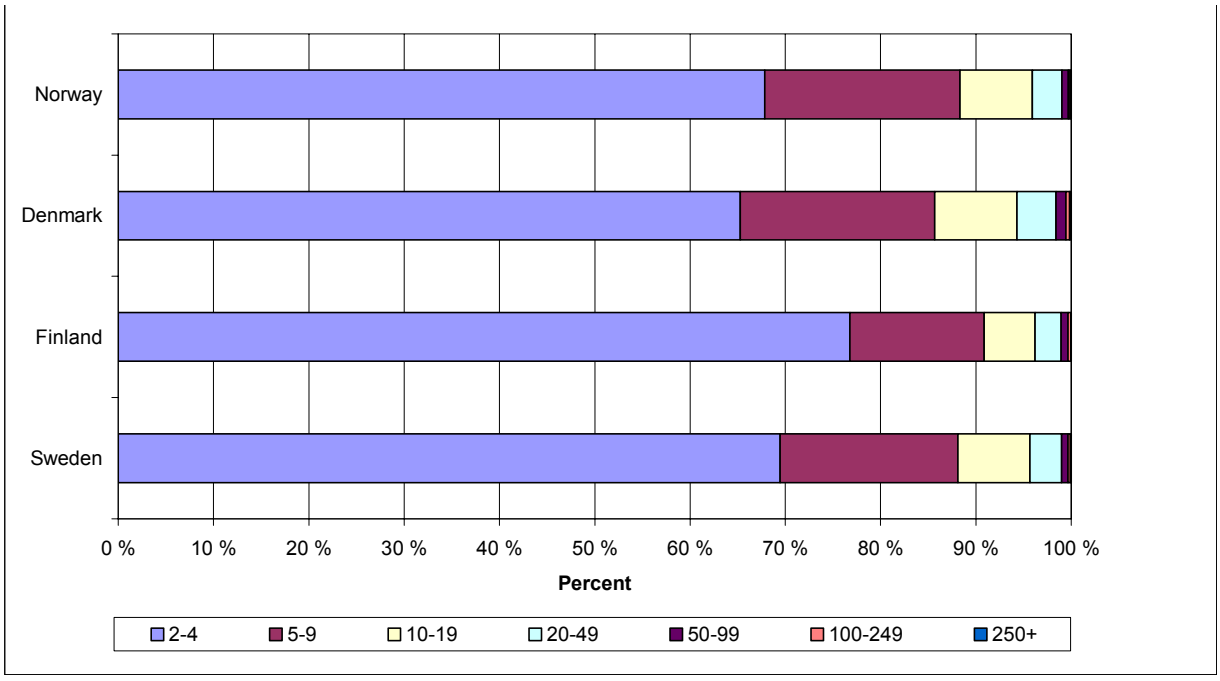


Figure 4-7 New establishments within new enterprises by size classes. Number of employees.

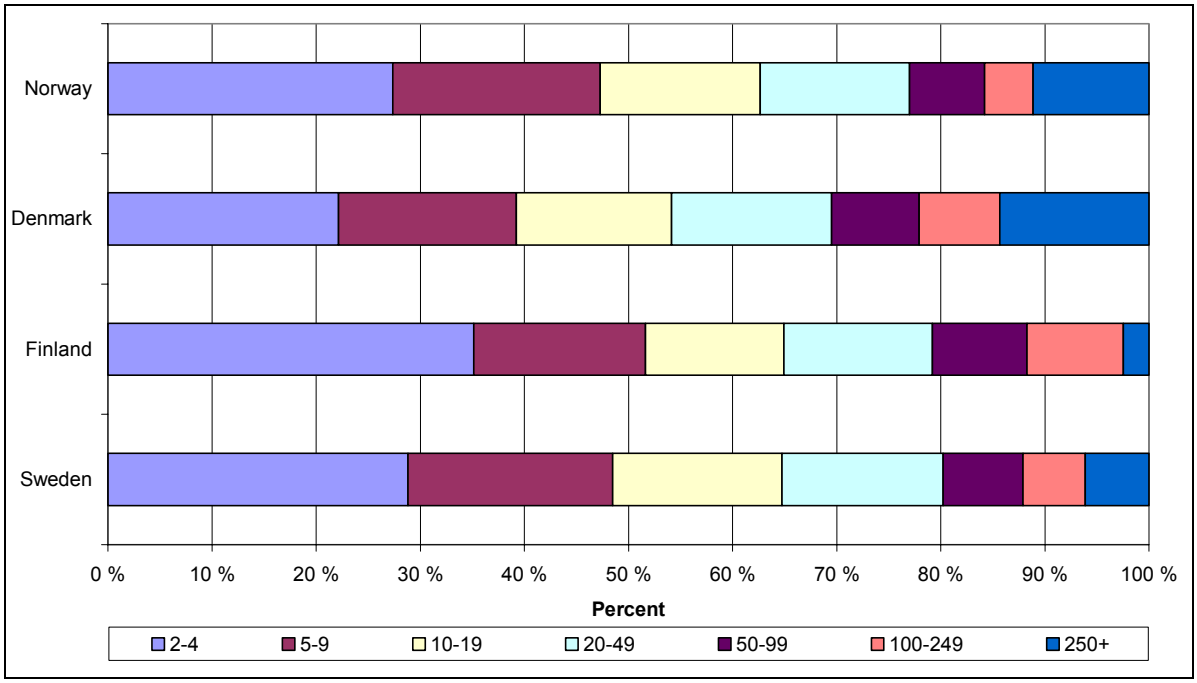


Table 4-9 New establishments within new enterprises 1999-2000 by size classes. Sweden, Finland, Denmark, Norway. Number of establishments and percents of total number of establishments year 1.

	Sweden	Finland	Denmark	Norway	Sweden	Finland	Denmark	Norway
Size class	N	N	N	N	Percent	Percent	Percent	Percent
2-4	**8 235**	4426	3471	4410	9,4	12,7	8,2	9,6
5-9	**2 213**	809	1084	1332	5,7	3,9	4,0	5,0
10-19	**892**	310	459	492	3,9	2,8	2,8	3,3
20-49	**395**	157	217	205	2,8	2,4	2,3	2,6
50-99	**80**	42	55	42	1,9	2,0	2,1	1,8
100-249	**34**	17	22	13	1,6	1,5	1,6	1,1
250+	**8**	2	8	7	1,0	0,4	1,5	1,7
Total	**11 857**	5763	5316	6501	6,9	6,7	5,3	6,3

Table 4-10 New establishments within new enterprises 1999-2000 by size classes. Sweden, Finland, Denmark, Norway. Number of employees and percents of total number of employees year 1.

	Sweden	Finland	Denmark	Norway	Sweden	Finland	Denmark	Norway
Size class	N	N	N	N	Percent	Percent	Percent	Percent
2-4	20892	10992	9046	11474	8,9	11,3	7,7	9,0
5-9	14248	5162	6986	8362	5,6	3,8	3,9	4,8
10-19	11804	4152	6093	6434	3,8	2,9	2,7	3,2
20-49	11212	4457	6280	6017	2,7	2,3	2,3	2,6
50-99	5566	2843	3438	3023	2,0	2,0	1,9	1,9
100-249	4332	2900	3166	1961	1,4	1,7	1,5	1,2
250+	4446	769	5851	4667	0,9	0,3	2,0	2,1
Total	72500	31275	40860	41938	3,2	2,7	2,8	3,3

4.5 In which industries do we find the highest activity?

The significant number of new-in-new units established in each of the countries each year indicates a certain industrial renewal, even if the share of employment is smaller than the share

of units. This is accompanied with a large number of closures. The renewal is dependent on what kinds of businesses the new entrants (or closures) are occupied with. It clearly turns out that the majority of the dynamics goes on in the service sectors along with construction, even when excluding the typical non business public services of administration, health and education. Manufacturing account for a minor share of the number of establishments as is illustrated in Figure 4-8 and Figure 4-9 below. The same relationship holds true for closures, and the situation is very much the same in all the countries.

Figure 4-8 New establishments within new enterprises 1999-2000 by broad sectors. Sweden, Finland, Denmark, Norway. Number of establishments.

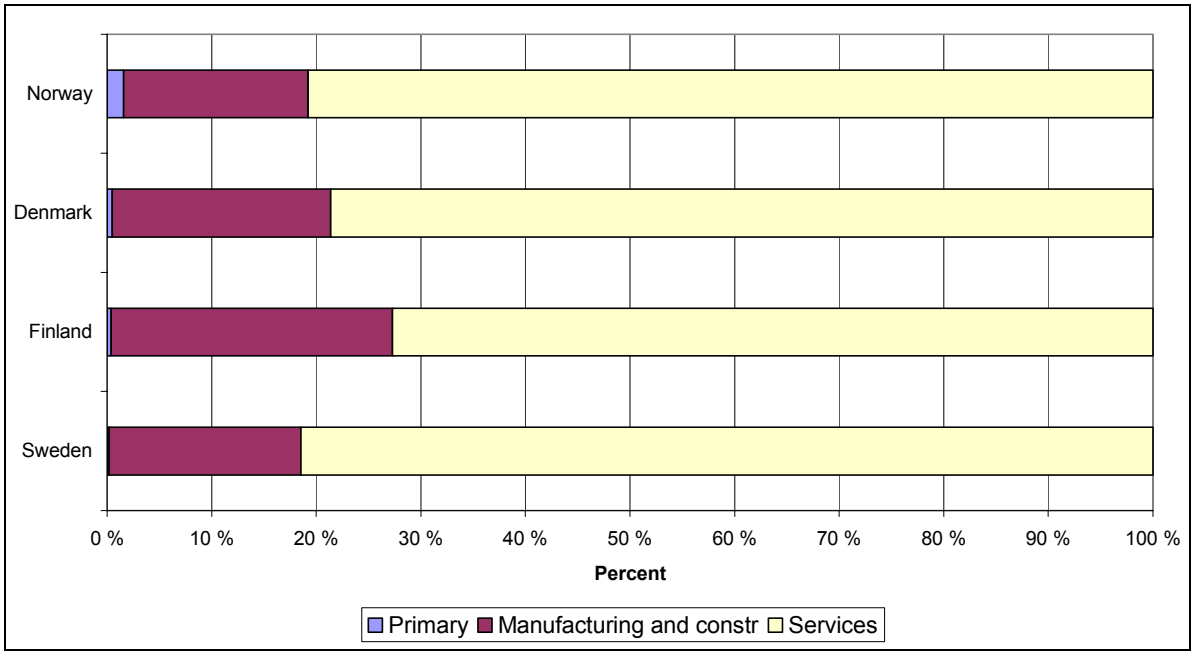


Figure 4-9 New establishments within new enterprises 1999-2000 by broad sectors. Sweden, Finland, Denmark, Norway. Number of employees

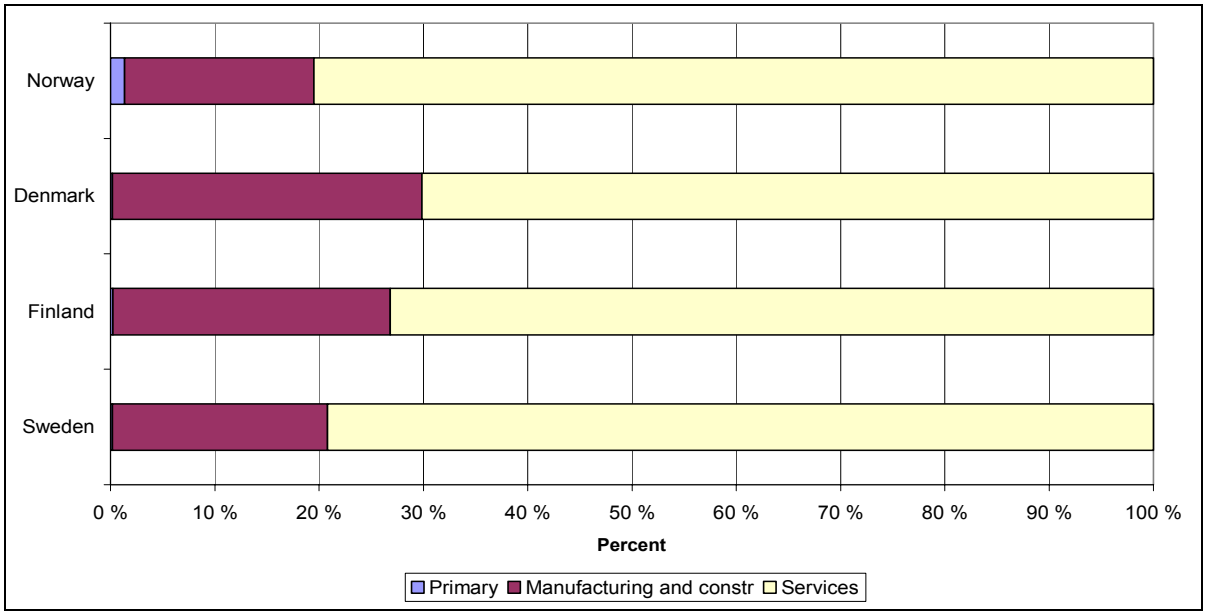


Table 4-11 (establishments) and Table 4-12 (employees) the new-in-new establishments in 1999-2000 are distributed by the industries where the establishments occur. An important

reason for the dominating position of the service industries is their large number of units and the high share of total employment. It is particularly the group of trade, hotels and restaurants that dominates with close to a third of the number of units. Bringing employment into the picture only marginally changes the situation. This is to a large extent because all 1 person establishments, which are numerous in the services, are removed in this context. All in all services account for 70-80 % of the new-in-new establishments and their employment. Denmark seems to be somewhat different, as the share is close to 80 % for number of units, and down to 70 % when bringing employment into the picture.

Table 4-11 New establishments within new enterprises 1999-2000 by industry. Sweden, Finland, Denmark, Norway. Number of establishments and percents of total number of establishments in each industry year 1.

	Sweden	*Finland*	*Denmark*	*Norway*	*Sweden*	*Finland*	*Denmark*	*Norway*
Industry[10]	*N*	*N*	*N*	*N*	*Percent*	*Percent*	*Percent*	*Percent*
Fishing	8	9	27	77	6,0	8,2	3,9	8,5
Mining etc	15	13		15	4,3	3,5	0,0	5,0
Oil and gas extraction	1			11	16,7		0,0	6,0
Food, beverages, tobacco	90	63	112	74	4,6	5,0	5,8	4,3
Textiles, leather	35	29	14	13	4,1	3,7	2,2	2,8
Wood and wood products	109	62	13	36	5,1	5,2	2,5	3,9
Pulp and paper	10	4	1	1	2,5	1,7	0,5	0,9
Printing and publishing	138	81	65	101	4,4	4,9	3,5	5,8
Chemicals and refining	20	13	9	6	3,9	4,2	3,3	3,4
Pharmaceuticals	3	0	1	4	3,1	0,0	1,3	12,9
Rubber and plastic products	27	18	12	11	2,7	3,3	2,1	3,4
Mineral products (non-met)	22	21	10	16	2,7	3,4	1,5	3,1
Basic metals	7	1	4	12	2,4	0,7	2,4	8,1
Metal products	233	108	66	31	4,6	4,5	3,0	2,8
Machinery and equipment nec	95	72	43	53	3,4	4,1	2,6	4,8
Office m. radio, tele, instruments	59	38	22	24	4,2	4,9	3,3	5,4
Eelectrical machinery and app.	24	12	22	10	3,0	3,2	3,8	3,0
Transport equipment ex air tr.	47	22	10	28	4,9	5,3	2,6	4,0
Air transport	7	0		0	12,5	0,0	0,0	0,0
Furniture and manuf nec	67	42	28	29	5,1	4,5	2,6	4,1
Recycling	4	3		8	3,0	4,6	0,0	9,4
Utilities (electricity, water, gas)	19	26	16	16	2,5	4,7	4,0	2,5
Construction	1 157	936	661	675	6,1	8,9	5,2	6,6
Trade, hotels, restaurants	3 571	1 510	1 998	2205	6,1	5,0	5,2	5,4
Transport and postal services	706	410	230	531	4,8	6,1	3,3	6,4
Telecommunications	195	78	23	36	15,9	16,6	7,8	14,3
Financial services, real estate, renting of machinery	592	346	245	371	6,2	5,8	4,1	7,7
Computer and related activities	1 064	396	465	419	20,2	19,9	25,3	21,4
Research and development	63	20	19	2	13,8	13,2	19,4	1,2
Other business services	2 228	931	702	900	10,2	9,9	8,3	8,8
Education	149	54	57	58	9,1	8,1	7,2	5,8
Higher education	0	1		0	0,0	3,1	0,0	0,0
Health	361	195	155	312	5,8	7,6	3,0	4,4
Other services, extraterr. org	439	249	286	361	7,3	8,5	6,2	5,7
Unknown	292			55	4,8			0,9
Total	11 857	5 763	5316	6501	6,9	6,7	5,3	6,2

[10] Industries are defined by their NACE code in chapter 2.

Table 4-12 New establishments within new enterprises 1999-2000 by industry. Sweden, Finland, Denmark, Norway. Number of employees and percents of total number of employees in each industry year 1.

