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SNEDIG: Small Nordic Enterprises, Developing IPR in Global Competition

- A pan-Nordic pilot-study to explore how small and medium-sized enterprises use IPR
- Addresses the needs of policymakers in the Nordic countries for reliable and comparative information
- Focus on patenting, linking national business registries with patent applicants



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Abstract: This report presents the results of a pan-Nordic study to explore how small and medium-size enterprises use IPR. It is a pilot study that demonstrates a commonly developed approach designed to overcome the barriers that hinder study of IPR use by small firms. The pilot study focuses particularly on patenting, based on the common approach linking national business registries with patent applicants. This is the first cross-country project of its kind to develop and execute such an exercise. It applies available definitions and approaches to improve comparability in the Nordic area and with other efforts (such as the OECD patent name harmonization activity). The intention is to demonstrate how this cross-country approach can address the needs of policymakers in the Nordic countries for reliable and comparative information about IPR use among the smallest firms.		
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Executive summary

The Snedig project effectively follows up on a 2001 World Intellectual Property Organization (Wipo) study which recognized the need to address the knowledge deficit on the relationship between SMEs and IPR across countries. The Wipo report recommended applying the approach developed for Norway in a cross-country study of small firm patenting in the Nordic countries, given similarities in country size, large numbers of small firms, institutional setup, data availability issues, etc.

The approach involves official business (administration) and accountancy data against the patent-record to create detailed empirical analysis with a high degree of granularity and currency. Today, we are at the frontier of using this approach to redefine the study of IPR use both in academic and not least in policy analyses.

The Snedig project is the first cross-country study to implement such a procedure in a coordinated manner. This report introduces the application of this approach to the Nordic countries and demonstrates the type of analysis that it can generate.

Main objectives: The main objective of the Snedig Project is to promote more effective, knowledge-driven policymaking which in turn will improve the climate for the relationship between SMEs and IPRs in the Nordic countries. It addresses the need for high quality comparative data that e.g. can (i.) provide useful information about how different types of firms approach and use the IPR system differently, (ii.) indicate where different sub-populations of SMEs seem to have problems using IPRs, and (iii.) provide insight into what potential there is for different firm populations to make better use of IPRs.

To this end this document develops and demonstrates an approach that can provide timely and policy-relevant information concerning tendencies and patterns of small firm patenting by country and across the Nordic area. This approach can be used to generate information that is useful to the specific concerns of policymakers and relevant agencies in the support structure.

This approach represents a marked improvement on existing approaches in that it:

- can identify the size and industry of the patenting firms: patent-counts only provide aggregate counts;
- includes a full-count of all enterprises: the Community Innovation Survey (CIS) excludes firms with under 10 employees, i.e. the majority of Nordic firms;
- provides a global picture in which particular populations can be focused on and compared; case-studies and other small-scale surveys provide limited evidence about the situation of individual firms.
- Can be linked to other existing survey-based studies (e.g. CIS) or lay the basis for targeted studies.

To demonstrate the approach, the report is designed:

- To acquaint policymakers with some of the opportunities and challenges involved in linking firm information with IPRs.
- To size up the total population of Nordic enterprises by industry and by size-class in a comparable manner.

- To present a breakdown of Nordic patenting according to firm-size, industry and other characteristics based on firm-level information identified by the linking procedure.

The Snedig approach goes beyond the dry and laborious exercise of generating data. Another innovation is to organize national workshops around a presentation of the approach and findings. Preliminary results of the project have thus not only been presented to research colleagues at the OECD (April 2008) but to national decision-makers in relevant ministries and support-structure agencies. The aim of this complementary activity has been to engage different types of stakeholders across organization boundaries in a discussion about IPR use by small firms. In addition this exercise has provided a vehicle to gather stakeholder feed back on how they see the relationship between IPRs and SMEs and to encourage these actors to identify specific areas for further exploration. This has among other things led to a follow-up project in Sweden involving the national patent office (PRV), Vinnova, and Statistics Sweden.

Method: The five country approach seeks to use the unique, high-quality data resources that are available (but underused) for each of the Nordic countries. Given this basis the project provides a framework to harmonize important dimensions in the extraction, compilation, analysis, and presentation of the data. It is based on devising a set of standards on which to build cross-country analysis. These include:

- Standards for the underlying databases
- Standards for the linking procedure
- Standards for cross-country analysis:
- Standards for cross-temporal analysis

The standard datasets are: (i.) European Patent Office (EPO) applications and grants in a given time-period (such as January 1 2000 to December 31, 2005); (ii.) domestic application data for the same period; (iii.) official registry (administration) data from each country. These are full-count registry data of national enterprises including information about firm-size, industrial activity, number of companies, (in later years) annual turnover, etc. The patent data is primarily based on an extraction from the EPO Worldwide Patent Statistical Database (PATSTAT), October 2007 edition. It is supplemented for some of the Country Reports by data directly from the national patent offices. In this demonstration, some countries did not have access to the official registry database (Sweden and Iceland) or to certain years of the data (Denmark uses 2000-2002; Finland 2001-2005).