	Sweden	*Finland*	*Denmark*	*Norway*	*Sweden*	*Finland*	*Denmark*	*Norway*
Industry	*N*	*N*	*N*	*N*	*Percent*	*Percent*	*Percent*	*Percent*
Fishing	33	29	86	322	6,6	7,4	3,3	5,4
Mining etc	108	44		83	1,5	1,2	0,0	2,2
Oil and gas extraction	2			159	10,0		0,0	0,6
Food, beverages, tobacco	693	362	1291	800	1,2	0,9	1,7	1,5
Textiles, leather	141	136	79	37	1,0	1,0	0,6	0,6
Wood and wood products	536	396	84	199	1,4	1,5	0,6	1,4
Pulp and paper	601	95	3	4	1,4	0,3	0,0	0,0
Printing and publishing	980	275	404	810	2,0	0,9	1,1	2,7
Chemicals and refining	300	327	3556	65	1,3	2,1	22,2	0,5
Pharmaceuticals	81	0	7	11	0,4	0,0	0,1	0,4
Rubber and plastic products	321	49	42	157	1,1	0,3	0,2	2,3
Mineral products (non-met)	174	122	85	74	1,0	0,8	0,4	0,8
Basic metals	153	10	25	166	0,5	0,1	0,3	1,1
Metal products	1473	881	447	352	1,8	2,3	1,1	1,9
Machinery and equipment nec	1098	757	766	330	1,2	1,4	1,1	1,5
Office m. radio, tele, instruments	765	441	201	257	1,0	0,9	0,7	2,3
Eelectrical machinery and app.	332	187	100	75	1,1	1,1	0,6	0,8
Transport equipment ex air tr.	394	176	195	202	0,4	0,9	1,2	0,6
Air transport	19	0			0,2	0,0	0,0	0,0
Furniture and manuf nec	346	232	187	274	1,2	1,6	0,6	2,1
Recycling	17	11		62	1,2	2,9	0,0	6,3
Utilities (electricity, water, gas)	271	352	439	334	1,2	3,1	4,7	2,1
Construction	6259	3505	4207	3 398	4,0	3,7	3,0	3,2
Trade, hotels, restaurants	16286	6158	12566	10 908	3,1	2,4	3,0	3,0
Transport and postal services	3177	2965	2331	4 654	1,6	3,3	1,7	3,6
Telecommunications	1929	1812	197	480	6,8	10,1	1,0	3,9
Financial services, real estate, renting of machinery	2949	1393	1432	4 414	2,4	2,2	1,6	7,1
Computer and related activities	7364	3277	4781	3 195	8,7	9,7	14,6	10,5
Research and development	649	88	90	6	5,7	2,3	5,5	0,1
Other business services	15048	5098	4270	6 207	6,3	4,7	4,3	5,2
Education	851	321	341	248	5,6	6,3	2,6	2,4
Higher education	0	2			0,0	0,4	0,0	0,0
Health	5766	740	837	1 699	7,4	4,6	1,8	2,5
Other services, extraterr. org	2226	1034	1811	1 686	4,0	3,6	4,1	3,4
Unknown	1158			270	2,1			0,5
Total	72500	31275	40860	41 938	3,2	2,7	2,7	3,3

As with stability over time, the results for the different change categories have been checked against industry in all countries (see *annex tables A4.33 to A4.48*). The results basically support what has been said above, so that we observe significantly higher stability (no change) within most manufacturing industries compared to the situation in most services. Weighting results by numbers of employees again tilts the results in the direction of even more stability, this time also for service industries. In addition we do of course observe a lot of variation between the industries when it comes to the importance of each type of change. In just a very few cases do the relative importance of the different categories change, meaning that the basic pattern we have observed is rather stable.

To further look into how the changes affect the relative position of the different industries we have put together the net difference between new and closing establishments for all the countries by industry. In Table 4-13 we present the actual numbers to be able to consider the orders of magnitude these processes makes up in each industry. In Table 4-14 the numbers are

related to the total numbers of establishments and employees in each industry in 2000 to take the industrial structure into account.

In absolute numbers the changes are very modest in most industries, both in terms of establishments and employees. The general picture shows a decline in the number of units in many manufacturing industries even if these are not always the same industries in all the countries. In services the general picture shows growth with both the numbers of establishments and employees being larger than for manufacturing.[11]

One should be aware that employment may grow even if the number of establishments is reduced, and vice versa. That is due to the size relationship between those closing down and those starting up. For instance there is a net increase by two new metal products establishments in Sweden but with a net effect on employment of 450 less.

We see the biggest changes in the larger industries such as construction with a positive development except for Sweden, trade, hotels and restaurant with a positive development, and other business services. Also computers and related services have a generally positive development in all countries, and in this case it is because the changes make up a big share relative to the size of the industry. This is contrary to what we find for production of office machinery, radio telecommunications and instruments, where there is a reduction in the number of employees except in Norway. In this case changes are fairly marginal to the size of the industry. Other industries with a predominantly negative development involve printing and publishing and wood and wood products (except for Finland). There are relatively big swings also for chemicals and refining when it comes to employment, but with opposite directions as there has been growth in Denmark and Norway, and decline in Sweden and Finland. For the manufacturing sector this is generally the case for the remaining industries, so that we see a positive development for one or two of the countries where the others have a negative development. For services this is generally not the case: All countries basically have a positive development with the exception of Sweden that has a decline in transport and postal services and in research and development. The Norwegian case is also special due to a recoding of sector codes for education and health units.

Looking at the relative importance of the net effects compared to the size of the industries again reveal that the changes in services are of considerable importance. They generally affect larger shares than what we find for manufacturing, and the pattern has much in common across the countries. For manufacturing we find a few industries where relatively high shares of the activity are affected, but these industries are generally not the same across the countries.

The picture presented here represents only one year, but shows much similarity across the countries when it comes to services. For manufacturing the evidence is more mixed. For quite a few industries, in particular in services, the changes are rather large compared to the sizes of the industries, and hence makes a difference for the development of the industries. To the degree these processes are more or less the same over time, a renewal of the industrial structures will result. This is, most importantly, dependent on the ability of the new establishments to survive and grow. If they are not successful in that respect, existing establishments and enterprises may expand and in effect conserve the existing industrial

[11] Please note that for Norway a change in sector codes for units in education and health has resulted in a sharp decline in both number of units and number of employees that is not a real effect of reductions in activity.

structure to a larger extent than one can get the impression of. We return to the issue of success for the new in chapters 6 and 7 below.

Table 4-13 Net effects 1999-2000 by industry. Sweden, Finland, Denmark, Norway. Number of establishments and number of employees

	Sweden	*Finland*	*Denmark*	*Norway*	*Sweden*	*Finland*	*Denmark*	*Norway*
Industry	*Est*	*Est*	*Est*	*Est*	*Emp*	*Emp*	*Emp*	*Emp*
Fishing	8	0	6	18	33	4	28	54
Mining etc	-6	-21	0	6	-41	-14	0	-8
Oil and gas extraction	0		0	0	-11		0	-505
Food, beverages, tobacco	-34	-14	3	-12	94	-110	-704	191
Textiles, leather	-7	-7	-10	-14	-76	39	-108	-80
Wood and wood products	-5	-23	1	-16	-643	123	-117	-252
Pulp and paper	-9	-5	-3	-5	48	-10	-74	-743
Printing and publishing	-63	-56	-4	8	-23	-1 095	-10	-41
Chemicals and refining	-2	5	7	5	-783	-713	2190	441
Pharmaceuticals	0	-2	1	3	-900	-69	7	-150
Rubber and plastic products	-6	-1	1	-2	144	-71	79	41
Mineral products (non-met)	-17	-7	3	-7	12	33	474	-467
Basic metals	-2	-4	0	7	153	31	-68	165
Metal products	2	16	9	-22	-449	862	8	102
Machinery and equipment nec	-17	16	10	-21	151	876	338	-304
Office m. radio, tele, instruments	-11	13	9	6	-1 603	-310	-137	199
Eelectrical machinery and app.	-7	6	17	-6	-164	219	383	-382
Transport equipment ex air tr.	12	4	-3	-8	701	99	-251	-1 626
Air transport	7	0	0	-1	29	0	-13	-2
Furniture and manuf nec	-6	-18	-1	-8	45	-144	101	11
Recycling	3	0	0	0	20	7	-13	-104
Utilities (electricity, water, gas)	-19	-17	5	-7	-324	140	311	46
Construction	289	71	365	205	-1 242	1 074	2243	977
Trade, hotels, restaurants	596	-292	847	439	3 930	2 759	5917	2 195
Transport and postal services	18	52	64	116	-717	2 752	1431	3 008
Telecommunications	86	74	26	27	1 678	2 328	615	284
Financial services, real estate, renting of machinery	107	7	100	109	1 395	362	485	2 693
Computer and related activities	807	275	386	281	4 909	3 104	3746	1 951
Research and development	34	16	11	16	-974	340	29	272
Other business services	1 035	211	390	371	10 020	3 869	2456	3 123
Education	101	23	1	-65	714	351	116	-3 469
Higher education	1	5	43	-3	17	39	265	-20
Health	210	164	0	-398	5 357	948	0	-5 652
Other services, extraterr. org	150	-10	98	10	955	297	508	195
Unknown	130		155	4	843		978	-79
Total	3 385	481	2537	752	23 298	18 120	21213	-1 278

Table 4-14 Net effects 1999-2000 by industry. Sweden, Finland, Denmark, Norway. Number of establishments and number of employees as a percent of total number of establishments and employees 2000

	Sweden	Finland	Denmark	Norway	Sweden	Finland	Denmark	Norway
Industry	Est	Est	Est	Est	Emp	Emp	Emp	Emp
Fishing	6,0	0,0	0,9	2,0	6,6	1,0	1,1	0,9
Mining etc	-1,7	-5,7	0,0	2,0	-0,6	-0,4	0,0	-0,2
Oil and gas extraction	0,0		0,0	0,0	-55,0		0,0	-2,0
Food, beverages, tobacco	-1,7	-1,1	0,2	-0,7	0,2	-0,3	-0,9	0,4
Textiles, leather	-0,8	-0,9	-1,6	-3,1	-0,6	0,3	-0,9	-1,2
Wood and wood products	-0,2	-1,9	0,2	-1,7	-1,7	0,5	-0,8	-1,7
Pulp and paper	-2,3	-2,2	-1,6	-4,4	0,1	0,0	-0,8	-8,0
Printing and publishing	-2,0	-3,4	-0,2	0,5	0,0	-3,8	0,0	-0,1
Chemicals and refining	-0,4	1,6	2,6	2,8	-3,3	-4,6	13,7	3,2
Pharmaceuticals	0,0	-6,5	1,3	9,7	-4,6	-1,4	0,1	-5,1
Rubber and plastic products	-0,6	-0,2	0,2	-0,6	0,5	-0,4	0,4	0,6
Mineral products (non-met)	-2,1	-1,1	0,5	-1,4	0,1	0,2	2,2	-5,0
Basic metals	-0,7	-2,8	0,0	4,7	0,5	0,2	-0,7	1,1
Metal products	0,0	0,7	0,4	-2,0	-0,5	2,3	0,0	0,5
Machinery and equipment nec	-0,6	0,9	0,6	-1,9	0,2	1,6	0,5	-1,4
Office m. radio, tele, instruments	-0,8	1,7	1,4	1,4	-2,1	-0,6	-0,5	1,8
Eelectrical machinery and app.	-0,9	1,6	3,0	-1,8	-0,6	1,3	2,2	-3,9
Transport equipment ex air tr.	1,2	1,0	-0,8	-1,1	0,8	0,5	-1,6	-4,5
Air transport	12,5	0,0	0,0	-12,5	0,3	0,0	-1,6	-0,4
Furniture and manuf nec	-0,5	-1,9	-0,1	-1,1	0,2	-1,0	0,3	0,1
Recycling	2,3	0,0	0,0	0,0	1,5	1,8	-3,5	-10,6
Utilities (electricity, water, gas)	-2,5	-3,1	1,2	-1,1	-1,5	1,2	3,4	0,3
Construction	1,5	0,7	2,9	2,0	-0,8	1,1	1,6	0,9
Trade, hotels, restaurants	1,0	-1,0	2,2	1,1	0,7	1,1	1,4	0,6
Transport and postal services	0,1	0,8	0,9	1,4	-0,4	3,1	1,0	2,3
Telecommunications	7,0	15,7	8,8	10,8	5,9	13,0	3,0	2,3
Financial services, real estate, renting of machinery	1,1	0,1	1,7	2,3	1,1	0,6	0,6	4,3
Computer and related activities	15,3	13,8	21,0	14,3	5,8	9,2	11,5	6,4
Research and development	7,4	10,5	11,2	9,6	-8,6	8,8	1,8	3,5
Other business services	4,7	2,2	4,6	3,6	4,2	3,6	2,5	2,6
Education	6,2	3,5	0,5	-6,5	4,7	6,8	1,6	-33,4
Higher education	9,1	15,6	5,4	-5,0	3,2	6,9	2,0	-1,3
Health	3,4	6,4	0,0	-5,7	6,9	5,9	0,0	-8,5
Other services, extraterr. org	2,5	-0,3	1,9	0,2	1,7	1,0	1,1	0,4
Unknown	10,1		3,4	1,6	18,2		2,2	-5,8
Total	2,0	0,6	2,5	0,7	1,0	1,6	1,4	-0,1

5 Spin-offs by labour tracking – narrowing down the case

In order to identify what we consider to be the real spin-offs and their backgrounds it is necessary to utilise labour tracking as explained in chapter 2. In the presentation below we differentiate three kinds of events that lead to new establishments. These are spin-offs, Greenfield births and other start-ups. All groups are generated from the "new-in-new" category described in chapter 4, consisting of establishments that have got new identities of both the enterprise it belongs to and of the establishment itself.[12] In addition comes corrections.

Firstly we identify the different kinds of start-ups and compare their numbers and employment between countries, over time and for high-tech and non-high-tech sectors. Secondly the information is broken down by industry and size classes, and thirdly by characteristics of the delivering establishment.

In addition we focus the special case of new establishments where at least one of the employees has a recent background in the research sectors (higher education or research institutes). For these cases we include even one person establishments in order to capture as many as possible of this kind. Start-ups with researcher participation are treated in part 5.4.

The different groups of new establishments are defined in line with the presentation in chapter 2, as follows:

1. Spin-offs

1. The new unit (spin-off) must be a new establishment in a new enterprise
2. There must be at least 2 persons from the delivering establishment in the new establishment
3. The persons spinning off must make up at least 30 % of the employees in the new establishment year 1
4. The persons spinning off must be less than 50 % of the employment in the delivering establishment year 0
5. The delivering establishment must be alive with at least 1 employee year 1

2. Greenfield births

This group consist of new-in-new establishments with at least two persons, where no more than one person originates from the same delivering establishment.

3. Other start-ups

This group includes all other new establishments (new-in-new) with at least two persons. It includes all the borderline cases where the requirements for being classified as a spin-off or Greenfield are not met. Parts of the observations therefore may have much in common with the spin-offs, and the size and composition of this group therefore is sensitive to modifications of the spin-off definition.

[12] The observed population in this chapter has been reduced in the same way as in chapter 4. This means that the population consists of all establishments with the following exceptions: Enterprises/establishments ruled by self-employed without any employees
One-person establishments
Establishments within the sector of public services
Establishments within agriculture and forestry
Establishments within non-profit sector

4. Corrections

Corrections are used to take care of cases where we consider that the establishment is not really new, i.e. it has been given a new identity number even if the activity seems to be a continuation of previous activity. The rule used here is that more than 80 per cent of the employees of the establishment come from one single establishment in the year before, or that more than 80 per cent of the employees of the "old" establishment is found in the new. In these cases the establishments are taken out of the other three categories and classified as a correction.

5.1 Describing variations of spin-offs

All in all a considerable number of new-in-new establishments are included in the analysis – around 27 000 *(see annex tables A5.1 and A5.2)*. Of these a total of some 4 100 spin-offs are identified in the four countries together, with almost 1 700 in Sweden, just over 600 in Finland, some 850 in Denmark and almost 900 in Norway (see Table 5-1*)*. The high-tech part of the spin-offs – defined by the sector of the new establishment – constitutes the minor part of the spin-offs. They total 311 in Sweden, 115 in Finland, 166 in Denmark and 135 in Norway – all together 727 establishments in all the countries. This, however, is the result for only one year, so that over time a considerable number may result.

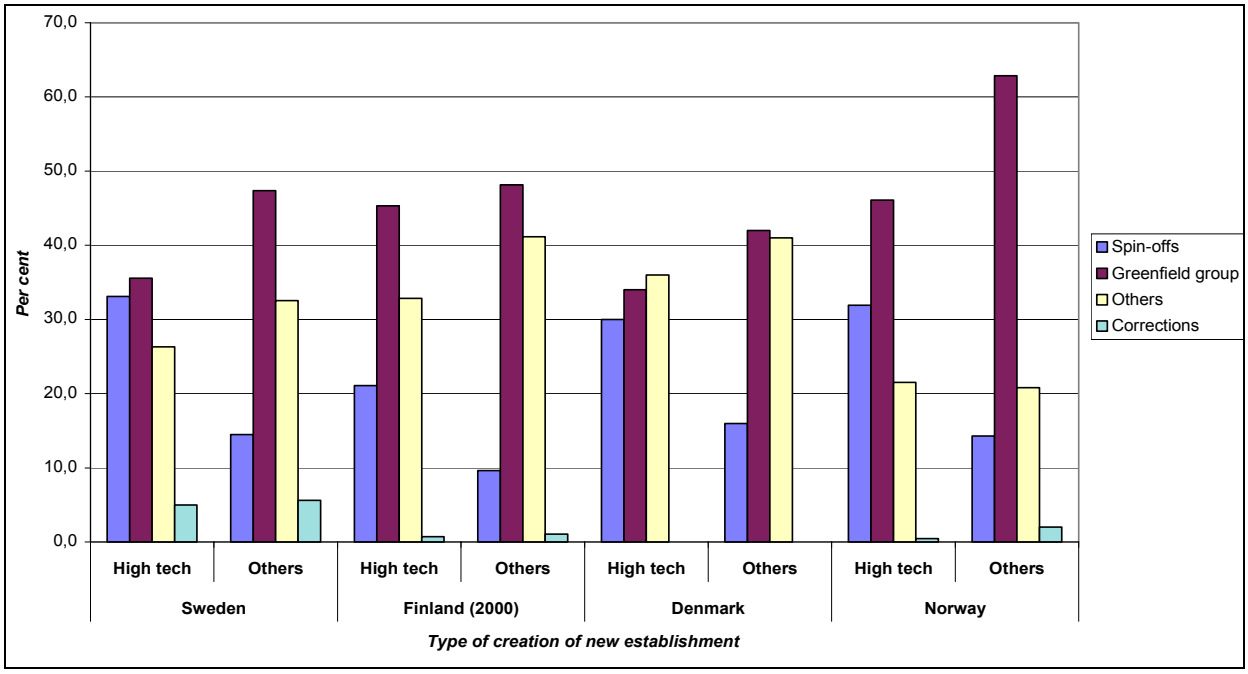
Table 5-1 Number of new establishments 2001 (2000) by type of demographic events.

	Sweden		Finland (2000)		Denmark		Norway	
	High tech	Others	High tech	Others	High tech	Others	High tech	Others
Spin-offs	311	1 355	115	503	166	783	135	760
Greenfield	334	4 431	247	2 513	189	2 020	195	3338
Others	247	3 044	179	2 147	197	1 961	91	1105
Corrections	47	525	4	55			2	106
Sum	939	9 355	545	5 218	552	4 764	423	5 309

Absolute numbers.

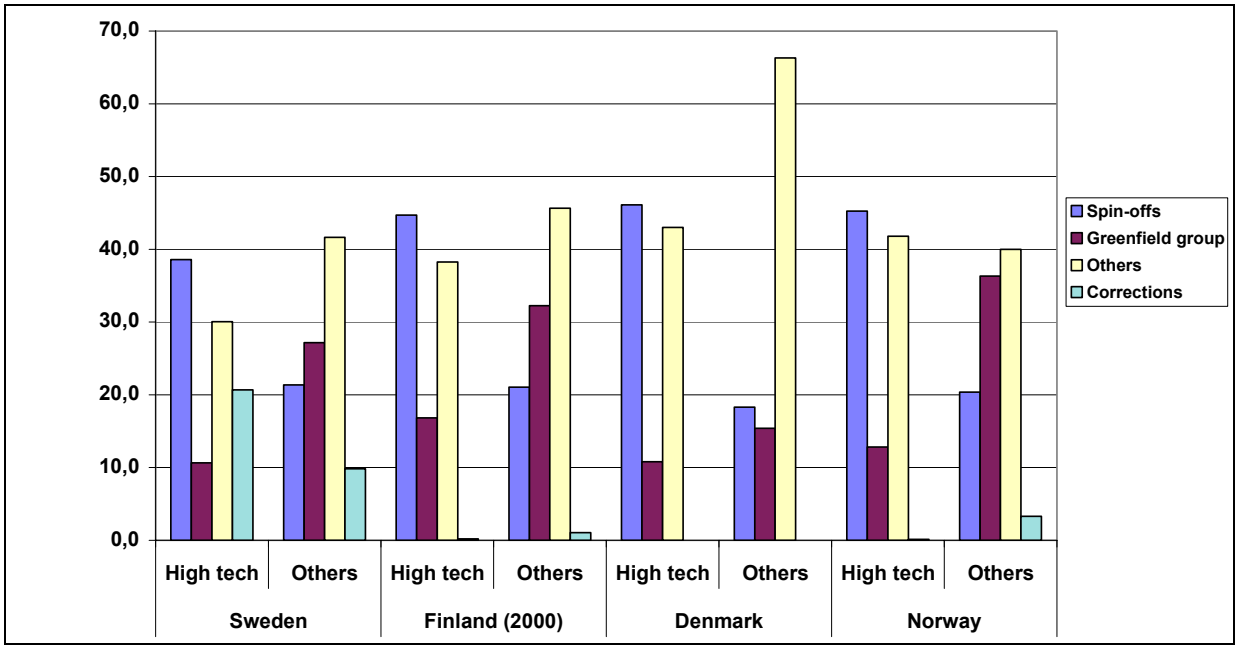
Out of all the new-in-new establishments the Greenfield cases make up the larger number in all countries as is illustrated in Figure 5-1 below, which means that most new establishments get their new staff from dispersed sources with only one person from each delivering establishment. This is the case both for high tech and other sectors. In second place we find the others group except for high-tech sectors in Sweden and Norway – in these cases spin-offs occupy the second place in the ranking. Spin-offs are generally the smaller group of the three. Corrections are of limited magnitude, but larger for Sweden than for the other countries.

Figure 5-1 New establishments by type of demographic event and industry type. Sweden, Finland, Denmark, Norway 2001 (2000). Percent.



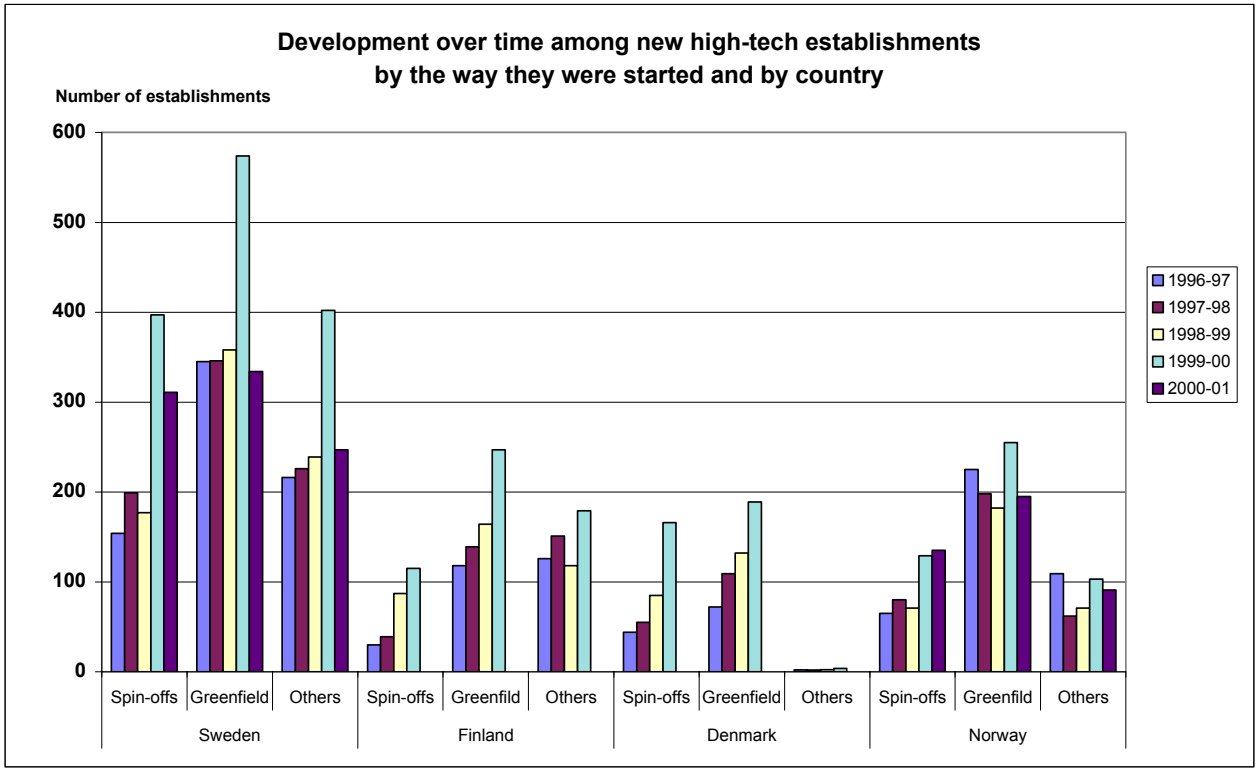
In Figure 5-2 the number and proportion of employees affected by the way new establishments are started are specified (see *annex tables A5.3 and A5.4* for details). The obvious difference compared with counting the number of establishments is that the dominating Greenfield group is exchanged with other ways of starting new establishments ("others") as the most common event among employees. This is most obvious among non-high-tech establishments in Denmark and Sweden, and is caused by the smaller average size of the Greenfield births. The relative importance of spin-offs in terms of employment is clearly bigger in high-tech sectors than in non-high-tech.

Figure 5-2 Number of employees in new establishments by type of demographic event and industry type. Sweden, Finland, Denmark, Norway 2001 (2000). Percent



Since the major part of our analysis concerns the latest available year, it is of importance to investigate if the results are in line with what is found for earlier periods. We have compared how the type of establishment creation is changing over time in the four Nordic countries studied (see *annex tables A5.5 and A5.6)*. In figure 5.3 this is examined among high-tech establishments. The number of new high-tech establishments is increasing in all countries independent of how they were developed. A clear peak can be seen for the development in the year 2000 (1999-00) especially in the Greenfield group. As for other changes there seems to be a downward trend in the share of Greenfield births except for Finland.

Figure 5-3 Development over time among new high-tech establishments by the way they were started by country



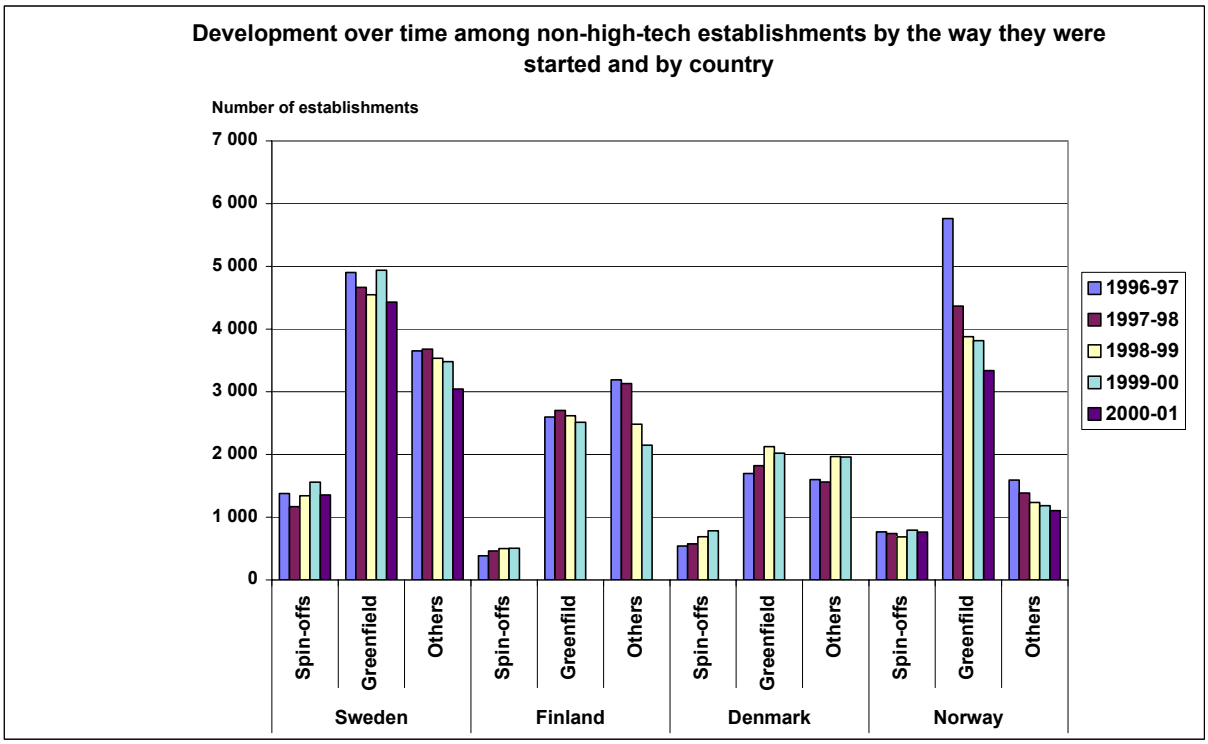
In Sweden the number and the proportion of high-tech spin-offs is increasing during the whole period. The same development but in a more rapid way can be found in Finland and Denmark, but in these countries also other forms of newly created high-tech establishments has increased. This is however not the case in Norway, where only the spin-offs category have increased among high-tech establishments during the period, while the Greenfield group and other new establishments show a more irregular picture over time.

Among non-high-tech new establishments the picture is evidently different (figure 5.4). In this group there are decreasing numbers over time. This picture is quite clear in Norway and Sweden, while Finland and Denmark shows a more irregular picture.

Apart from the above mentioned, the general picture though shows a relatively robust pattern between the different change categories over time within each country, and with the same basic pattern in all countries. In Norway, however, there is a particularly high share of Greenfield births at the cost of lower shares in the "other"-group compared to the other countries.

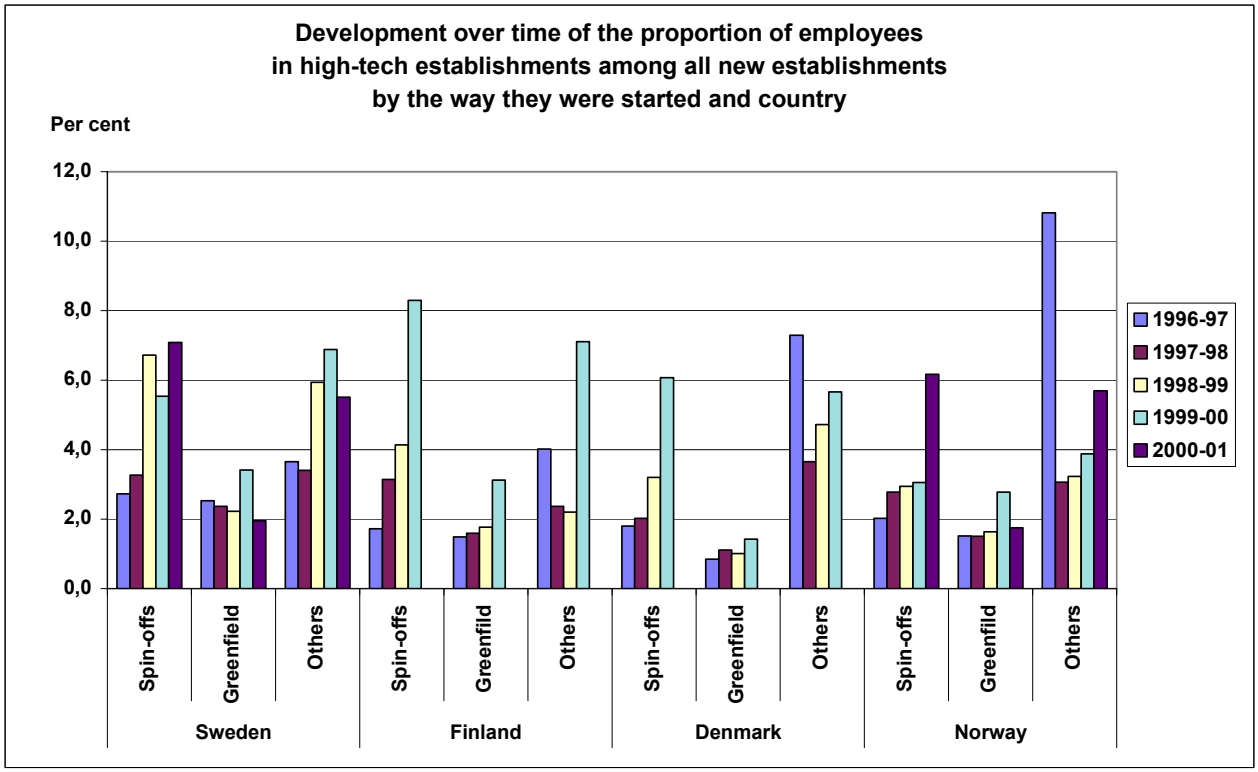
In all, even if the high-tech group is growing, keeping this in mind there is nothing very different in the composition of types of new establishments in the latest year which we focus here, compared to the previous periods. This changes somewhat when we look at the numbers of employees below.

Figure 5-4 Development over time among non-high-tech establishments by the way they were started and by country



The mentioned pattern is more accentuated when the number of employees is counted instead of the number of establishments (*annex tables A5.7 and A5.8*). In all countries 6-8 per cent of all persons affected by new establishment creation are in high-tech spin-off establishments in 2000-2001, while the same proportions in the beginning of the period (1996-97) were between 1,7 and 2.7 per cent in the four countries. The development is illustrated in Figure 5-5 below.

Figure 5-5 Development over time of the proportion of employees in high-tech establishments among all new establishments by the way they were started



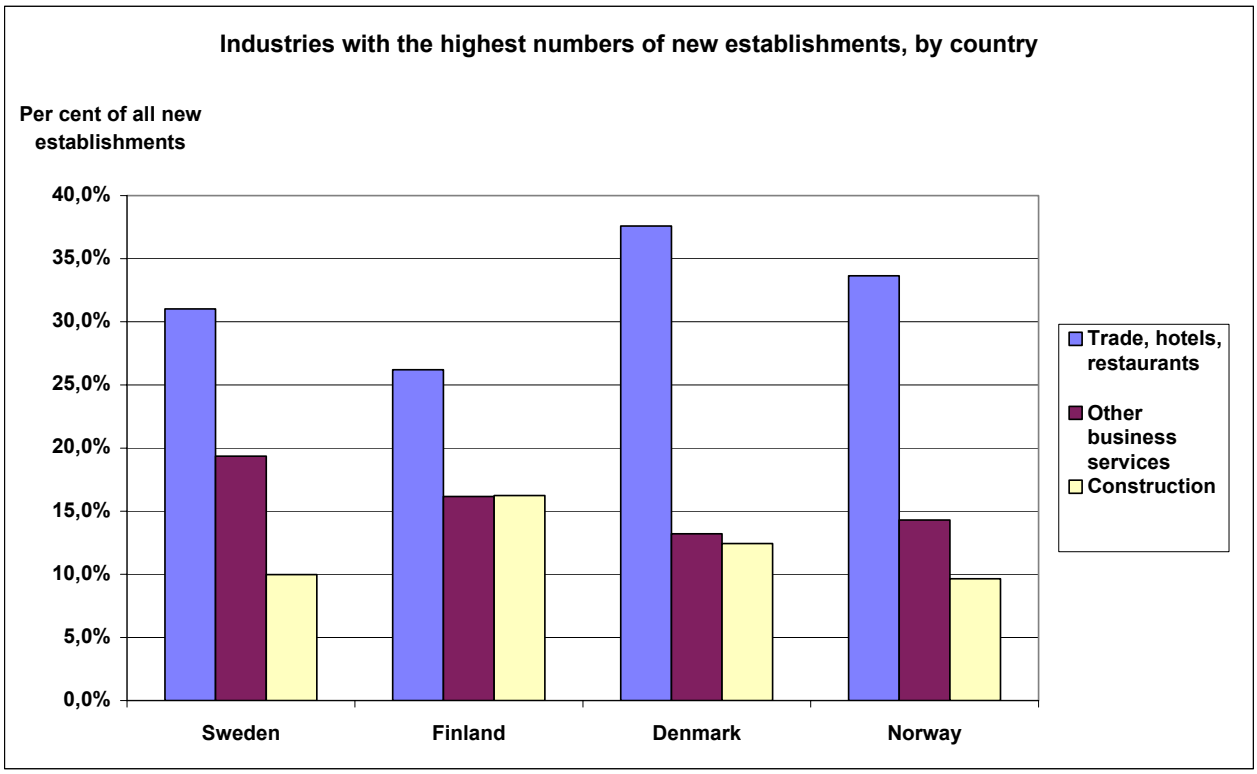
5.2 Spin-offs by industry and size

As was illustrated in chapter 4, the major part of dynamism takes place in service industries. We now look closer into the different types of creation of new establishments in different industries. This contributes to explaining changes in industrial structures as a result of business demographics. The way new establishments are created by industry and by size for the four countries is shown in *annex tables A5.9 to A5.16*.

In Sweden the distribution by industry *(annex tables A5.9 and A5.10a*) shows that among a total of 9 722 new establishments, almost a third is related to the industry of "Trade, hotels and restaurants" (Figure 5-6). Another industry with a high amount of new establishments is "Other business services" with around 1 900 new establishments. High-tech industries account for about one tenth of all new establishments in Sweden. Among these, "Computer and related activities" stand for the highest number, which is almost 700 new establishments. Classifying by the way the new establishments are created, the high-tech industries have a much larger proportion of spin-offs than among all new establishments. The highest amount of spin-offs is still among "Other business services" (363 establishments), but the high-tech industry "Computer and related activities" has had as many as 231 spin-offs in 2001.

In Finland "Trade, hotels and restaurants" is dominating among the new establishments more than in Sweden. Of 5 763 new establishments in 2000 as many as 1 510 were in the "Trade industry". Also in Finland the industry "Computer and related activities" was dominating among new high-tech and still more among high-tech spin-offs.