The exercise is designed in order:

1. To present total population of Nordic enterprises by industry and by size-class in a comparable manner. This overview achieves several goals: it provides the necessary backdrop against which to understand the population that currently use the patent system (and by implication those which do not); it provides the information about employment and turnover necessary to categorize firm-sizes according to the standardized EU definition of SMEs used; it provides a platform to include other relevant data, particularly R&D expenditure; and it provides the basis for comparison across countries.

2. To acquaint policymakers with some of the opportunities and challenges involved in linking firm information with IPRs. The approach implemented here involves a comprehensive process of harmonizing tens of thousands of names across databases with hundreds of thousands of records.

3. To present a breakdown of Nordic patenting according to firm-size, industry and other characteristics based on firm-level information identified by the linking procedure. This presentation combines these firm-level characteristics with characteristics of patenting, such as where different types of Nordic firms file for patents (the EPO/Euro-PCT or domestically), in what technical fields, and when. Some indications of what happens after application are also sketched. Questions that emerge here include: are small firm patents granted as frequently as large, are they withdrawn, how long do they live, and are they opposed.

This is a timely exercise. Today, linking administration and accountancy data against the patent-record is fast becoming a viable tool for academic as well as for operational study of patenting behavior. Several developments are defining the frontier both at the national level (e.g. US, Belgium, Nordic Countries) as well as internationally (OECD, Eurostat).

Main results

Finland: The report finds that at the aggregate level, large enterprises account for a very large share of all Finnish patent applications, while the small enterprise share is significantly higher in national applications than in EPO or PCT applications. Moreover, the report observes that in addition to accounting for a large share of patent applications in absolute terms, large enterprises produce more applications per employee than smaller ones (with the exception of enterprises with 0 employees). On the other hand, at the aggregate level, smaller enterprises appear to produce much more applications per unit of R&D expenditure than larger ones. Moreover, the report finds that the relationships are not stable across industries and technologies.

Finally, the report points out that, when interpreting patent statistics for Finland, one needs to understand the extent to which the results are driven by individual enterprises such as Nokia. Moreover, the results – especially for specific industry and enterprise size cohorts – are affected by anomalies such as seemingly very small enterprises that belong to large groups.

Norway: This explorative study indicates some interesting features of the relationship between firm-size and patenting in Norway. SMEs dominate the Norwegian population, with small firms (less than 50 employees or the equivalent) making up 97 percent of Norwegian enterprises. However, most applications (630) filed by Norwegian firms at the EPO involve large firms. The next largest group is from the smallest firms (495). There are also differences in terms of where applications are filed. Large firms file on average 1 EPO filing for every 2 domestic applications. Small firms (10-49) file on average 1 EPO application per every 4 domestic applications.

Size-effects tend to coincide with the patent-propensity of sectors with a concentration of large firms. Patent intensity by number of firms and employment is highest in the Chemicals sectors, followed by the R&D sector. These are industries where the proportion of small firms (<50 employees) is lowest. Yet, Small firms account for over half the patenting in roughly half (14) of

the industries. The proportion is nearly 90 percent in the case of Computers and Technical Consultancy where small firms dominate the demographics. The combination of size and sector factors not only appears to affect the decision to patent but also the decision of where to patent. Certain industries show a preference for domestic and not European patenting, especially technical consultancy where small firms dominate. Most patents to EPO utilize the PCT. Only 8 percent of Norwegian applications applied domestically utilize the PCT.

The study also briefly explored other dimensions of patenting than the application process to look for differences between small and large firms. Data for patent-grants, opposition, and application withdrawal were considered. The proportion of grants to Micro firms is substantially less (19 percent) than its share of total applications (24 percent). This may suggest that the applications of these firms are less successful than that of the large firms where grant rates are substantially higher than application rates. The study supported earlier work (Wipo 2003) showing that the incidence of Non-Grant to be skewed, with the highest proportions found among the smallest applicants

Iceland: Iceland was poised to join the EPC at the end of period of study here. The overall number of patents involving Icelandic enterprises however is very few in the period. In total 227 Icelandic applicants (including non-enterprises) filed through the national office and 180 through the EPO in the period 2000-2005. The linking effort of the EPO patents against Icelandic enterprises was however not successful using the Amadeus database due in part to the small numbers of entities involved and poor employment data. The utility of the approach for Iceland should be revisited in future.

Sweden: Swedish large companies in technological area of electricity and electronics applied for 4,116 patents, while SMEs in the same technological area applied for 924 patents. Share of applications of large companies have an average of 66.9% which is more than twice that of SMEs. Large discrepancy in patenting activities between larger firms and SMEs can be found in electricity and electronics area: approximately 82% of patenting activity is performed by large companies

The number of patents per employee decreases as the size of company increases. Among industrial sectors, finance, insurance, real estate and business services sector has the highest average number of patents per 1,000 employees (535.1) and mining and quarrying industrial sector has the lowest (1.8). It is surprising that the average number of patents per 1,000 employees in manufacturing sector, which is regarded as the source of patenting activities, is 173.9.