Figure 5-6 Industries with the highest numbers of new establishments by country



In Norway and Denmark the pattern from Sweden and Finland is repeated with the same industries in the top concerning all new industries as well as high-tech industries created by spin-offs.

From *annex table A5.10 b* it is possible to see how common the development of new establishments is in relation to total number of establishments in each industry. The share of new establishments among those industries with the highest amount of new establishments mentioned earlier turns out to be rather low, around 5 per cent which is just a little more or almost equal to the mean.

The highest share of new establishments are in the "computer industry", "research and development" and "telecommunications" in all countries. In most industries the shares of new establishments in the four countries are somewhat more than 10 per cent. From this "rule" Norway diverges with a low proportion new establishments within "research and development" (2,8 per cent) and "telecommunications" (6,6 per cent).[13] On the other hand Denmark shows exceptions with very high proportions within "manufacture of electrical machinery and apparatus nec" (25,3 per cent) and "education" (15,6 per cent).

Comparisons of new establishments within high-tech and other industries confirm differences between the countries (*annex table A10 b*). In Sweden and Norway the high tech industries are over represented among new establishments (Figure 5-7), while the establishments belonging to non-high-tech industries are more common in Finland and Denmark.

[13] One should keep in mind that large parts of the industry "research and development" is classified as private non profit and thus left out of the analysis.

Figure 5-7 Proportions of new establishments of high-tech and other industries

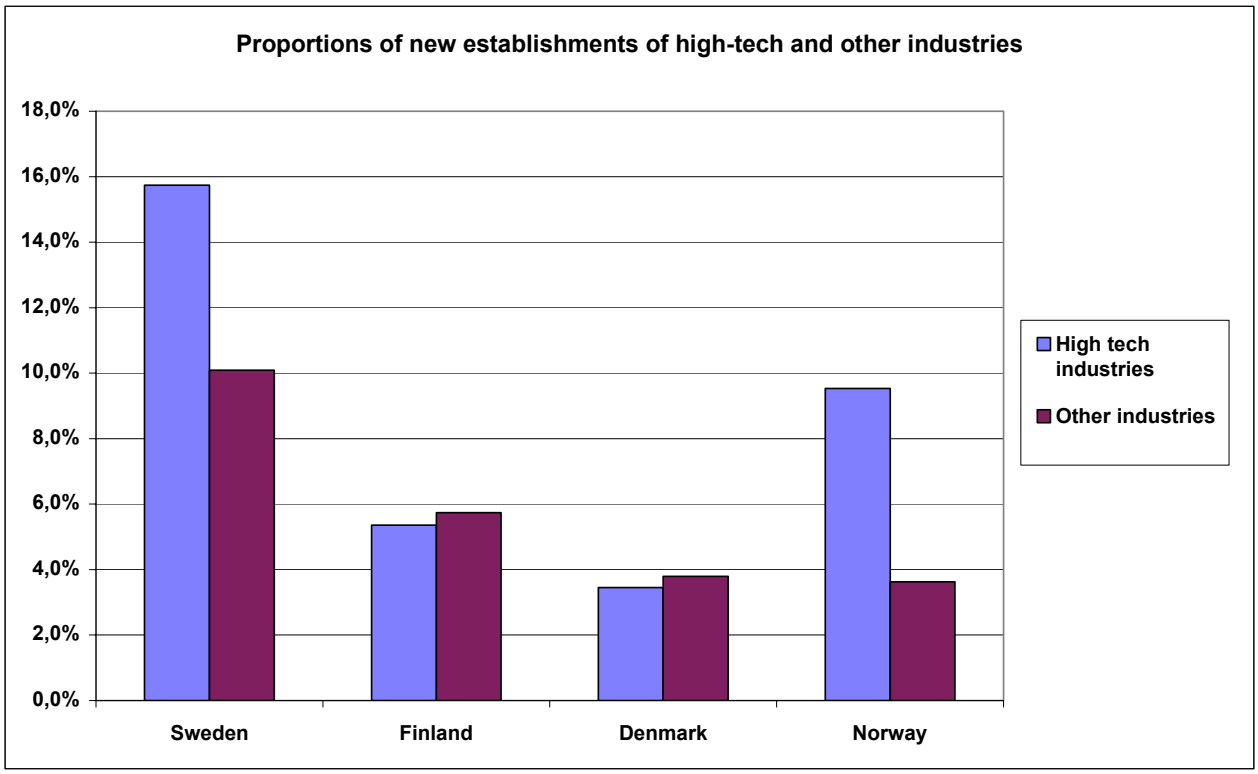
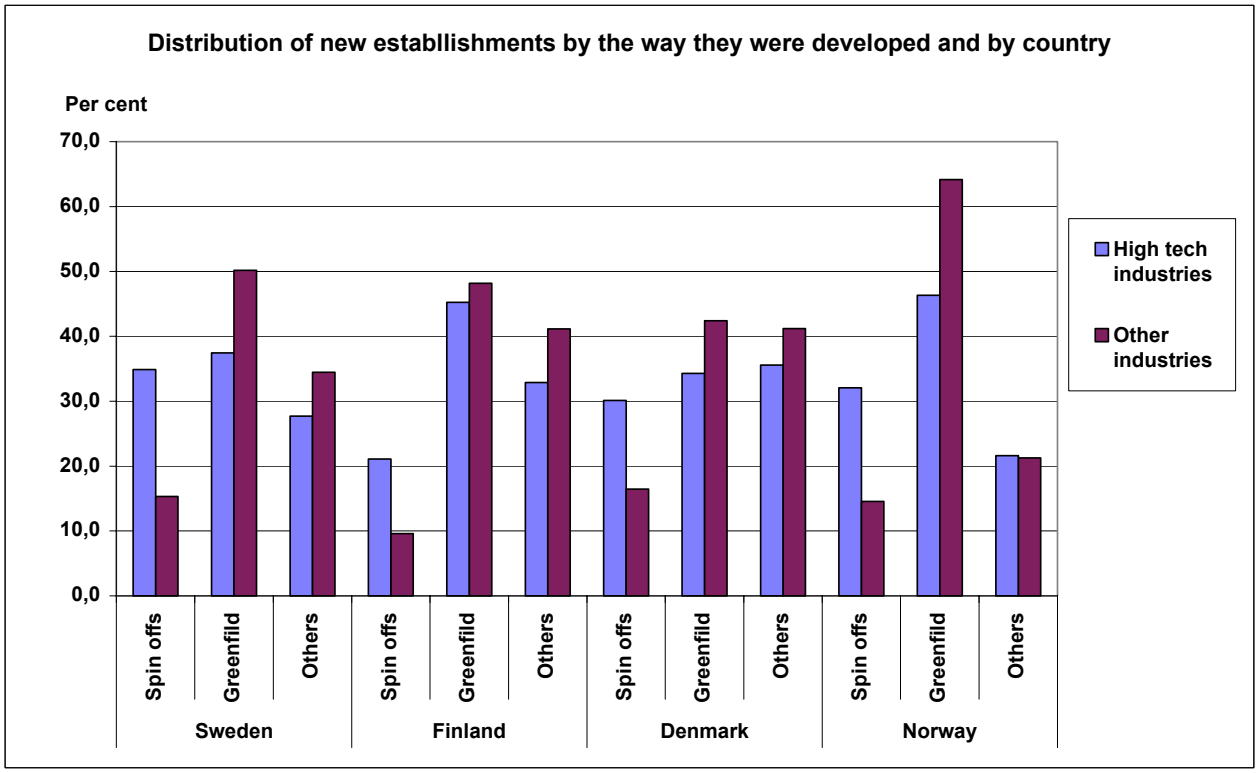


Figure 5-8 Distribution of new establishments by the way they were developed and by country

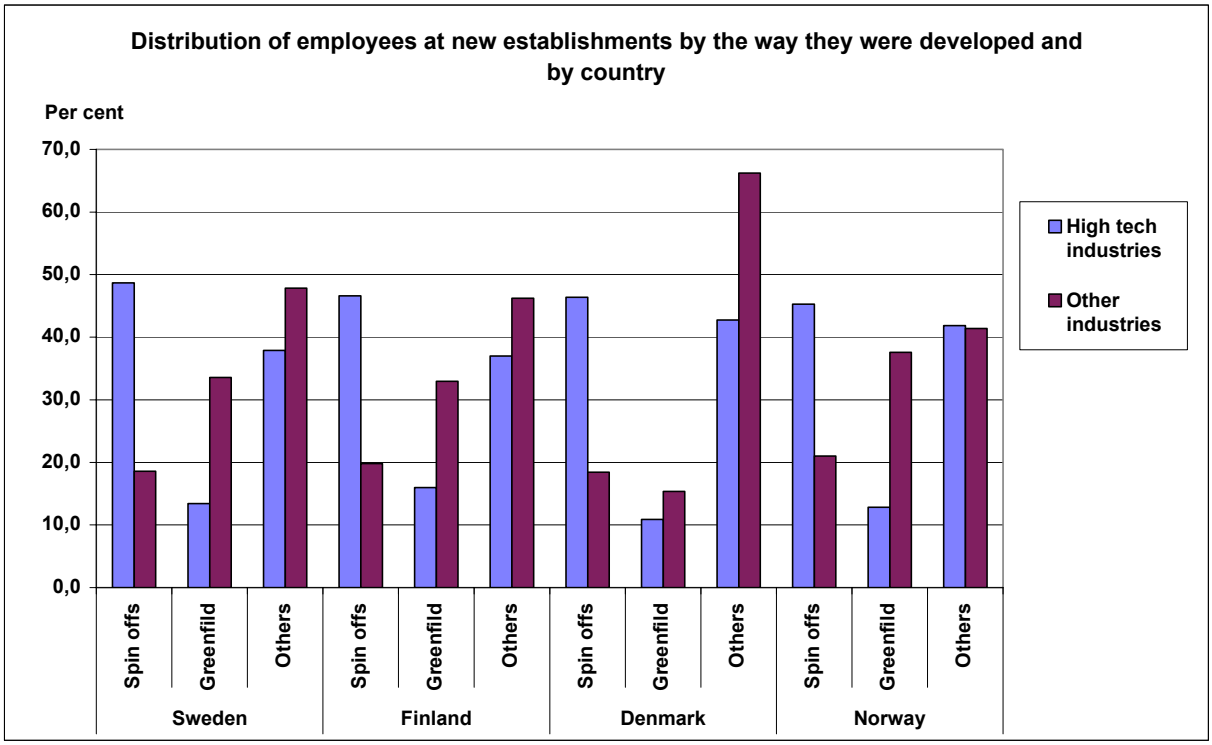


The percentage distribution shown in *annex table A5.10 c* compares which type of demographic event that has been most common when the establishments have been created

within and not within a high-tech industry. The Greenfield case dominates both in the high-tech and other industries in all countries (Figure 5-8).
The only hesitation concerns Finland, where "other" types of new establishments occur almost as often as "Greenfields". Spin-offs appear to be much more common among high-tech industries than among the non-high-tech.

Looking at the distribution of employees (*annex tables A5.11 and A5.12*) we can observe that there are much higher proportions of persons that are affected by spin-offs and other events than by Greenfield births. This depends on the fact that spin-off establishments as well as "others" generally are much bigger than the "Greenfield" establishments (Figure 5-9).

Figure 5-9 Distribution of employees in new establishments by the way they were developed and by country



Our next focus is on the size of the exclusively spin-off establishments (see *annex tables A5.13 - A5.16)*. As illustrated in Figure 5-10 the smallest size groups are dominating both in high-tech and non-high-tech industries in all countries.

Figure 5-10 Number of spin-offs by size of the establishment and country

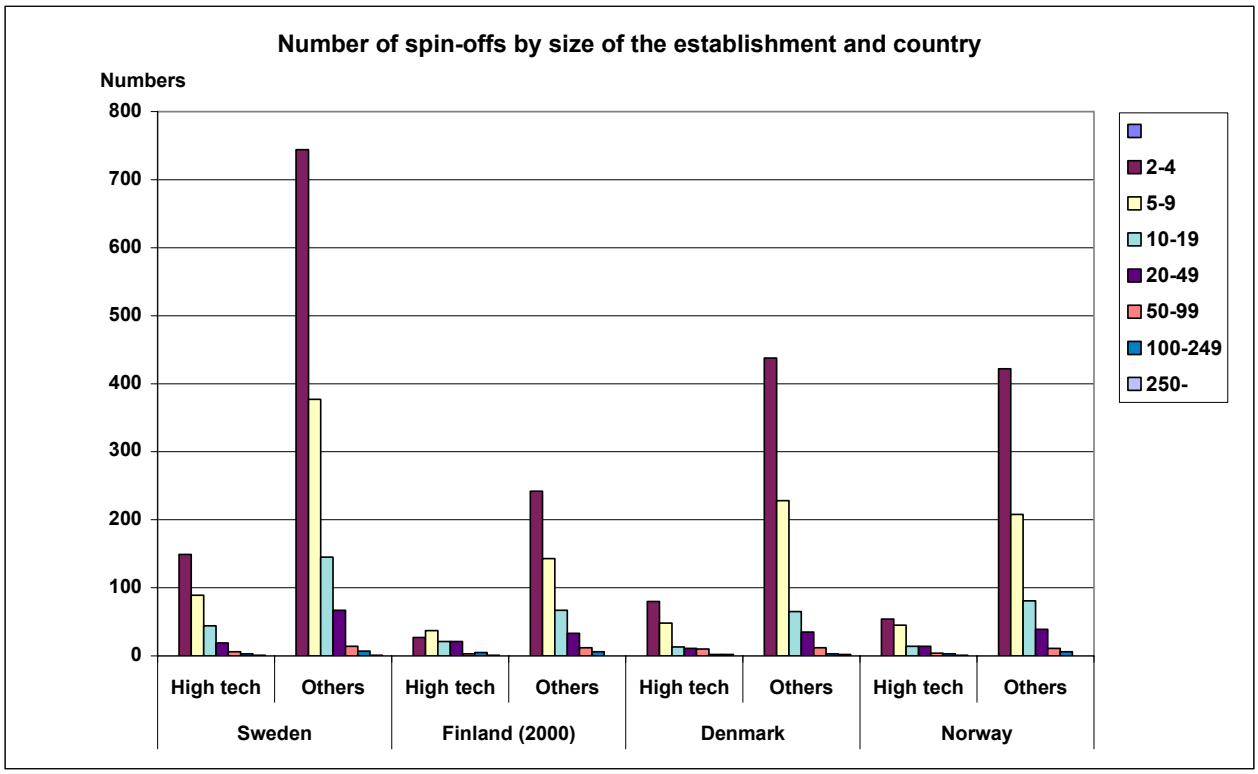
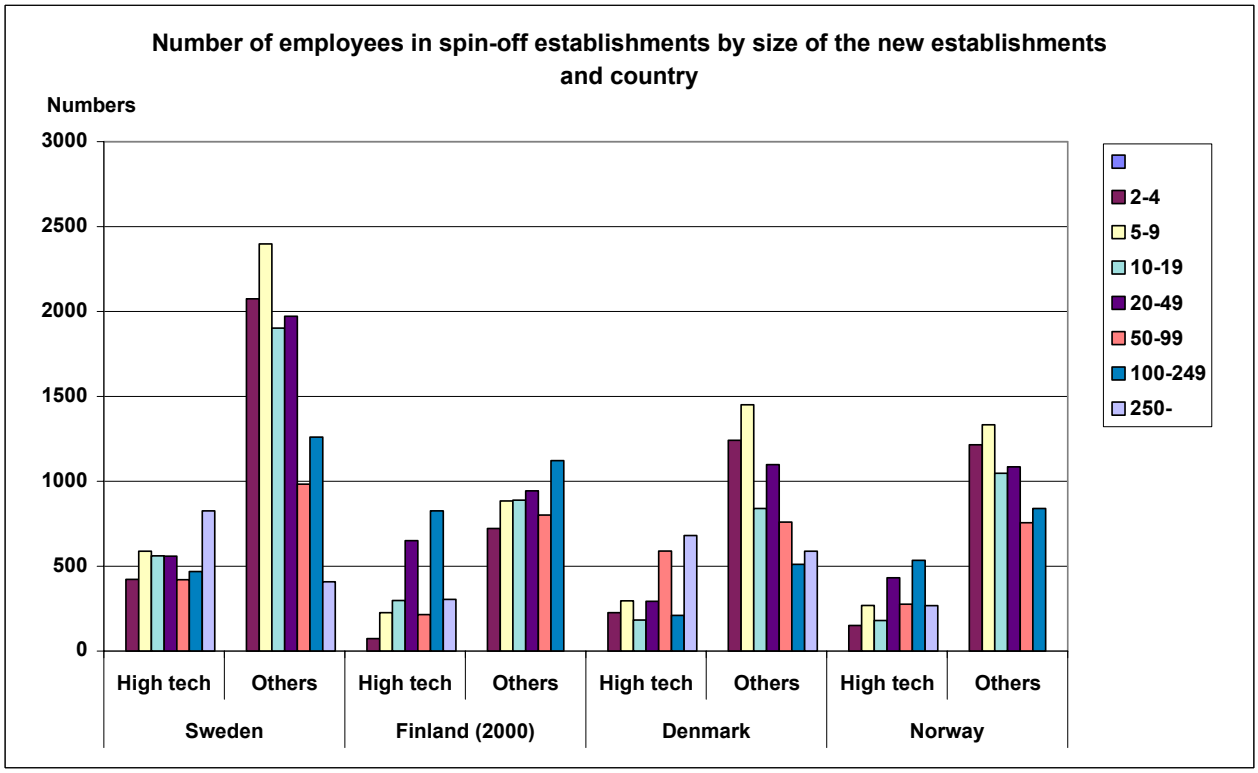


Figure 5-11 Number of employees at spin-off establishment by size of the new establishments and country



When weighting with the number of employees affected by the spin offs we get quite another picture of the relationship between the size classes (Figure 5.11). The larger numbers of employees in the larger size classes to a large extent outweighs the larger numbers of cases

among the smaller establishments. However there are differences between the countries. Among the establishments that are not among high-tech industries, the small spin-off establishments have got more employees. The exception is Finland, where there is quite clear that the big establishments hold more employed persons also among non-high-tech local units.

5.3 Spin-offs by characteristics of delivering establishment

An alternative way of classifying spin-offs is to look at characteristics of the delivering establishment. This was taken up as an alternative way of identifying high-tech activity in chapter 3, and is followed up in part 5.4 below where the focus is spin-offs with participation of a person originating in the research sector. Here we look at the size and industry of the delivering establishments.