The Swedish team went ahead to explore modes to use the data to estimate changes in technological advancement, productivity and efficiency among manufacturing firms. This analysis indicated that efficiency improvement dominated over technical advancement in 2000-2002, suggesting that most companies attempted to catch up with companies with frontier technology. In 2002-2004, however, technical advancement dominates over the efficiency improvement, suggesting that most companies made an effort to innovate rather than to catch up.

Denmark: Innovation mainly takes place large firms in the manufacturing sector. Here only 13.1 per cent of R&D expenditure and 26.1 per cent of patent applications are made by SMEs. These

results are primarily driven by the sub-industries of manufacturing of chemicals and plastic products and manufacturing of food, beverages and tobacco, in which SMEs perform only very little innovation as measured by R&D and patent applications. The result for transport, post- and telecommunication shows little R&D activity in SMEs, which account for half of all patenting.

The results for the finance and business activities sector span from the finance and insurance industry, where small and medium-size enterprises account for a very small share of R&D expenditure, but a surprisingly large share of patent applications (50 per cent). In public and personal services, on the other hand, all R&D expenditure is made by SMEs and 40.5 per cent of patent applications are made by SMEs. This result comes almost entirely from the business activities industry, where a large share of innovation is performed by SMEs (77 per cent of R&D expenditures and 68 per cent of patent applications). Danish SMEs patent most in the technological areas of fixed constructions, transporting, physics, electricity and human necessities. On the other hand, chemistry and metallurgy appears to be areas where large firms patent. These findings corroborate the findings of industry structure, as the chemistry industry is also characterized by large firms undertaking most of the innovation and patenting.

Project recommendations: Experience from this pilot project confirms the ability of the approach to provide reliable and comparative information about how different types of firms approach and use the patent system differently, while also suggesting where SMEs seem to have problems using IPRs. Other measures should build upon this pilot study to further improve knowledge about the inter-relationship between SMEs and the IPR system. This is needed to substantiate policy concerns about this relationship and to inform policymakers of areas for potential improvement. A follow project is already funded in Sweden to deepen this analysis.

The Nordic level is the right level at which to coordinate this work. This experience supports the Nordic countries should use this approach to monitor and analyze the IPR activity of domestic small and medium-size enterprises. This type of ‘now-casting’ (Patent Manual 2008) should be further integrated with the recently started work at the OECD where Snedig participants already contribute. One specific area where Nordic countries could draw on each other’s experiences involves understanding how the transition between national and regional patent offices (EPO) has affected small firms.

In the near term this sort of study should be periodically updated now that the groundwork has been laid. Results from periodic updates of such a study should be used to promote dialogue between different parts of the innovation system which involve SMEs and IPRs.

One particular area to study here builds on the relatively high incidence of non-grants to small entities suggested by the study (see the Norwegian report especially). The fact that small firms withdraw their patent applications may indicate that the patent-system is not suited to their needs. The first question to explore is whether this is the case and, if so, what factors are responsible for withdrawal of applications. It is possible that other rights types, such as Design or of ‘petty patents’ (brugsmønster, Gebrauchsmuster)—which are designed for small firms and available in some countries (e.g. Denmark)—are better suited to certain small-firm needs. The approach used here would be instrumental in studying this question in greater depths.

In the longer term, the Nordic countries should institute an IPR Observatory (virtual or real) to coordinate work on the micro-foundations of IPR use. One area of study should concentrate on ‘now-casting’, or monitoring and analyzing the changing IPR use and needs of the region’s many small firms. The core of this Centre would be a full-scale database of this approach which can be used to address specific policy concerns. This analytical basis would be complemented with contextual competencies to address emergent and recurrent concerns. It would separate from the operational aspects of ministries and patent offices.

Nordic countries should cooperate on systematically linking the organizational number of IPR applicants with the applications. This exercise is already underway in individual countries (e.g. in Denmark, France, etc). It would be useful in unifying the identity of the applicant and for other administrative purposes, not least in facilitating coordination with other international offices, especially the EPO. It would also greatly facilitate analysis of this kind in future.

1. Introduction

Nordic policymakers are concerned that their large populations of small firms are in some sense ‘underachievers’ in taking advantage of the IPR systems. Despite general and specific concerns, there is relatively little systematized and comprehensive information about the level and nature of ‘IPR-achievement’ of different SMEs to substantiate these concerns and to inform policymakers of areas for potential improvement. The lack of reliable and comparative empirically-based information obscures the SME-IPR relationship and prevents better policy development.

This project builds on the premise that empirical information is needed to better understand how different types of firms use the IPR systems and how ‘achievement levels’ vary. It is a pilot study designed to demonstrate how the concerted study of micro-level IPR data can address policy and operational concerns at the Nordic level, specifically those involving the efforts to small firms. The main objective is to promote more effective, knowledge-driven policymaking which in turn will improve the climate for the relationship between SMEs and IPRs in the Nordic countries. It addresses the need for high quality comparative data that e.g. can (i.) provide useful information about how different types of firms approach and use the IPR system differently, (ii.) indicate where different sub-populations of SMEs seem to have problems using IPRs, and (iii.) provide insight into what potential there is for different firm populations to make better use of IPRs.

This demonstration is laid out in the following way. The first section introduces the case for a knowledge-based strategy on this front. Section 2 lays out the basic premise for the common approach and data-resources, which form the centre of the project. The third section goes on to supply cross-country comparisons of industrial structure in the Nordic area, with a focus on small-firms. The subsequent section builds on this demographic presentation to identify what type of firms in each country file for patents (EPO). The final section focuses on the size aspect of current patenting patterns in the different countries.

2. The need for a knowledge-based strategy: Challenges and opportunities¹

Nordic small and medium-size enterprises are often seen as vulnerable in today's increasingly competitive, increasingly international, increasingly knowledge-driven, and thus increasingly IPR intensive environment. This preliminary section briefly reviews the case for policy concern about IPR use among SMEs. It lists some of the general concerns while illustrating the particular relevance for the Nordic countries. The implication is that this is a policy-area that is particularly well adapted for policy collaboration at the pan-Nordic level.

2.1. What makes policy focus important

SMEs are integral to the Nordic economies today, and the capabilities developed in this broad category of firms will be important to their development tomorrow. This broad group of firms forms a central part of the economic life of the Nordic societies. Their competitive viability in a changing world is a central socio-economic concern. The idea that we are moving to a "knowledge-based economy" assumes that the key condition underlying wealth creation is innovation through the generation, exploitation and diffusion of knowledge. The changing environment emphasizes the importance of a well-built, competent infrastructure that can help relevant SMEs decide whether and how best to use the IP-system. In this framework, the protection of innovation through intellectual property (patents, trademarks, copyrights) is gaining in importance. Quickly moving technical areas like ICTs and biotech are areas that hold challenges and opportunities for the way IPRs are used in certain markets. Heightened activity will tend to make room for start-ups and spin-offs where IPRs may play critical roles.

To address the concerns here, it is first important to recognize that there are several discourses that shape and focus policy concerns about SMEs and their use of intellectual property rights. These range from basic argumentation about the differential resource positions of small and large firms, to anecdotal evidence based on individual cases, to theoretical and analytical discussions of industrial renewal, to policy developments in other countries.

¹ This section draws on the report (D01: Nordic efforts to coordinate firm-matched patent-data for policy decision making) presented at the EPO OECD Conference in Venice 2007.

The starting point is however the basic expectation that SMEs tend to lack the resources (in the form of time, money, and expertise) that larger firms have to understand the IPR-system and to use it to their best advantage. This general concern is compounded in the small open economies. Specific reasons for concern include several factors for the different Nordic countries. These start with the fact that Nordics are small open economies with high proportions of very small firms.² Domestic SMEs play significant roles in these economies and indeed in the wider societies. SMEs tend to account for high shares of employment and to support high levels of economic activity not least in the regionally distributed districts of the Nordic region.

Small firms are also important in industrial renewal processes in these economies. Their economic role can be seen in terms of traditional fears of economic monoculture which remain current in light of the small size of the economies and their structure (e.g. Iversen, 2008). Policymakers have tended here to follow international trends to promote growth oriented around startups and spin-offs into emerging sectors such as ICT and pharmaceuticals, which are highly knowledge intensive, highly competitive, and in turn where the IPR dimension is particularly relevant (Moulin et al, NICE).

These sector-oriented cases of policy-focus tend to highlight concerns about IPR use among SMEs, since IPR are widely recognized as central to making it ahead in the face of international competition. More important however is to recognize that the IPR concern extends more generally right through the open economies and includes research-based as well as tradition-based, manufacture as well as service, urban as well as regional small firms.

2.2. What makes policy focus difficult

In general there is relatively little systematized and comprehensive information about the level and nature of 'IPR-achievement' of different SMEs in the Nordic area to substantiate these concerns and to inform policymakers of areas for potential improvement. If the relationship is so important, why is so little systematic work done here?

A better policy knowledge base

² Statistics Norway reports that the number of Norwegian companies with employees rose from 164,000 in the first quarter of 2003 to 173,000 (Q1) 2006. Less than two percent of these companies had over 99 employees (2600-2700), while around four percent had over 49 employees. This example of Nordic business demography illustrates a large proportion (more than 95%) had less than 50 employees and thus qualified as small.

There is an initial need to consolidate policy attention on SMEs and their use of intellectual property rights. Policy attention in the area tends to be unfocused over any duration. There is first a tendency for this concern to be spread, relatively thinly, through or subsumed under other areas of better defined and more sustained policy areas (such as targeted focuses in given industries or regions). Focus on this issue might also periodically emerge in relation to a more general focus on improving the innovative capability of SMEs or on improving the efficiency of design or other IPR.