As is evident from Table 5-2 below the major part of spin-offs originates in non-high-tech industries. This is to the major part due to the dominating size of these industries. Going into the details we find that industries within the high-tech sectors are over-represented as delivering establishments for spin-offs (see *annex tables A5.21 – A5.24)*. Non-high-tech industries accounts for practically an identical amount in Denmark, Finland and Sweden (82,5 percent), and somewhat more in Norway. When it comes to distribution between different delivering high-tech industries, the same ones dominate in all the countries, but to varying degrees. The most important delivering high-tech industry is computers and related industries. In Sweden and Finland also telecommunications has some impact, whereas the other industries in Norway and Denmark all are of more marginal importance.

Table 5-2 Percentage of spin-off establishments by industry of the delivering establishment and by country 2001

Delivering industries	Sweden	Finland (2000)	Denmark	Norway
Pharmaceuticals	0,5	0,0	0,0	0,2
Manufacture of office machinery and equipment, radio, tele, instruments	1,4	2,4	0,7	1,4
Manufacture of electrical machinery and apparatus nec	1,2	0,8	0,7	0,8
Air transport	0,1	0,0	0,0	0,0
Telecommunications	2,5	6,1	0,8	0,7
Computer and related activities	10,7	7,4	14,2	7,2
Research and development	0,7	0,5	0,9	0,4
Higher education	0,5	0,0	0,0	0,4
All high tech industries	17,5	17,3	17,5	11,2
From other industries	82,5	82,7	82,5	88,8
All industries	100,0	100,0	100,0	100,0

When counting the number of persons in the spin-off the picture is more dispersed (see *annex table A5.24*). The "Computer and related industries" are then even more important, in Denmark 90 percent of the persons spinning out from high-tech industries belong to this industry. In Finland the "telecommunication" industry stands for the highest proportion (57 percent).

Figure 5-12 Percentage of spin-off establishments by size of the original establishment and by country 2001

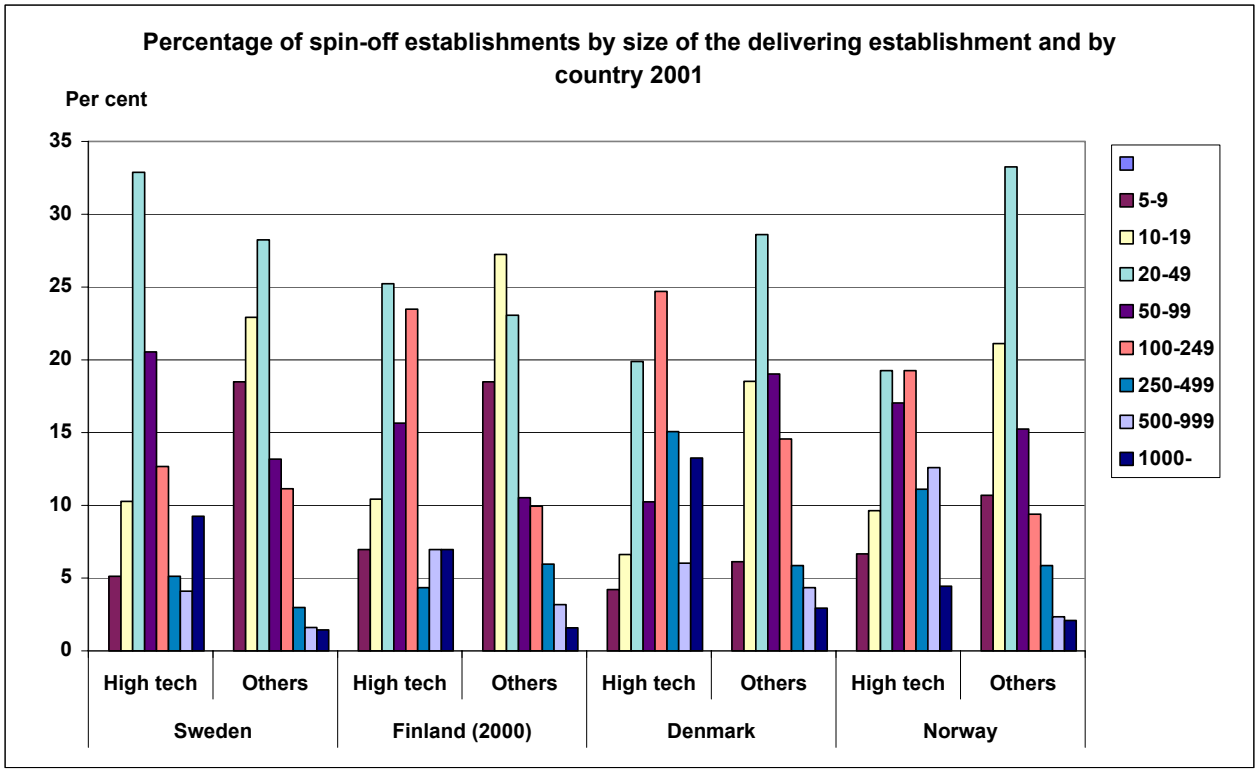
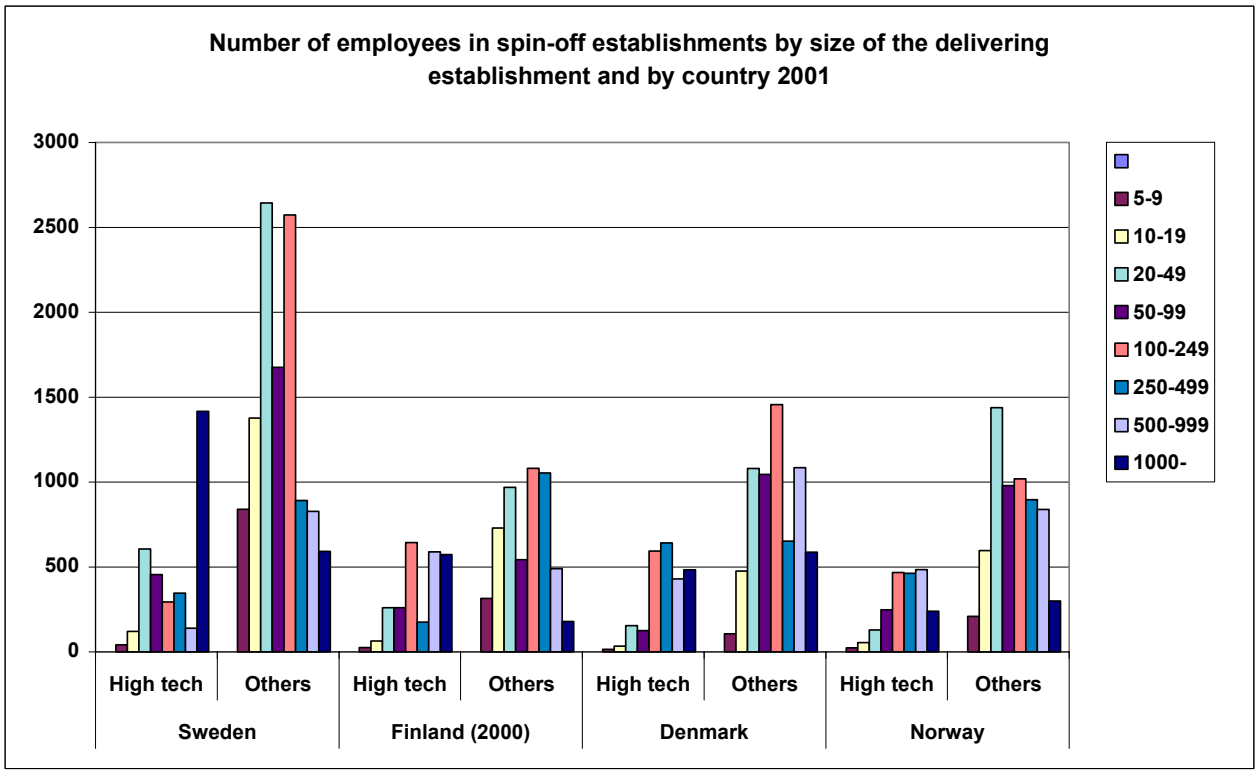


Figure 5-13 Number of employees at spin-off establishments by size of the original establishment and by country 2001



Besides the industrial background of delivering establishments it is of interest to know if spin-offs basically occur from small units, or whether the larger ones are dominating. This is illustrated in Figure 5-12 below for numbers of spin-offs, and in Figure 5-13 for total numbers of employees in the spin-offs. Size of the delivering establishments is grouped according to the number of employees.

In terms of number of new spin-off establishments the moderate size classes seems to dominate the picture in all countries, with some tendency in the direction of larger delivering establishments for high-tech than for non-high-tech. Weighing by the number of employees in the spin-offs makes the picture more fuzzy, but generally results in tilting the importance of the larger delivering establishments upwards. That indicates a larger average size of spin-offs from larger companies than from smaller ones.

Lastly we include an overview of the number of new establishments within the high tech group of industries (see *annex tables A5.25 – A5.28)*. The first obvious notice is that the "computer and related industries" is dominating also among the new spin-off establishments in all countries (58 – 84 per cent) with "telecommunications" on second position in three of four countries.

The numbers of employees involved in the new spin-off establishments are also dominated by the industries mentioned above.

5.4 New establishments with researcher participation

We will now briefly look at the topic of high-tech spin-offs from a somewhat different angle, by looking at new establishments with researcher participation. The idea is that the new establishments then may be seen as spin-offs from the research activity.

In this section we have only data for Norway, Sweden and Finland, and thus have to exclude Denmark.

We use the same data sources as elsewhere in this project. This means that the definition of researcher and of new establishment must be based on the information contained in the matched employer-employee register data.

The definition of a new establishment brings in nothing new in relation to what has been presented elsewhere in this report. We are looking at establishments where both the establishment itself and the enterprise in question are new, i.e. category 6 as defined in Chapter 4, above.

We will look at all new establishments regardless of whether they are 'spin-offs' or 'greenfield births' or 'other new' as defined above, though excluding the error corrections, i.e. the cases where we have reason to believe that a continuing ('old') establishment has been assigned a new identification number by mistake.

We will here *not* exclude new establishments with only one person employed, i.e., in this case where the researcher employs only himself or herself.

5.4.1 Definition of researcher

Our definition of researcher must be based on the information in the employee register data. These data tell us which establishment the employees work for, and which industry the

establishment is in, but it does not tell us more precisely what kind of work each employee performs.

Our definition has three elements: which sector one works in, level of education, and a condition relating to time.

1. Sector. To be classified as a researcher, one must work within the R&D institute sector or within higher education.[14] There are many people who work as researchers outside of these sectors, for instance inside R&D departments in large manufacturing enterprises. These are not captured by our definition. Our definition thus explicitly focuses on the effects of the activities in the R&D institute and higher education sectors.

2. Education. To classify a person as a researcher we also require that the person has higher education.[15] This is in order not to register people who do different kinds of service jobs in the institution, but who do not work as researchers. There is, of course, a danger that we will here also register as researchers some people in higher administrative jobs who have nothing to do with research or the management of research as such. We have not made any requirements as to the kind of higher education the person has. We have, for instance, not made any requirement that the person must have higher education inside engineering or natural science.

3. Time aspect. We also have to specify *when* the person in question must have been a researcher in the above sense. Here we have used two different criteria, one stricter than the other. The stricter criterion says that the person must have been a researcher in the above sense the year before the new establishment appears, i.e. in our case in the year 2000. The less strict criterion says that the person must have been a researcher at least one of the three preceding years, i.e. in our case at least one of the years 1998, 1999 or 2000.

5.4.2 Delimitation of industries

We have excluded some industries when counting new establishments in this case. This applies to the R&D institute and higher education sectors themselves, and to the rest of education. Furthermore we have excluded the primary industries except fish farming, public administration, health services and member organizations.[16] The motivation for this is to capture the dynamics that take part in the private business sector.

5.4.3 How good is the indicator?

This is no "perfect" indicator for research based startups. It is imperfect when it comes to who will be counted as a researcher. Furthermore, even when we correctly classify a person working in a new establishment as a former researcher, we cannot know if this person simply has decided to start working with something completely different. In this case the new establishment cannot be said to be generated from research, and we will consequently be registering something we do not intend to register.

[14] R&D institute sector is NACE 73, higher education is NACE 80.3.
[15] Higher education is classified according to the ISCED standard at levels 5 A and 6 or higher. Comparisons of education levels across countries are difficult and are one likely source of differences between the countries in the numbers of researchers identified.
[16] Rest of education is NACE 80 apart from 80.3. Primary industries are NACE 02 and 01, fish farming is NACE 05.02. Public administration is NACE 75, health services NACE 85 and member organizations NACE 91.

It is in this connection also a problem that we have no information on the roles or positions of the different employees in the new establishment, so we do not know whether the researcher is the entrepreneur or is taking part in launching the enterprise, or whether he or she has simply applied for a job in an enterprise which someone else established. We nevertheless believe that this indicator may give valuable information on the extent of the phenomenon of researcher participation in the establishment of new business enterprises. At least when it comes to research based spin-offs and other startups where the researcher him- or her self participates it will be registered. In this sense the analysis captures an outer bound of such activity.

5.4.4 Strict definition of researcher participation

The strict definition requires that one has worked as a researcher in the above sense the year before the new establishment was started. In our case this means the year 2000 (1999 for Finland). This definition gives the following figures for Norway, Sweden and Finland (see Table 5-3).

Table 5-3 New establishments with researcher participation 2001, strict definition.

	Norway	Sweden	*Finland
No. of establishments	55	320	73
No. of researchers	64	355	91
No. of employees	952	2442	1 366
average researchers per establishment	1.2	1.1	1.2
average employees per establishment	17.3	7.6	18.7

Strict definition of researcher: educated worker in research sector the year before the start-up.
*The figures for Finland apply to 2000, and correspondingly the definition of researcher refers to 1999.

To take Norway as an example, there are 55 new establishments with researcher participation in 2001, with 64 researchers involved. In 51 of the establishments there is only one researcher involved, and the average number of researchers per establishment is only 1.2. The average number of employees in these establishments is 17.3, but here the distribution (not unexpectedly) is very unequal (positively skewed). The median is only 3, the third quartile is 10. In the small number of cases where the researcher accounts for a quite small proportion of the employees one may doubt if we are dealing with researcher participation in the launching of the establishment. But, as pointed out above, we do not know whether the researcher in question is an entrepreneur or leader or a subordinate employee.

There are clear differences in the level of researcher participation in new establishments across the countries. In particular, Sweden stands out from the other two countries. While Finland and Norway have about the same size of their economies, Finland has a somewhat higher number of new establishments with researcher participation and of researchers involved than Norway, more precisely 33 and 42 per cent higher, respectively. For Sweden, on the other hand, both these figures are more than five times as high as the Norwegian, and about four times the Finnish. Even though Sweden has an economy which is substantially larger than the Norwegian and the Finnish economies, these differences are not large enough to account for the differences in the number of new establishments with researcher participation.

It is not immediately easy to explain why we get so large differences in the number of new establishments with researcher participation across the countries. We suspect that differences in the cut-off level for higher education are a contributing factor behind the difference. Another factor is the differences in the total population of researchers across the countries, as here

defined. Table 5-4 compares the number of researchers involved in new establishments in 2001 to the total population of researchers the year before, and shows the ratio between these two magnitudes.

Table 5-4 The total population of researchers in 2000, the number of these which we find in new establishments in 2001, and the ratio, in per cent, of the latter to the former figure.

	Norway	Sweden	*Finland
Population of researchers 2000	17745	43556	24339
Researchers in new establishments 2001	64	355	91
Ratio, per cent	0.36	0.82	0.37

*The figures for Finland apply to 2000, and correspondingly the definition of researcher refers to 1999.

To take Norway as an example again, we see that according to the definition of researcher used here, the total population of researchers in 2000 is 17745. Of these we find 64, or 0.36 per cent, in new establishments in the following year.

We see that the difference between Finland and Norway in the number of researchers participating in new enterprises is mirrored by a similar difference in the size of the population of researchers, so that the proportion of researchers involved in new establishments is virtually the same in the two countries.

In Sweden the total population of researchers is somewhat less than twice as large as in Finland, which is reasonable. However, the number of researchers involved in new establishment was four times as large. Thus, Sweden has a ratio of researchers involved in new establishments out of the total population of researchers of 0.82 per cent, more than the double of the Norwegian and Finnish ratios.

5.4.5 Less strict definition of researcher participation

A less strict definition of researcher participation we get by making the condition on time less demanding. Still keeping the conditions on sectors and education, one may require that to be counted as a researcher one must not necessarily have worked as a researcher the year before the start-up of the new establishment, but only for some time in the course of a longer period. Here we have chosen as an alternative specification of the time requirement that one must have worked as a researcher at least one of the last three years, i.e. in our case one of the years 1998-2000.

In addition to those included under the stricter definition we now also count as researchers those persons who did not work as researchers last year, but who did at least one of the two preceding years. These additional persons may have had another type of job between working as a researcher and participating in starting up a new business, or they may in this period have worked as a researcher in enterprises in sectors other than the R&D institute or higher education sectors.

With this less strict definition, we get the figures presented in Table 5-5:

Table 5-5 New establishments with researcher participation 2001, less strict definition

	Norway	Sweden	*Finland
No. of establishments	87	528	111
No. of researchers	113	637	145
No. of employees	1855	4238	2 724
average researchers per establishment	1.3	1.2	1.3
average employees per establishment	21.3	8,0	24.5

Definition of researcher: educated worker in research sector at least one of the three years before the start-up.
*The figures for Finland apply to 2000, and correspondingly the definition of researcher refers to the period 1997-1999.

With this less strict definition more employees are counted as researchers, and we register more new establishments with researcher participation and more researchers involved in these. The pattern is by and large the same as in Table 5-3 above, including the differences in level among the countries.

5.4.6 Distribution by sector

We will now look at some distributions by a rough sectoral classification into 5 groups.[17] We use the less strict definition of researcher, based on fulfilling the sectoral and educational requirements at least one of the last three years. We then get more observations than when using the stricter definition, and thus get more substance to the distributions.

We first look at the number of new establishments with researcher participation, which is shown in Table 5-6 below:

Table 5-6 New establishments with researcher participation 2001, by sector.

	Norway		Sweden		*Finland	
	no.	per cent	no.	per cent	no.	per cent
high tech manufacturing	4	4.6	9	2.1	4	3.6
other manufacturing	3	3.4	15	3.5	5	4.5
knowledge intensive services	73	83.9	312	72.1	84	75.7
other services	6	6.9	92	21.2	16	14.4
other sectors	1	1.1	5	1.2	2	1.8
total	87	100	433	100	111	100
unknown			95			

*The figures for Finland are for 2000.

For all the countries we find that a clear majority of the cases of new establishments with researcher participation are found inside knowledge intensive business services, which

[17] We use a 5 sector classification since the number of observations are limited, as follows:
1) High tech manufacturing: Pharmaceuticals (NACE 24.4), office machinery and computers (NACE 30), electrical machinery (NACE 31), radio, television and communication equipment (NACE 32), instruments (NACE 33), and aircraft and spacecraft (NACE 35.3).
2) Other manufacturing: The rest of manufacturing (NACE 15-37, excluding high tech manufacturing).
3) Knowledge intensive business services: Telecommunications (NACE 64.2), Computer activities (NACE 72), and other business activities (NACE 74).
4) Other services: The rest of the service sector.
5) Other activities: Fish farming (NACE 5.02), mining and quarrying (NACE 10-14), electricity, gas and water supply (NACE 40-41).

accounts for between 70 and 85 per cent of the cases.[18] The differences across the countries which we observe here are not statistically significant.[19]

Many of these cases under knowledge intensive business services are more precisely classified under 'other business activities,' i.e. consultancy. In Norway, for instance, this applies to 48 cases, which is 66 per cent of the cases under knowledge intensive business services, and 55 per cent of all cases of new establishments with researcher participation.

We also see that Sweden has a substantially higher proportion inside 'other services' than Finland and, especially, Norway. The differences among the countries seem to be statistically significant here. If we distinguish between 'other services,' on the one hand, and all other sectors, on the other, we find that the differences among the countries are significant at the 1 per cent level[20].

Let us now look at the number of researchers involved. This is shown in Table 5-7 below.

Table 5-7 The number of researchers in new establishments 2001, by sector.

	Norway		Sweden		*Finland	
	no.	per cent	no.	per cent	no.	per cent
high tech manufacturing	7	6.2	55	10.2	9	6.2
other manufacturing	3	2.7	29	5.4	5	3.4
knowledge intensive services	96	85.0	355	65.9	110	75.9
other services	6	5.3	95	17.6	18	12.4
other sectors	1	0.9	5	0.9	3	2.1
total	113	100	539	100	145	100
unknown			98			

*The figures for Finland are for 2000.

There are few important differences from the distribution of establishments with researcher participation. In Sweden the mean number of researchers in new establishments with researcher participation in high tech manufacturing is a little above 6, whereas for the other combinations of sector and country it is less than 2, apart from high tech manufacturing in Finland, which has 2.25. Therefore the largest discrepancy between the share of establishments and the share of researchers is for high tech manufacturing in Sweden, which accounts for 10 per cent of the researchers but only 2 per cent of the establishments.

5.4.7 Researcher participation relative to all new establishments

We will now compare the sectors and the countries with regard to the relative frequency of new establishments with researcher participation, expressed as a proportion of all new establishments. We still use the less strict definition of researcher, counting as researchers all who satisfy the sector and education requirements at least one of the three last years prior to the start-up of the new establishment. Tables are collected in the statistical annex.

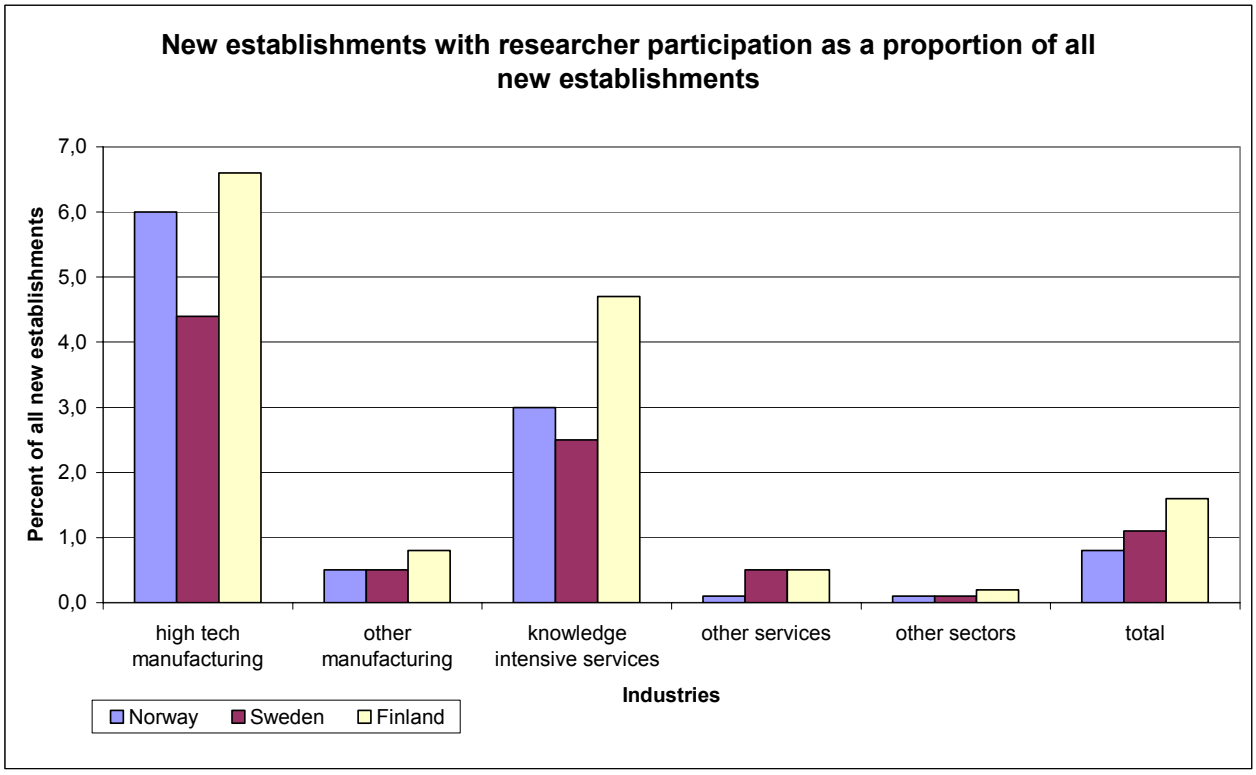
[18] For Sweden information on industrial classification is missing in 95 establishments, or close to 20 per cent of all cases.
[19] We here distinguished between knowledge intensive business services and all other sectors and then performed a chi square test.
[20] A chi square test is performed.

In the case of Norway there are altogether 10510 new establishments in Norway in 2001. Of these, 87, or 0.8 per cent, have researcher participation. This ratio varies quite substantially across the five sectors.

In Sweden we see the same kind of pattern. Of the new establishments, 1.1 per cent has researcher participation. We may note that the group of establishments which we do not know which sector belongs to has exactly the same ratio as the total of those which we are able to classify by sector. This may indicate that the new establishments with missing value on the sector variable are simply drawn randomly from the population of new establishments. Or, to be more precise, it does not contradict an assumption to that effect.

For Finland the proportion of all new establishments who have researcher participation is 1.6 per cent, which is higher than both Norway and Sweden. At the same time, we see that the total number of new establishments is quite low, not only in relation to Sweden, but also in relation to Norway. The higher ratio here thus to a considerable extent reflects a relatively low denominator rather than a high numerator.

Figure 5-14 New establishments with researcher participation as a proportion of all new establishments, by sector, 2001. The three countries compared



The comparison between the countries is illustrated in Figure 5-14. We see that in all the countries there are very clear differences across the sectors. As a whole the differences across sectors are highly significant in all three countries. High tech manufacturing and knowledge intensive business services have much higher ratios of researcher participation in new establishments than the rest of the sectors. This is statistically highly significant in all three countries. The three other sectors are clearly below the ratio for the total in this regard. For 'other services' and 'other activity' this difference is statistically highly significant in all countries, for Sweden this difference is also statistically significant for "other manufacturing."

These results seem very reasonable, which we may take as corroborating that we by the method used here actually do get an indicator of what we try to capture, namely the researcher participation in new establishments.

There are also differences in the ratio of new establishments with researcher participation to all new establishments across the countries. Comparing the ratios for all sectors combined, we find that Finland has a higher ratio than Sweden, which in turn has a higher ratio than Norway. All the three pair wise differences are statistically significant.

When we control for sector, using a logistic regression analysis, we still find that there are highly significant differences across the countries. However, in this case not all three pair wise differences are statistically significant. Finland still differs from the other two countries in a statistically highly significant way, but the difference between Sweden and Norway is no longer significant. This indicates that the difference between Sweden and Norway which we found in the bivariate case largely is an expression of differences in industrial structure: Sweden has a higher proportion of the sectors with a high relative frequency of researcher participation in new enterprises than Norway.

We also find a statistically significant interaction effect between country and sector in these data (the interaction effect is significant at the 1 per cent level). This means that the effect of sector on the probability that a new establishment has researcher participation varies across the countries. More precisely this significant interaction effect seems mainly to express the fact that Norway is somewhat atypical when it comes to the 'other services' sector. In all the three countries the 'other services' sector has a lower probability of having researcher participation in new establishments than all the sectors combined. However, in Norway the difference in probability between 'other services' and all the sectors combined is even larger than in the two other countries, and this difference between Norway and the two other countries in this regard is statistically significant.

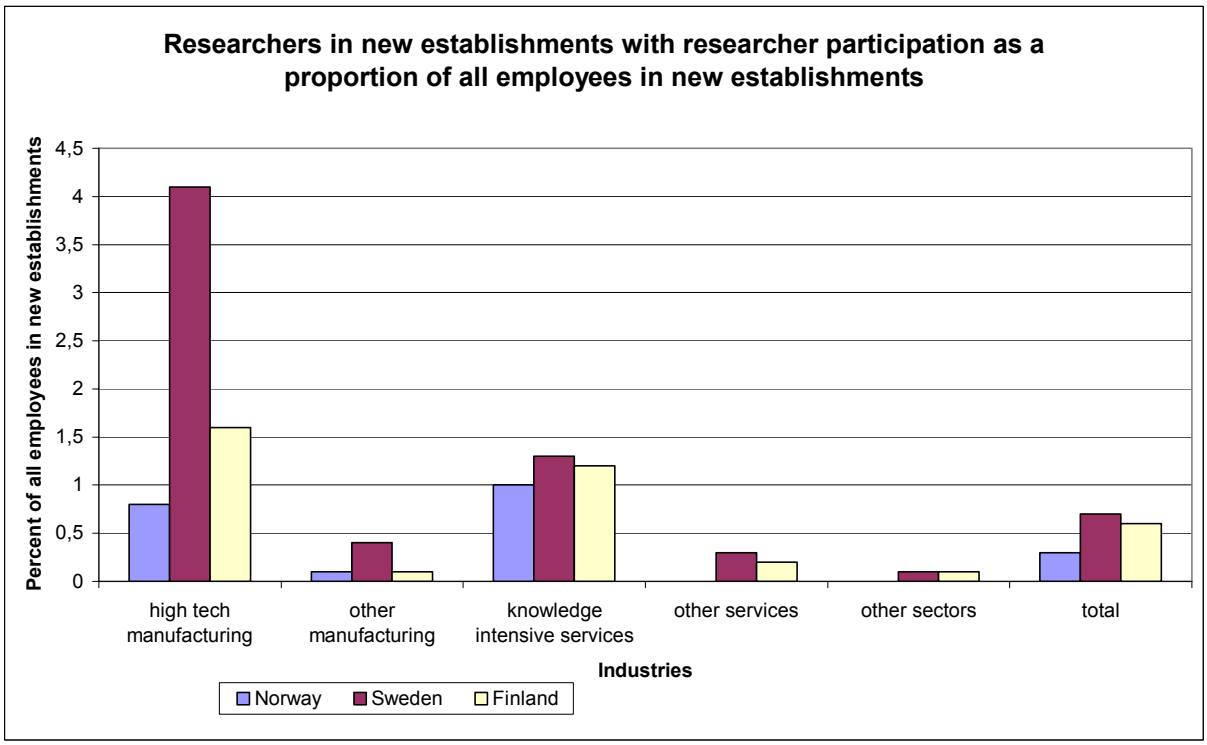
Lastly we turn to the ratio of the number of researchers in new establishments to all employees in new establishments, by sector *(see table section 5.4 in the annex)*. The tables show the number of researchers in new establishments, the total number of employees in new establishments, and the ratio between these two magnitudes for each of the countries separately.

In Norway researchers in new establishments make up 0.3 per cent of all employees in new establishments. This is a substantially lower proportion than the proportion of new establishments with researcher participation measured against all new establishments, which was 0.8 per cent, as we saw. Basically this is so because the mean number of employees in new establishments without researcher participation is higher than the mean number of researchers in new establishments with researcher participation (3.5 against 1.3), while at the same time the researchers on average make up a small proportion of the employees of new establishments with researcher participation.

Also in Sweden the ratio of researchers to employees is lower than the ratio of new establishments with researcher participation to all new establishments, 0.7 per cent as against 1.1 per cent, but the difference is somewhat smaller than in the case of Norway. Basically this is because the new establishments without researcher participation on average are smaller in Sweden than in Norway (averages are 1.6 and 3.5, respectively).

0.6 of the employees of new establishments in Finland are researchers, while the corresponding ratio for establishments with researcher participation measured against all new establishments was 1.6 per cent. This difference is rather similar to the one for Norway, and thus larger than the one for Sweden.[21]

Figure 5-15 Researchers in new establishments as a proportion of all employees in new establishments, by sector, 2001. The three countries compared



Again we illustrate the comparison of the countries, see Figure 5-15. The pattern from when we looked at the proportion of all new establishments accounted for by establishments with researcher participation is evident also here. In 'other manufacturing', 'other services' and, especially, 'other activity,' the proportion of researcher among the employees in new establishments is very low. It is substantially higher in 'high tech manufacturing' and 'knowledge intensive business services.' This applies to all the three countries.

We note the particularly high proportion for 'high tech manufacturing' for Sweden compared to the two other countries. This is something which is not mirrored in the table for the proportion of all new establishments accounted for by establishments with researcher participation. Instead, this reflects the fact, referred to in the comments to Table 5, above, that in Sweden the mean number of researchers in new establishments with researcher participation is particularly high in this sector.

[21] Measured in logits, this difference is 1.07 in Finland and 1.03 in Norway, but only 0.50 in Sweden.

6 Tracking performance of spin-offs

6.1 Introduction

In this chapter we look at the most basic aspect of the performance of newly borne establishments/firms, namely the extent to which they survive during their first years after birth. For this purpose we take as our point of departure the new establishments started up in year 1996 and follow them up to year 2000 (for Norway and Sweden, for which data allow us to do it, we follow them one year further to 2001) and compute for each year the proportion of the original 1996 population that have survived.

Table 6-1 shows the well-known fact that firm (here: establishment) mortality is relatively high especially in the first years. Thus, for both Denmark and Norway we can observe that about a third of the establishments observed in 1996, have not survived into the fourth year. From the table we can furthermore see that the countries fall into two groups regarding the levels of survival rates: Finland and Sweden with a higher rate of survival than Denmark and Norway that persists during the four (five) year period studied. The probability of death is highest in the first year and then declines successively during the subsequent years. In all four countries there is a similar times series development of the survival rates with survival rates decreasing albeit at a decreasing rate. The pattern observed for the 1996 establishments is quite typical for that of other cohorts (years) as is illustrated by *annex tables A6-2a* to A*6-2d*.

Table 6-1 Survival of all establishments in 1996

Country	**1997**	**1998**	**1999**	**2000**	**2001**
Finland	0.94	0.89	0.83	0.78	n.a.
Denmark	0.88	0.81	0.75	0.71	n.a
Norway	0.90	0.83	0.77	0.73	0.69
Sweden	0.93	0.87	0.82	0.77	0.72

6.2 The survival of new establishments

Turning next to the survival of new establishments, we start by looking at the 1996 cohorts, which we follow over the subsequent four (five) years; see *annex table A6-3*. Comparing the countries with respect to survival rate levels, the same two country pairs emerge. A higher proportion of new Danish and Norwegian establishments do not survive the first years. The shares surviving of the new Finnish and Swedish establishments are clearly lower. The country pairs have one other feature in common: the number of new establishments relative to the stock of establishments in a given year (a measure of the inflow of new establishments) is higher in Denmark and Norway – in 1996, 11-12 per cent -- than in Sweden and Finland, where it is 5.5 and 7.6 per cent, respectively. Thus, it appears that starting up new establishments is considerably more frequent, or easier, in Denmark and Norway, but so are also the events of deaths. Especially the low rate of new establishment start-ups in Sweden is notable. There are moreover some slight differences between the countries regarding the composition of the new establishment inflows. In Finland and Sweden, the proportion of new establishments in the manufacturing sector is somewhat higher (10-13 per cent) than in Norway and Denmark (7-8 per cent).

The survival rates of new establishments are as expected considerably lower than for all establishments existing in year 1996. After four years 50 to 60 per cent of the new

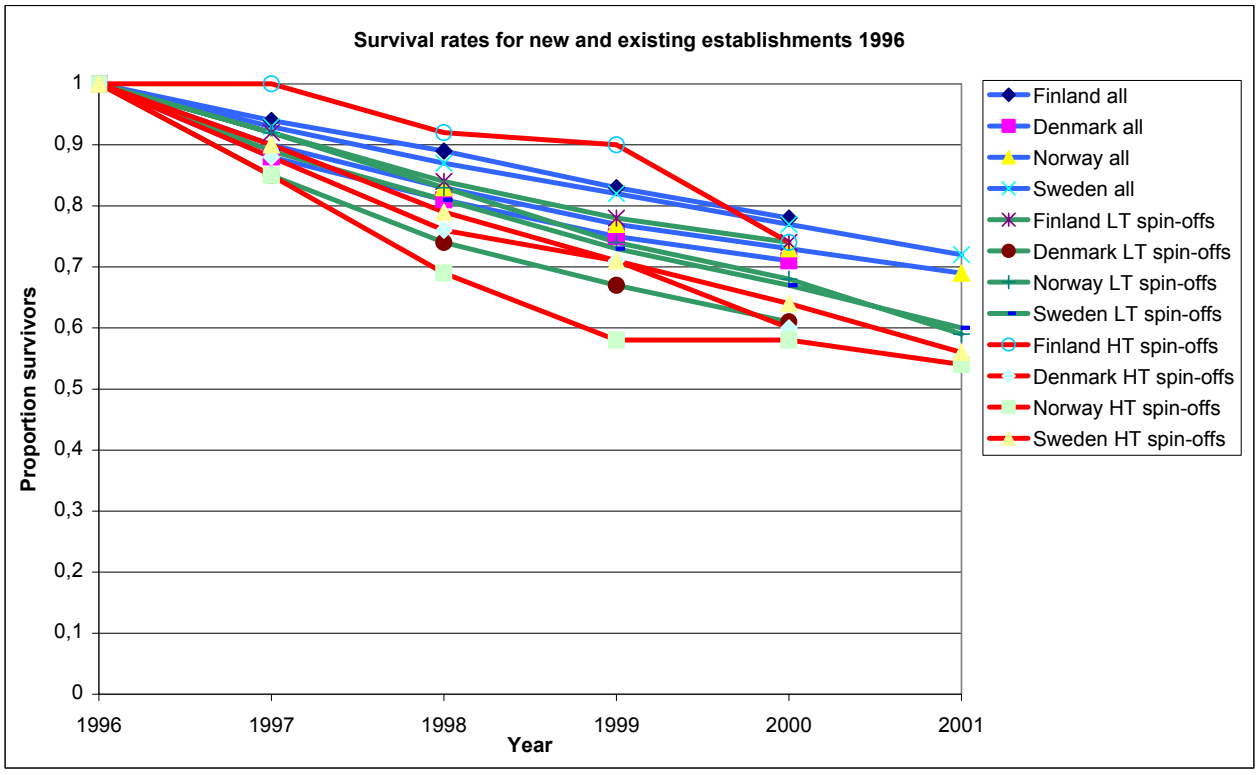
establishments still exist. (The number for Finland is higher: 68 per cent.) Thus, of all establishments exiting during a year, the new establishments make up a relatively large proportion.