There are currently a range of policy concerns associated with SMEs and IPRs in the Nordic countries that can benefit from a better understanding here. These include:

- General analysis of R&D productivity and small firms
- Research duplication and patent withdrawal (see e.g. Finland)
- Research collaboration and small firms (general currency)
- Analysis of entrants and exit by size (general currency)
- Regionalisation of IPR and implications for small firms (transition to EPO) (see Norway and Iceland particularly).
- The effects of R&D Tax schemes (see Norway)
- Analyzing strategic patenting and its effects on small firms
- Analysis of 'bruksmønstre'/Petty patents (see Denmark)
- Academic patenting and spin-offs (all countries)
- Opposition and small firms
- Support-schemes targeting SMEs (see pending plans in Norway which identify IPRs specifically)

The overall tendency is that what policy attention is directed at understanding how SMEs currently use the IPR-System and, on this basis, whether this use—and the conditions for it—can be improved, is currently secondary, intermittent, and generally divided between its IPR and its SME parts. Recognizing that not all policy questions can or should be primary and that policy priorities must and do change, a greater degree of sustained and concerted attention on the specific concern of IPR use among SMEs would have clear benefits (and low costs). This more ad hoc approach means that any learning effect or any general level momentum tends to be lost in the current situation, and must be built up again each time.

Better empirical knowledge base

A major limiting factor is the availability of good, detailed, and comparable data. Work in the area in fact tends to be restricted in different ways, e.g. work tends to involve single-country, single industry, single rights-type generally using sample data. In addition, there are some other constraints to a more comprehensive analytic view, including the fact that the relationship itself is remarkably complex (different subpopulations of firms, fundamentally different rights-types...).

Policymakers have to contend with a general lack of useful knowledge about how their many SMEs use the IPR system. In general there is relatively little systematized and comprehensive information about the level and nature of 'IPR-achievement' of different SMEs in the Nordic area to substantiate these concerns and to inform policymakers of areas for potential improvement.

This empirical shadow consists of two components; (a.) the availability of data which allows firm-level analysis to take place, and (b.) agreement on appropriate ways to analyze it for policy purposes. Some can be addressed relatively simply, by coordinating efforts (see below). What is needed is first of all a cross-country framework that can provide reliable and comparative information about how different types of firms approach and use the IPR system differently, where SMEs seem to have problems using IPRs, what potential there is for different firm populations to make better use of IPRs, etc. We find that that the agreement on appropriate ways to analyze it for policy purposes has become a major bottle-neck.

Empirical analysis of the relationship between SMEs and IPRs is hobbled by a combination of factors which can magnify one another. These include:

- The complexity of the underlying factors introduces problems for how to approach IPR use by size: A long list of factors may shape IPR use, from the more generic features, (such as the firm's market position, financial position, other key physical dimensions), to organizational features (e.g. strategy, ownership) and potentially on down to unit specific factors (e.g. serendipity).
- Statistical problems in the form of measurement uncertainty and sampling bias emerge as the observed variables struggle to pick up real effects.

- This has knock-on effects for specification and analysis of the relationship.

There is thus the need to address the empirical shadow that obscures the SME-IPR relationship and prevents better policy development. In short it is based on linking two types of data: the firm-level registry data (where the Nordic countries have unique resources) and IPR databases (including but not limited to patent data). The approach stresses that the data should be:

- tractable: it should make comparative analysis possible across countries and time
- comprehensive: it should cover the broad population of SMEs
- granular: it should however be fine-grained enough to identify important differences e.g. between industries.
- It should be reliable and up-to-date.

Here we note that there is an increasing effort dedicated to the relationship between SMEs and IPRs. Some of the more focused but less well-known studies are;

- Patent statistics by size-class in Indicators work (e.g. Statistics Finland, the 1990s, The Norwegian Indicator report (from 2003), current work for the Danish Ministry of Trade)
- Saarenheimo's (1994) game-theoretic framework indicates firm-size is inversely related to the propensity to patent
- Iversen (2003, 2007) indicates that SMEs account for a large part of domestic patent and trademark growth (varies for sectors), but much more likely to withdraw own applications.
- WIPO's SME division based largely on national case-studies, since late 1990s
- Kaiser and Schneider (2004) developed a CEBR matched patent/patent applicant/employee database.
- Webster and Jensen (2004) indicate that Australian SMEs actually have higher rates of patent, trademark and design usage controlling for industry effects
- The Small Business Administration on US SMEs and enforcement (Mogee): Survey-based.

Work on this front does appear to be on the increase. However, it remains somewhat disparate, based on different approaches (from case-studies, to surveys, to exercises based on matched-databases). In this limited tradition of dedicated inquiry, analysis based on matching IPR

(primarily patents but also trademarks) to enterprise registries is gaining momentum. The general approach has some clear advantages over existing approaches. The firm-level patent-data

- can identify the size and industry of the patenting firms: patent-counts only provide aggregate counts;
- includes a full-count of all enterprises: the Community Innovation Survey (CIS) excludes firms with under 10 employees, i.e. the majority of Nordic firms.
- provides a global picture in which particular populations can be focused on and compared; case-studies and other small-scale surveys provide limited evidence about the situation of individual firms.

2.3. Toward a Nordic policy

In the international environment, timing is also important. We argue that now is an opportune time to take stock of the relationship between IPRs and SMEs since the institutional framework for patenting changes. One aspect is the changing division of labor between national and pan-national patent offices, particularly the EPO. As Iceland and now Norway transition to the EPO a consideration is what the role of the national support-structures with patent-office playing a central role will do.