Although there are some differences across the countries, in all four the vast majority of the new establishments are within the services sector (and a large fraction of these are in turn in the hotels and restaurants industry). Distinguishing between the manufacturing and services sectors, we can see that the survival rates are somewhat higher in manufacturing. The differences are more pronounced in Denmark and Norway.

Next, we distinguish between five groups of newly started firms/changed establishments: (1) spin-offs, (2) Transformations and takeovers, (3) Moves, (4) Greenfield births, and (5) Other new borne establishments. The definitions are the same as the ones we employed in chapters 4 and 5. Within each category we furthermore apply the OECD distinction between low- and high-tech firms. The survival rates for the different groups of new establishments are set out in *annex tables A6-4* to A*6-8*. Comparing the survival rate levels between the different groups, we may note that likelihoods of mergers and acquisitions and transfers surviving the first four years are higher than for the other groups. The lowest survival rates are found for Greenfield and other births.

From *Table A6-4*, we may see that a non-negligible portion of establishments change their status due to transformations and takeovers. For Finland and Norway, their survival rates are of about the same size as for all establishments, whereas for Denmark a higher fraction of the establishments with transformations and takeovers are surviving the next four years.

Figure 6-1 Survival rates for spin-off and existing establishments 1996 by country and high-tech/low-tech sectors.



As for spin-offs – see Figure 6-1, and Table 6-2 below – we may note two things. First, they clearly survive longer than the new start-ups. Second, the patterns in survival rates differ quite a lot between the three countries. The survival rates are highest in Finland. On the other hand, there are relatively fewer Finnish spin-offs. In Denmark and Sweden low- and high-tech spin-offs have about the same survival rates, whereas in Norway low-tech spin-offs survive at a higher rate than high-tech ones. One should, however, be cautious in comparing low- and high tech spin-offs (as well as the other categories according to this dimension) as the number of the latter is relatively small: about a tenth of all spin-offs. Thus, assigning a few more low-tech establishments to the high-tech group can significantly change the survival rates for the high-tech category, while at the same time the low-tech figures remain largely unchanged. A relatively unimportant category of change, especially for the high-tech establishments is transfers; see *annex table A6-6*.

Table 6-2 Survival of the 1996 cohort of spin-offs

	1997	1998	1999	2000	2001
Finland Low-tech					
(#)	335	308	284	270	
(%)	0.92	0.84	0.78	0.74	
Finland High-tech					
(#)	39	36	35	29	
(%)	1.00	0.92	0.90	0.74	
Norway Low-tech					
(#)	474	429	382	354	308
(%)	0.92	0.83	0.74	0.68	0.59
Norway High-tech					
(#)	41	33	28	28	26
(%)	0.85	0.69	0.58	0.58	0.54
Denmark Low-tech					
(#)	644	560	506	461	
(%)	0.85	0.74	0.67	0.61	
Denmark High-tech					
(#)	37	32	30	25	
(%)	0.88	0.76	0.71	0.60	
Sweden Low-tech					
(#)	986	893	802	738	661
(%)	0.89	0.81	0.73	0.67	0.60
Sweden High-tech					
(#)	94	83	74	67	59
(%)	0.90	0.79	0.71	0.64	0.56

"Greenfield births" is the most common form of new establishments. As is clear from *annex table A6-7*, Greenfield births also constitute the major source of the death of new establishments. There are relatively large differences in survival rates across countries. They are highest in Finland – about 70 per cent remain after four years – and lowest in Denmark: slightly below 40 per cent. Norway and Sweden fall in between these extremes with survival rates of 50 and 60 per cent, respectively.

Annex table A6-8 contains the survival rates for the category "others". This seems to be a quite prevalent group in Denmark and both the levels and time series properties of the survival rates resemble closely those of Greenfield births.

For most of the new establishment groups there does not seem to be any noteworthy differences in survival rates between high- and low-tech establishments. The only exception is spin-offs for which high-tech establishments have slightly lower survival rates than low-tech spin-offs. (The other group for which there is a difference is moves. However, the number of high-tech establishments is too low here to draw stronger conclusions.)

6.3 Changes in employment

It should be noted that although infant mortality is substantial among new establishments, this does not mean that employment in them is decreasing to the same extent. Many of the firms and establishments that die are small whilst the surviving firms are more likely to be growing and hence, the survival rates in terms employment are higher. This is evident from *annex tables A6-9a* and *b*, from which we in particular can see that the proportion of employees surviving is significantly greater than the fraction of establishments surviving. Naturally, this is very important in assessing the impact of the creation of new firms.

Furthermore, for Finland and Sweden employment in surviving new establishments actually increases and stays higher during the first years, whereas in Denmark and Norway there is a drop in employment. In Finland there is even an employment increase in all establishments, presumably reflecting the strong recovery of the Finnish economy in the late nineties. In Norway, the employment decline is stronger in new establishments than in all establishments.

6.4 What happens to start-ups?

Turning next to look in more detail at the success of spin-offs versus other start-ups, we utilise three different measures of success. The first is simply whether the establishment has survived as an independent unity in the first five years of its existence. The second is in addition to survival that the establishment "continues" as part of another firm, that is, as being acquired. The third is a more demanding definition of success: not only should the establishment have stayed alive during the first five years but also have grown during the same time period. "Growth" is defined by a formula requiring that establishments starting out with 1 or 2 employees in 1995 should be 3 or 4 or more five years later; those with 3, 5 or more five years later; those with 4-5, 6-7, 8-9 and 10 or more, 1.7, 1.5, 1.4 and 1.3 times the number of employees in 1995.[22] As we do not have access to economic information about the new firms, we cannot at this stage construct and use measures related to the financial success of the firms. Table 6-4 Full results are found in *annex tables 6-10a-d*. A first observation is that adding the acquired establishments to the establishments that have survived as independent units, affects the survival rates only marginally. In contrast, adding the requirement that the establishments should not only have survived but also have grown, does change the levels of the survival rates a lot. Thus, the success measure is typically reduced by a half or two thirds and in the case of Denmark even by more.

In Denmark and Finland there are considerable differences in success measures between spin-offs and other start-ups, whereas the differences are smaller in Norway and Sweden. In Denmark and Finland there are also differences between high- and low-tech spin-offs and among Finnish other start-ups, too. In Norway and Sweden the differences between high- and low-tech spin-offs and start-ups are smaller. In chapter 7 below, we will make an attempt to analyse some of the factors underlying the differences in success across establishments.

[22] This "growth definition" is of course completely ad hoc. The motivation for it is that we want to relate the change in the number of new employees to the initial stock of employees. We have experimented somewhat with alternative algorithms, and for marginal changes in the "growth coefficients" – that is, 0.1 to 0.2 – the samples of growing and non-growing establishments do not change considerably.

Table 6-3 Success rates for spin-offs and other new start-ups in 1995, all countries. Criterion is survival 4 years.

	Denmark	Finland	Norway	Sweden
Spin-offs, low-tech	0.598	0.752	0.682	0.658
Spin-offs, high-tech	0.756	0.739	0.583	0.638
Start-ups, low-tech	0.338	0.622	0.536	0.571
Start-ups, high-tech	0.322	0.632	0.563	0.570

Table 6-4 Success rates for spin-offs and other new start-ups in 1995, all countries. Criterion is survival 4 years and growth.

	Denmark	Finland	Norway	Sweden
Spin-offs, low-tech	0.090	0.371	0.204	0.315
Spin-offs, high-tech	0.200	0.435	0.188	0.276
Start-ups, low-tech	0.026	0.277	0.119	0.175
Start-ups, high-tech	0.027	0.363	0.188	0.283

The next stage in the analysis describes the changes in the size structure, in terms of the number of employees, of the new establishments; *see annex tables A6-11* to *A6-14*. As we cannot make use of percentage growth numbers, because they are very sensitive to the initial size of the establishment, we employ a classification into four size categories for the initial size in year 1996 : 1-2, 3-5, 6-10 and 11 or more employees. Next we describe the position of the establishments in year 2000 according to whether they are: still in the same size class, in a smaller size class, a larger class, or have stopped existing.

For Finland three noteworthy features can be observed. First, the proportion of new establishments growing in the first five years of existence is higher for smaller start-ups. In other words, if an establishment has already from the beginning more than ten employees, then it is (perhaps not very surprisingly) less likely to grow than an establishment starting with 2-5 employees. On the other hand, the larger establishments are less likely to stop existing. This pattern is found in the services sector but not in manufacturing. Second, among the new high-tech establishments, larger start-ups are more likely to grow also in subsequent years whilst for new low-tech establishments, the small start-ups grow more often than the larger ones. Third, the proportion of the new high-tech establishments growing during the first five years after birth is substantially higher than in the other Nordic countries.

Norway displays a different pattern. Here, the larger start-ups are more likely to grow in the next years and a higher proportion of small start-ups do not exist five years after birth. As for Finland, this pattern is also found in services but not for manufacturing (where there are no differences). The larger new high-tech establishments are more likely to grow than the smaller ones. The opposite is true for low-tech start-ups.

Sweden also has a different pattern. Here the proportion growing is more or less the same irrespective of the original size of the new establishment start-up. As for Finland and Norway this mirrors the services sector but not the manufacturing, where larger start-ups are more often growing than the smaller ones. The proportion dying declines with birth size and this holds both for the manufacturing and services sectors. Among new low-tech establishments, those with smaller birth size are more likely to stop existing within the following five year period. Sweden differs from the other Nordic countries in that there are no differences in the likelihood of subsequent growth between start-ups of different size.

7 The success and failure of spin-offs

7.1 Introduction

The principal aim of this chapter is to address the following question: What characterises successful spin-offs and failures, respectively? Naturally, this is the key question in particular from a policy perspective as answering it may provide some guidance as to what instruments to use in promoting entrepreneurship arising from spin-offs. The previous literature[23] on this issue is surprisingly small and is furthermore almost exclusively based on either case-studies or rather unrepresentative samples. To the best of our knowledge, the current study is the first in exploiting large, nationally representative data sets.

Identifying possible success factors of course presupposes some definition of what constitutes success. Neither the academic nor the more applied literature comes up with a consensus view on the matter, so we have chosen to adopt a rather pragmatic approach using the three alternative definitions that we already implemented in chapter 6.

Thus, the first is a very simple one, namely that the establishment still exists after four years. This is obviously not a very strong condition for success, but on the other hand, as we have seen, a rather large fraction of spin-offs, and start-ups in general, die within the first years upon birth. The second definition adds the additional requirement that the establishment also has had some growth in its workforce.[24] The third definition of success we employ is that the establishment either has survived as an independent firm or has been acquired by another firm and hence continues as part of a new firm. The second possibility is allowed for in order to account for the possibility that some of the successful start-ups are acquired by other, typically larger firms.

In the following econometric analysis we are using the three above-mentioned definitions in operationalising success as a dichotomous dependent variable equal to unity when satisfying the conditions for success, and zero otherwise. The explanatory variables can be grouped into three categories: the characteristics of the team behind the spin-off, the characteristics of the "old" firm from which the new firm spun off, and some characteristics of the new firm. The idea is to look for whether differences in success can be attributed to differences across establishments in these dimensions. A key question is of course whether it matters wherefrom the new establishment originates, that is whether it is a Greenfield birth, a spin-off or some other form of new firm. Other questions are whether the composition of the team starting up the new firm matters, if spin-offs emanating from a large firm or from the same industry are more successful, whether survival with and without growth is more common among new high-tech firms, etc.

Annex table A7-1 contains a summary of the means of key factors used in the econometric analysis. From this is can be seen that spin-offs constitute a relatively more prevalent form of start-ups in Sweden and Denmark than in Finland and Norway. Greenfield births are roughly equally common in the countries except Norway where they make up as much as almost 80 per

[23] Cooper (1973), Dietrich and Gibson (1990), Lindholm (1994), Roberts (1968), Roberts and Wainer (1968), and Utterback (1974).

[24] "Growth" is defined by a formula requiring that establishments starting out with 1 or 2 employees in 1995 should 3 or 4 or more five years later; those with 3, 5 or more five years later; those with 4-5, 6-7, 8-9 and 10 or more, 1.7, 1.5, 1.4 and 1.3 times the number of employees in 1995.

cent of all start-ups. The workforces of the start-ups also differ across the Nordic countries. Thus, the proportion of employees with a university education is clearly higher in Finland and Sweden. In all four countries on average 60 per cent of the start-up firms' employees are men – in Finland the share is even higher: 80 per cent. This reflects the fact that the majority of private sector employees are men (whereas the public sector is female-dominated). The average age of the employees is around the mid-thirties (and lowest in Denmark).

Spin-offs emanate predominantly from relatively large firms (in terms of number of employees). Thus, the delivering firm on average has 120-180 employees. Only Finland deviates from this pattern: here, the average size of the delivering firm is 85 employees. The bulk of the delivering firms are not high-tech companies; in fact, in all four countries less than ten per cent of the spin-offs originate from firms classified as belonging to a high-tech industry. Therefore, it is hardly surprising to find that approximately the same proportion of the spin-offs is classified as high-tech.

As for all start-ups, Norwegian and Danish spin-offs have a considerably smaller proportion of employees with a university education than their Finnish and Swedish counterparts. The same pattern can be observed also for the teams behind spin-off. More than every second (save Sweden) spin-off operates within the same industry as the company where the spin-off team was employed before.

7.2 The model and the estimation results

It should be clear from the outset that we should not hope to be able to explain but at most a rather small part of the variation in success across establishments. Key success factors are typically idiosyncratic of nature or for other reasons hard to quantify. Thus, one example of an obvious key factor is managerial talent which we cannot observe and does not need to be strongly correlated with the variables we observe in our data sets. Our analysis should, therefore, be considered more an investigation into how useful observable data like characteristics of the "old" and the "new" firm and the team behind a spin-off are in explaining the subsequent development of establishments during the first years after their birth. If it turns out that observable data is of only limited value in this respect, this also tells us something about the limitations of public policies and the difficulties in selecting which establishments, or types thereof, to support.

The analysis is in fact concerned with two related questions. The first is what distinguishes successful start-ups in general, that is, including also other start-ups than spin-offs. The idea here is to see whether spin-offs differ from other start-ups regarding the factors underlying their success. As a consequence, for this analysis we use a sample that in addition to the spin-offs, encompasses also all other forms of start-ups. The other question is more specifically about spin-offs, comparing exclusively successful spin-offs with the not successful spin-offs. As the dependent variables in both analyses are dichotomous, the statistical model to be estimated is the logit. As we are estimating the same model on four countries, it should be noted that the significance levels for finding a statistically significant relationship in all four countries is lower than for a single country. Consequently, finding a similar relationship for three of the four countries, can be considered as evidence in support of the existence of such a relationship.

Beginning with the estimations for all start-ups – see Table 7-1 for survival and growth, and *annex tables A7-2a, A7-3a, A7-4a* and A*7-5a* for full results – we may note the following results. In all four Nordic countries, save Finland, spin-offs are more probable to survive than

Greenfield births and other start-ups. Greenfield births are estimated to be less likely to survive than other start-ups in Finland and Norway, but the estimate is not statistically significant in the former. On the other hand, in Denmark and Sweden Greenfield births are more likely to survive than other births. There are less differences between different forms of start-ups when it comes to surviving with some growth; spin-offs are found to be more likely to both survive and grow in all four countries, but Greenfield births only in Sweden.

Table 7-1 Logit estimations for survival and growth of all start-ups in all four countriesa

	Denmark	Finland	Norway	Sweden
Constant	-1.322***	-0.562***	-1.825***	-1.123***
	(0.186)	(0.207)	(0.197)	(0.146)
Log employment in 1996	0.159***	-0.316***	0.171***	-0.378***
	(0.057)	(0.057)	(0.052)	(0.031)
Spin-off dummy[b]	0.405***	0.579***	0.531***	0.677***
	(0.111)	(0.122)	(0.130)	(0.083)
Greenfield birth dummy[b]	0.136	0.092	0.072	0.331***
	(0.094)	(0.066)	(0.096)	(0.062)
High-tech dummy	0.079	0.403**	0.315**	0.028
	(0.197)	(0.157)	(0.156)	(0.125)
Proportion males in 1996	0.018	0.243*	0.399***	-0.039
	(0.118)	(0.137)	(0.098)	(0.085)
Prop. highly educated in 1996	0.259	0.223	0.411	0.154
	(0.324)	(0.170)	(0.279)	(0.135)
Mean age of workforce in 1996	0.001	-0.012***	-0.019***	-0.005*
	(0.005)	(0.004)	(0.003)	(0.003)
Number of obs.	3,499	5,037	10,463	11,164

a. The 99, 95 and 90 per cent significant levels are marked with ***, ** and *, respectively. Industry dummies have also been included but their estimates are not reported in the table.
b. The omitted reference category is "other start-ups".

As for the third success criterion, survival or being acquired, there is more heterogeneity among the countries and forms of start-ups. In Finland there is no difference between spin-offs, Greenfield births and other forms of start-ups (as there is not for the simple survival criterion, either). In Denmark and Norway the same pattern is the same as for survival, that is Danish spin-offs and Greenfield births are both more likely to have been acquired or to have survived than other start-ups whereas Norwegian spin-offs are less likely and Greenfields more likely to have survived or been acquired by another firm. In Sweden, surprisingly, spin-offs and Greenfield births are less likely to be successful according to our third criterion, whereas they were more successful than other start-ups according to the other two criteria used.

All in all, the pattern with respect to different forms of start-ups is rather mixed, and understanding the differences between countries is clearly an interesting area for further research. Despite the differences, there is at least one similarity worth noting: spin-offs appear to be more successful than the two other forms of start-ups in almost all countries and by almost all three success criteria used.[25]

The size of the start-up has a negative effect on survival in Sweden but has a positive effect in the other countries. Surviving and growing is negatively related to original size. Likewise, larger establishments are less likely to survive or be acquired in all four countries. The probability that high-tech establishments survive does not differ significantly from that of non-high-tech ones. However, they are found to be more likely to survive and grow (and statistically significantly in Finland and Norway) than other establishments.