There are reasons to organize at least elements of such an exercise at the Nordic level, perhaps in line with other developments such as the move towards a Nordic Patent Institute. This preliminary section lays out a basic case that together the Nordic countries have a unique opportunity to address the empirical shadow and thus improve empirical and policy knowledge in this area. A preliminary step the possibility that the Nordic countries could play a leading role in international efforts to analyze cross-country data (e.g. WIPO, EU and Oecd efforts).

3. Approach and Data

This pilot study explores the complex relationship between IPR activity and enterprise size by looking at national and European patent applications filed by Nordic enterprises at national patent offices and at the European Patent Office (EPO), including those that utilize the Patent Cooperation Treaty (PCT) procedure. The project has collected and collated firm-level patent data based on a common approach that links patent applicants and firm-level information from national business registries. This has been done in each country based on national data and national expertise.

The empirical strategy is based on data-sources that can ensure a sufficient degree of reliability, coverage, compatibility, and granularity to allow Nordic countries to monitor and analyze the IPR activity of domestic small and medium-size enterprises. The common approach involves framework to harmonize important dimensions in the extraction, compilation, analysis, and presentation of the data.

The general approach is described elsewhere (D01) while information specific to each country is provided in the country reports. A brief overview of the databases and the approach is found in the Appendix. The basic ingredients of the approach are:

- A cross-country concerted effort concurrently involving national teams³ to adapt the approach to national conditions and data-concerns and to interact with national actors.
- Compatible patent and registry (administrative) data.
- The reliance where possible on standard approaches and analytical approaches

The key element is that patent data is linked to full-count public registries of all enterprises in a consistent manner for each country in the study. This has not been done for more than one country in a concerted way before. There is however a wider set of smaller but important challenges that are involved in consistently matching and analyzing the data.⁴ A preliminary concern is to use common definitions on which the common approach can be built. Some of these are introduced here.

The presentation of firm-size for example relies on the EU definition (2003); the correspondence between International Patent Classes (IPC) utilizes a common key first developed for the OECD Patent Manual (1994); the name-harmonization process relies on existing studies (WIPO, 2003; Eurostat, 2006).

Small and medium-size enterprises: For the sake of comparison, the study employs the EU definition of SMEs (EU, 2003). This definition is pegged to the number of employees, but recognizes that size involves overall resources. Therefore a measure for turnover or balance-sheet total is included which overrides the purely employment based division.

The four categories are:

1. Micro (0-9 employees and less than €2 million in turnover)

³ The report for Iceland was developed in Sweden after the original Icelandic partner changed positions.

⁴ This is not a trivial matter and it has recently become the subject of work at the OECD where members of the Snedig have been involved.

2. Small (10-49 employees and less than €10 million in turnover)
3. Medium-sized (50-250 employees and €50 million in turnover)
4. Large (firms with more than 250 employees or greater than €50 million in turnover).

Industry

Classification of Industry: The enterprise's industry is defined via the EU's NACE classification (Nomenclature générale des Activités économiques dans les Communautés Européennes). The most up-to-date classification is used if this had changed over time. The aggregation used is provided in Appendix 2.

3.1. EPO Worldwide Patent Statistical Database

Domestic, regional and international patent applications are used in this pilot-study. The focus is however on applications to the European Patent Office (EPO), either directly or through the Patent Cooperation Treaty (PCT) procedure. The five Nordic countries are now full members of the EPC. EPO data is supplemented by domestic patent data, not least since Iceland and Norway only became full-members after the period (2000-2005) under study. It is also important to look at the division of labor between the regional and domestic application processes since these represent different propositions to different applicants. The main patent data is extracted from the EPO Worldwide Statistical Database (PATSTAT)⁵:

Fractional Counts: The contribution of the applicant(s) to applications involving more than one applicant is computed as a fraction of that application (i.e. fractional or normalized counts are used). EPO applications include patents that arrive at the EPO either through the Patent Cooperation Treaty (PCT) route or directly.

Technological Areas: The primary IPC classes of the patent applications were associated to Technological Areas by a widely-used Correspondence Key: the OST-INPI/FhG-ISI Key, Version 3. This correspondence key is suggested in the OECD Patent Manual (1994; 2008).

Time-span: Patents applications are based on the year they are received by the relevant Office. In the case of the European patents, the date is date of publication at the EPO. For the domestic data the date of application is when it was received by the office. The common time-span is 2000-2005.

⁵ This data may be supplemented by data from private vendors or directly from the domestic patent office in order to supplement information type (e.g. status or oppositions). See the country reports.

3.2. Enterprise register data

The pilot study utilizes a combination of official register data and accountancy data. Nordic countries are at the forefront in making available registry or administrative data to researchers. This data forms the official registry of all economic actors in the respective country, including information about employees, turnover, industrial activity, status, etc. These official data are often linked to tax registries and are thus kept up-to-date and provide reliable figures for employment and turnover. The availability of this data has greatly improved the study of industrial organization/industry dynamics in these countries. This has been extended to the study of patenting as well first in Finland (from the 1990s) and Norway (from 2000).

This forms the basis for the study. But in two cases (Sweden and Iceland) this data was not available and accountancy-data was used in its place (AMADEUS). Accountancy data tends not to include all the smallest firms since it is largely based on the submission of annual accounts, supplemented by other sources. The advantage of the data is that it includes more financial information about the enterprises. In future the project recommends using the official data registries as the basis for the link, supplemented by accountancy data.

In general the enterprise-level is used and all values (number of employees and turnover) are aggregated up to this level. Public companies and institutions are excluded in most tables but available for individual countries where specified. The details of the data-sources for each country are found in the Appendix, and further explicated in the individual country reports.

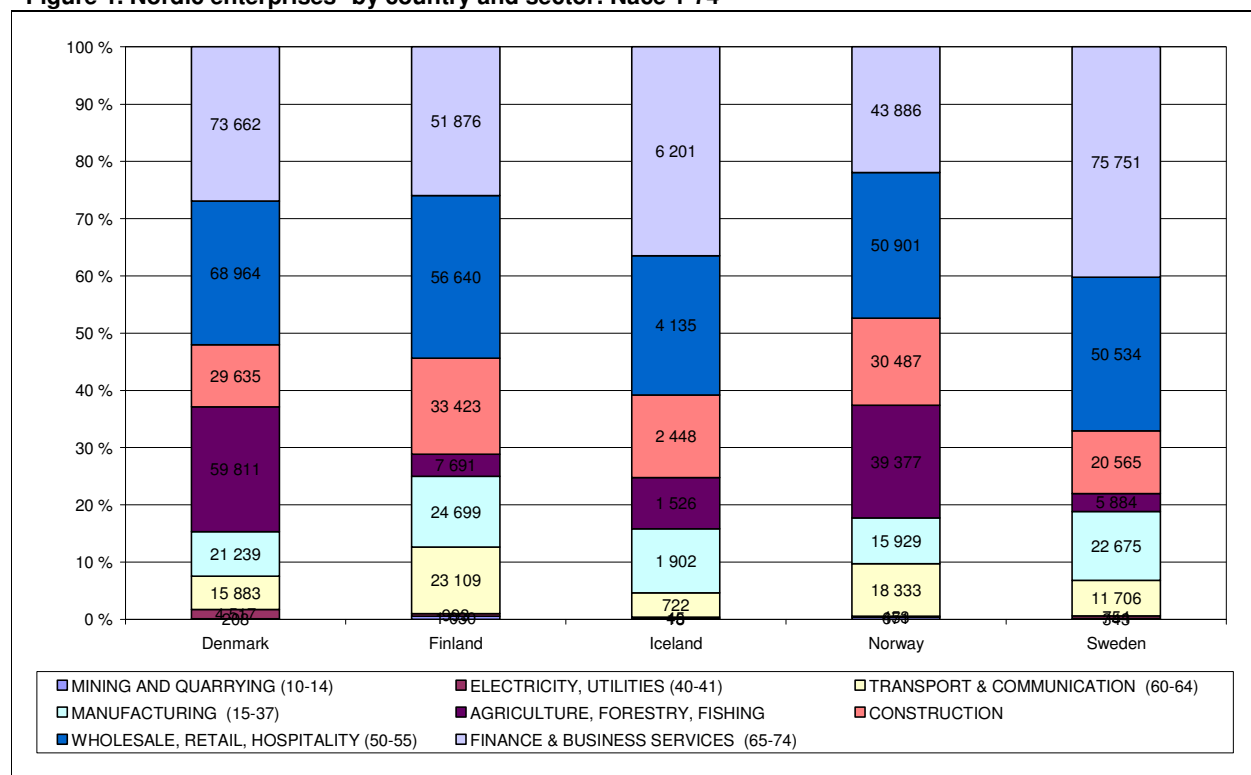
4. *Economic Activity in Nordic Countries*

Some 880,000 enterprises operate in the primary, secondary and tertiary sectors of Nordic economies.⁶ A breakdown by country indicates (figure1) that more than half of these entities operate in two areas of the service-sector, namely in Wholesale, Retail & Hospitality and in Financial and Business Services. Hotels, stores, and a large number of other small entities which are not expected to be involved in patenting (but maybe in the use of trademarks) are found here.

⁶ See Appendix 2 for the aggregation of NACE industries. These industries correspond to NACE 1-74; social services (including hospitals) and governmental organizations are excluded from this presentation. The base year is 2005 (see note). The numbers for Sweden and Iceland are based on the financial reports of firms as captured in the Amadeus database. Otherwise official business registries are used.

Sub-areas (of retail trade) of each however hide high levels of patenting activity as a closer look will reveal.