[25] The same conclusion is reached in a research paper using the same Danish data set as here, but from a longer time period, and adopting somewhat different econometric techniques; see Eriksson and Kuhn (2003).

Regarding the workforce characteristics, we may observe that the average age of the personnel increases the probability of survival (and survival or growth) whilst it decreases the probability of survival combined with growth. Thus, establishments with relatively younger workers are more likely to grow and contribute to employment growth. This could for instance be due to establishments with younger workforces utilising more modern technologies or production processes or producing new products, to the extent these cannot be captured by our crude high-tech and industry dummies. The gender composition of the workforce matters only in Norway, where a higher proportion of male employees is associated with a higher likelihood of success. The share of employees with a university education increases the probability that the establishment will survive or will be acquired. There are positive relationships also with the other success criteria, but they are not statistically significant.

The analysis of spin-offs only – see *annex tables A7-2b* to *A7-5b* − does not dovetail any significant differences between high- and low-tech spin-offs with respect to the three success measures. Differences in establishments and in spin-off teams with respect to education do not turn out to be an important feature of the data, either. Spin-offs into the same industry as the origin firm are estimated to have a higher probability of surviving, but are statistically significant only in the case of Sweden. The characteristics of the spin-off team are found to have no influence on the probability of survival with or without growth.

In fact, the models' ability to explain, and consequently also to predict, is very poor. In the case of Norway, the estimations overall are not even far from statistically significant at conventional significance levels. Provided that we have included the key observable characteristics in the estimated models, this indicates that the overwhelming bulk of the variation in the success of newly started establishments, and in particular of the spin-offs sub-category, is driven by idiosyncratic factors.

In order to keep the analysis simple and to be able to compare findings across the Nordic countries we have estimated a common, fairly parsimonious specification for all four countries. Naturally, this approach neglects potential country-specific factors that might be important. For that reason, we have also experimented somewhat with including additional explanatory variables which aim at capturing in particular regional differences. Thus, for instance for Norway two additional dummy variables were entered to the estimated model: one, distinguishing between the Oslo metropolitan area and the rest of the country, and another distinguishing between establishments located in areas eligible for regional policy support and those that are not. The results from these estimations were rather disappointing as the new dummy variables attached coefficients that were either of the opposite sign than expected or did not differ significantly from, or were not robust to changes in the specification of the model. The same is true for the regional indicators added to the Danish and Swedish estimations. Also the estimates from Finland from specifications including indicators for urbanised areas or regions eligible for EU regional support are not robust. Although the results exploiting regional differences are somewhat disappointing and yield mixed results, it should be noted that we have far from exhausted the possibilities of including them, and hence, the results in this respect should be considered more as tentative rather than the final word on the matter. Still, our conjecture is that a considerable part of the variation in success is due to idiosyncratic factors.

7.3 Concluding remarks

In this chapter we have made a first attempt at an empirical analysis of the determinants of the subsequent success of new start-up firms distinguishing between different forms of start-ups and focussing on spin-offs in particular. As almost always in empirical research, the analysis yields findings which in turn suggest new questions that need to be answered. We find quite different patterns across the four Nordic countries, but also some similarities. In particular, it should be noted that spin-offs seem to be more successful than other forms of start-ups in the sense hat they are more likely to survive the first four to five years of their existence and also to expand their employment.

Finding observable characteristics of the establishments, their workforces or the team behind the spin-off, which would help in distinguishing between successful and not successful ones, turned out to be much more difficult. Spin-offs which operate in the same industry as the firm from which the founders spun off are found to be more probable to survive the first post-birth years, but otherwise it appears as if old and new firm traits as well as characteristics of the team behind the spin-off are poor predictors of the success of a spin-off.

A number of caveats should, however, be noted. The current analysis is concerned with only one cohort of start-ups and although as we have seen in chapter 6 the pattern of subsequent developments does not differ much across cohorts, expanding the set of observations to include several cohorts may of course change the results.[26] One advantage of having access to data on several cohorts is that then it is possible to carry out duration analyses, allowing for different lengths of the period of success. Another thing to notice is that the success measures used are very crude and that the most used measure businesses' success, profitability, is not one of them. Finally, our analysis lacks information about potentially important determinants of success such as the background of the spin-off team, whether the delivering firm is a single- or multi-plant firm and indicators for local conditions (for instance with respect to knowledge capital or the competition the spin-off or start-up is facing). All three avenues of further research are on our agenda.

[26] Eriksson and Kuhn (2003) use a substantially larger data set covering years 1981 to 2000 and find that the results are quite robust to the inclusion of more cohorts.

8 Conclusions and policy implications

Conclusions from this project relate to several different aspects. One concerns the feasibility of studying spin-offs by the methodology we have used, which, according to our knowledge, has not been applied elsewhere. Another aspect concerns the concrete results of the analysis; that is the occurrence and performance of spin-offs and other kinds of start-up establishments in the different countries. Lastly we must ask if the analysis leaves room for or identifies any needs for policy intervention to improve the performance of the ongoing industrial restructuring and renewal that spin-offs and other start-ups form part of.

8.1 The methodology

Methodologically the project has proven that spin-offs can be identified in a meaningful way by use of the matched employer-employee data. By use of reasonable criteria which we would argue resembles the basic idea of being a spin-off a substantial number of cases has been identified. The spin-offs are clearly distinguishable from other kinds of changes, and the relationship between the spin-offs and establishments with other kinds of changes, or with no observable change, seems to be rather robust both over time and between the countries.

Our definition of a spin-off requires, among other things, that a group of at least two persons move out from an existing establishment to create a new establishment/enterprise. We also require that it is not the whole of an existing establishment that is spun out, in which case we consider it a reorganisation of an existing establishment. This allows the integration of the study of corporate spin-offs with the study of research-based spin-offs, utilising the same criteria to identify the two kinds of cases, and thus to compare them. This is clearly different from the usual approaches where the two represent different strands in the literature, with huge variations in definitions within both.

Among the major achievements of this approach are clearly defined characteristics of what is meant by a spin-off. In previous work the definitions vary considerably, and in survey based approaches it has been left to the respondents to select the spin-off cases. Since the information in our register based approach is collected for other purposes than studies of business demography there is no room for opportunistic behaviour like it may be for respondents to a survey asking about their achievements when it comes to spin-offs. In this sense we think our results are more reliable.

Our approach also allows comparisons of spin-offs to all other kinds of changes taking place in the population of business firms. This way spin-offs are put in relation to the totality of demographic changes (and stability) going on. Thus the importance and consequences of the activity can be assessed in a quantitative way.

We will also point to the fact that the approach is open ended in the sense that it is possible to bring in additional information in the analysis. Since the databases has full coverage of all establishments, enterprises and persons it is in principle possible to merge in additional information that is identifiable at the same level. This has not been done in the present analysis, but we will point to the opportunity in particular for adding accounting data to describe performance and challenges confronting the enterprises.

Finally we will point to the fact that utilising register data this way is a very cost effective approach as long as the methodology is established and tested, and the data are available.

There are of course problems with the approach. Firstly, only a limited number of countries have this kind of data available for analysis at present. As a result the opportunity to do comparable studies is limited. This is gradually changing, however, as more and more countries see the advantages of taking the data source into use.

Secondly there are differences between the national data sources that are hard to get around and correct for. That implies extra work and cautiousness when interpreting results. In particular we recommend putting more emphasis on the differences in structures rather than differences in levels in the comparisons. On the other hand, all kinds of international comparisons are hampered by problems of data quality and in particular differences in the national settings that influence how the information can be interpreted in each country. We do not think that our approach is worse off than other kinds of comparative analysis. Compared to the majority of studies on spin-offs, high-tech or not, and the abundant literature on new technology based firms, we would argue that the broad perspective and full coverage of cases that our approaches allows strengthen the confidence in the results.

All in all we see big opportunities for further work and analysis on the basis of the current approach. Being the first attempt inevitably has caused us some problems that have take time and effort. In light of this the current analysis should be regarded as a first attempt, laying the basis for future work by testing and developing a functioning methodology.

8.2 Spin-offs identified

This first analysis has, however, produced a series of interesting results. The vast majority of establishments remain unchanged between two years. Different kinds of transformations of existing establishments account for a very limited number of cases. New establishments and closures are more or less balancing each other out in numbers, but with variations between the countries and over time. The order of magnitude is from about 5 000 to around 12 000. The basic structure is, however, very similar across the countries.

The new-in-new group is reclassified and broken down by use of labour tracking, thus distinguishing different kinds of creation processes. The dominating group is the Greenfield births, characterised by have no more than one employee coming from the same previous employer. Spin-offs, characterised by at least two employees coming from the same place, account for around a fourth of the Greenfield births. In the last step a condition is added for the industries where the spin-offs are created, in order to capture the cases that are considered “high-tech”. The significance of spin-offs of the high-tech type seems to be very limited in terms of number of cases. Other kinds of changes, and unchanged establishments, completely dominate the picture. This is the case in all the other Nordic countries, even though the numbers of high-tech spin-offs is somewhat lower in the Norwegian case.

One should keep in mind that the definition of "high tech" applied here is rather restrictive, although it is the one advocated and used by the OECD. In particular, in high wage cost countries like the Nordic ones, production is likely to be high-tech also outside the industries classified as high-tech by the OECD, but high-tech in this sense is more problematic to identify, as we have argued.

Also, spin-offs are generated every year, and some of them may grow to become important firms in terms of size and economic results. Thus it is too easy to solely to conclude that high-tech spin-offs have no importance. There are two major reasons for this: Firstly, the highly successful cases are probably so rare that it is difficult to identify them – and if we did, we

probably would leave them out of the analysis as outliers. Secondly it may take a long time for a new establishment to succeed. The time horizon in our present analysis of 4 to 5 years is presumably too short to capture the effect when, and if, growth takes off.

This touches upon another aspect of the development in new start-up firms. A certain fraction of establishments drop out of business every year, leaving the share of survivors down towards 50 – 70 percent after five years. High-tech spin-offs seems to have a somewhat lower survival rate than low-tech spin-offs, and clearly lower than survival among all firms which are dominated by the ones that are unchanged (save Finland). Compared to other forms of new firms however, like Greenfield births and other start-ups, spin-offs seem to perform better in this respect. One possible interpretation of this is that spin-offs involve persons with experience from participating in a business that strengthens the likeliness of survival.

Service sectors completely dominate in terms of numbers of new establishments, and numbers of employees involved. Changes are relatively modest in manufacturing both in terms of numbers of establishments involved and their share of the number of existing establishments. We see the biggest changes in the larger industries, such as construction with a positive development except for Sweden, trade, hotels and restaurant with a positive development, and other business services. Also computers and related services have a generally positive development in all countries, and in this case it is because the changes make up a big share relative to the size of the industry. This is contrary to what we find for production of office machinery, radio telecommunications and instruments, where there is a reduction in the number of employees except in Norway. In this case changes are fairly marginal to the size of the industry.

Other industries with a predominantly negative development involve printing and publishing and wood and wood products (except for Finland). There are relatively big swings also for chemicals and refining when it comes to employment, but with opposite directions as there has been growth in Denmark and Norway, and decline in Sweden and Finland. For the manufacturing sector this is generally the case for the remaining industries, so that we see a positive development for one or two of the countries where the others have a negative development. For services this is generally not the case: All countries basically have a positive development with the exception of Sweden that has a decline in transport and postal services and in research and development

Looking at the relative importance of the net effects compared to the size of the industries again reveal that the changes in services are of considerable importance. They generally affect larger shares than what we find for manufacturing, and the pattern has much in common across the countries. For manufacturing we find a few industries where relatively high shares of the activity are affected, but these industries are generally not the same across the countries.

The picture presented here represents only one year, but shows much similarity across the countries when it comes to services. For manufacturing the evidence is more mixed. For quite a few industries, in particular in services, the changes are rather large compared to the sizes of the industries, and hence makes a difference for the development of the industries. To the degree these processes are more or less the same over time, a renewal of the industrial structures will result. This is, most importantly, dependent on the ability of the new establishments to survive and grow. If they are not successful in that respect, existing establishments and enterprises may expand and in effect conserve the existing industrial structure to a larger extent than one can get the impression of.

We have also focused a special case of new establishments, namely those cases where a researcher has taken part in the new firm. The way it has been specified, results should include all cases that are usually considered to be spin-offs from the research sector, provided that the spin-off includes personnel from the mother organisation. Results show a number of such cases around 100 for Norway and Finland, and around 500 for Sweden. The majority of the cases are very small units, and can by and large be found within knowledge intensive services. Adding other services to the list brings the share of cases over 90 percent in all the countries.

8.3 Success factors

The basic success factors we have focused in this study are limited by the data available in the registers. They include survival, development in employment, and the special case of survival involving being taken over by another enterprise but with a certain share of the employees still working together. This last category turns out to be of minor importance, however, whereas requiring growth in addition to survival on average more than halves the success rates. On this basis we have sought to explain variations in success by use of the remaining information available. Central explanatory factors in this respect are spin-offs versus other kinds of start-ups, and high-tech start-ups versus start-ups in other sectors.

Firstly, being in high-tech industries does not seem to affect the probability of survival (and growth). This could signify that being in the high-tech sector is not necessarily in itself enough to be advanced or successful. It is the performance compared to the competitors that matters, and in high-tech sectors all will presumably be familiar with the same basic technology of the actual industry. We actually find quite different patterns across the four Nordic countries, but also some similarities. In particular, it should be noted that spin-offs seem to be more successful than other forms of start-ups in the sense hat they are more likely to survive the first four to five years of their existence and also to expand their employment.

Finding observable characteristics of the establishments, their workforces or the team behind the spin-off, which would help in distinguishing between successful and not successful ones, turned out to be much more difficult. Spin-offs which operate in the same industry as the firm from which the founders spun off are found to be more probable to survive the first post-birth years, but otherwise it appears as if old and new firm traits as well as characteristics of the team behind the spin-off are poor predictors of the success of a spin-off.

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8.4 Room for policy?

A first point is that high-tech spin-offs in many respects seem to be a rather marginal phenomenon. The numbers of establishments involved and the numbers of employees in them

are quite limited each single year. The activity is to a large extent concentrated to particular parts of the business services industry, in many cases involving small consultancy firms that employ few others than the original members at the time of creation. In terms of industrial renewal this kind of change has very limited short term effects in quantitative terms, and other kinds of dynamics in the populations of business firms thus should be given greater attention. A more thorough analysis of the most influential types should be investigated utilising and building on the methodology presented here.

Even if high-tech spin-offs are not found to be of any major importance so far, that does not necessarily imply that it should continue on the same track. On the contrary one can argue that the limited activity we have had so far accentuates the need to achieve better in this respect. A rationale could be that high-tech spin-offs are presumed to be a mechanism for bringing advanced knowledge to use in new businesses. This may very well be the case, but the present work has had no means of settling such an issue – except for the fact that most spin-offs happen in industries that are not considered to be high-tech, also when originating in high-tech sectors.

Spin-offs seem to be more important in some cases than others. In particular, spin-offs are more widespread in high-tech sectors than in other sectors, and they have a higher survival rate than other new start-ups. This could indicate that the experiences that the employees bring with them when spinning out are important, and more important in high-tech sectors than in other sectors. This could be an argument for considering how to foster spin-offs in the high tech sectors if the goal is to expand such sectors presence in the economy. It should be emphasised though that we talk about small numbers, but they may be of importance for the development within small industrial niches.

The likeliness of succeeding is somewhat higher for spin-offs than for other start-ups, like Greenfield births – and this could perhaps be an argument for promoting this form of new establishments. On the other hand it is difficult to identify the factors influencing the likeliness of success. In isolation this is an argument against getting involved with policy measures, simply because we have not sufficiently knowledge about the decisive - or significant - factors. In particular the variables included that directly bears on policy, such as localisation and in particular being eligible for regional or structural support has no impact on the likeliness of success.

The lack of explanatory power could be due to at least three different reasons. The first is that there is so much chance and uncertainty involved in establishing new businesses, particularly if research is involved, that it is practically impossible to identify any factors that with some degree of accuracy are able to predict success or failure. Our analysis can point in that direction, as there are no statistically significant relationship between the likeliness of success and our explanatory variables. If this is right, again there is little room for policy. On the other hand the variables entered into the analysis are limited, and the possibility that there are omitted explanatory factors constitute the second reason that we have so far not been able to explain variations in success rates. As argued above there are several opportunities for expanding the information utilised in the analysis, and before policy action is decided upon one should make the most of these opportunities.

Thirdly, the combination of the numbers of cases identified and the time horizon we have had available for analysis have influenced the results. It may well be that some of the cases we have investigated will develop into major successes over time. So far the horizon has been limited to 4 to 5 years, and this may be too short. It is, however, difficult to figure out what is an adequate

horizon. As time passes the link to the original event of being a spin-off is weakened, and other events come into play that disturbs the analysis. Related to this is the relatively low number of spin-offs that form basis for the analysis. Small numbers of observation makes it statistically more demanding to establish robust relationships. Also related is the fact that we so far have been able to include only one cohort in the analysis. This cohort may not be representative and thus disturb the results. Therefore a solution could be to pool all identified spin-offs from different years. It would, in combination with bringing in additional information, contribute to making the analysis more reliable and robust. On the basis of the present experiences there is a good basis for doing this.

When making policy bureaucrats may have more detailed and nuanced information about some of the cases. On this basis it may be possible to identify cases where high-tech spin-offs seem to be a promising opportunity that could be helped to life with appropriate support systems. This essentially goes on in all countries via different support systems. Part of the problem with this kind of support that requires very detailed knowledge about each case is that the bureaucrat gets too involved and can run into problems prioritising among the candidates. And to repeat, these cases should be captured by the present analysis that show a very limited impact of the high-tech spin-offs.

An aspect that is rarely brought up in discussions of (high-tech) spin-offs relates to the cost side to spin-offs for the delivering establishment. Considering the social return on the activity one must also take the costs into account. One such case could be when researchers leave their research organisation to establish a new firm, thereby removing competence from the delivering organisation. Depending on the situation this may constitute a cost, but may also contribute positively by focusing the activity in the delivering organisation better.

There is also a cost side to policy, as resources always have alternative applications, and advantaging some actors or activities always comes at the cost of others. Assessing the sum of advantages and disadvantages usually is difficult, and we think that in the current case there is not enough margin to neither recommend nor advice against getting involved in policies to influence (high-tech) spin-off activity. On the other hand, the analysis has contributed to a much broader and more nuanced view of high-tech spin-offs, offering both a background for future policy thinking and a standing for better targeted future analyses.

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