Figure 1. Nordic enterprises* by country and sector: Nace 1-74

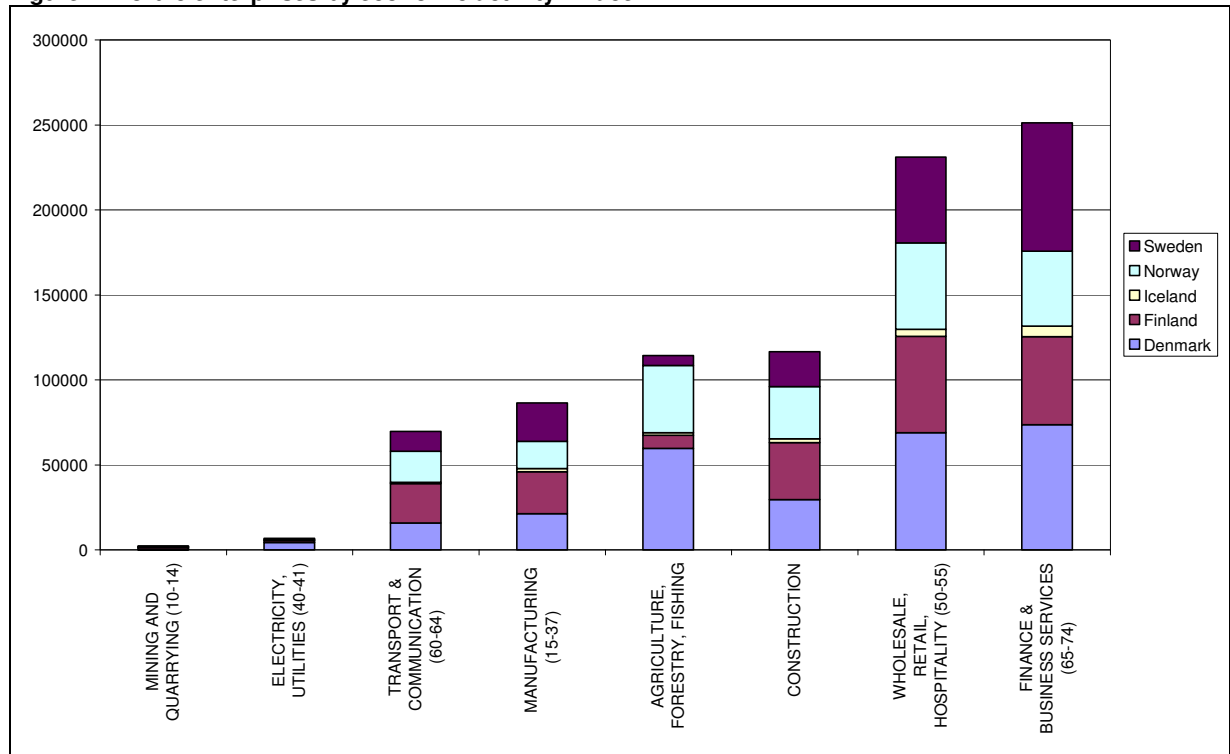


*The reference year is 2005 except for Denmark (2002) and Sweden (2005)

The overall mix appears relatively similar across the Nordic countries, when one takes into account some aspects of the different registries used here⁷. In general, broad areas of economic activity which are dominated by small enterprises—such as Construction—claim high proportions of Nordic economic entities: a closer look can identify areas of current or potential use of intellectual property rights. There are some notable differences, for example the high proportion of Swedish firms involved in the broad sector of Other Business Services, under Finance & Business Sectors (Nace 65-74).

⁷ E.g. that many of primary-industry enterprises in Sweden (and Iceland) are not reported here. And the fact that the Finnish data requires a level of economic turnover, which seems to exclude many entities in Agriculture and other primary industries.

Figure 2. Nordic enterprises by economic activity*: Nace 1-74



*The reference year is 2005 except for Denmark (2002) and Sweden (2004)

**Accountancy data (Amadeus) is used for Sweden and Iceland; 2004 and 2005 respectively

Patenting is associated primarily with manufacturing firms. In the mix, between 8 and 12 percent of the Nordic enterprises are involved in manufacture according to this tally. This category is also relatively broad and includes a wide array of different activities, from the making of textiles to chemicals, from publishing to shipbuilding. Table 1 introduces an overview over the more disaggregated levels of the Nordic entities⁸. This detailed picture specifically unpacks Manufacturing and Business Services, as sub-areas of these sectors will account for a large proportion of current patenting among Nordic entities. Public Services (sectors with **) are included here, noting that a full count of public entities (including hospitals and universities) are only included for Norway and Denmark in this round.

⁸ Iceland is dropped from the comparison due to many missing values in employment and the largely unsuccessful link with the small number of Icelandic patents.

Table 1 Breakdown of economic entities by economic activity and employment

	NORWAY			SWEDEN*			FINLAND			DENMARK		
	total firms	total emplo	% Small firms	total firms	total emplo	% Small firms	total firms	total emplo	% Small firms	total firms	total emplo	% Small firms
AGRICULTURE, HUNTING, FORESTRY AND FISHING	39 377	63 453	100	5 884	23 945	99	7 691	19 850	100	59 811	91 440	100
MINING AND QUARRYING	671	39 621	90	343	8 660	96	1 030	3 404	99	208	3 117	95
MANUFACTURING	15 929	257 330	93	22 675	695 772	93	24 699	395 552	95	21 239	459 510	93
Food products; beverages and tobacco	1 683	51 106	87	1 452	45 522	92	1 821	36 672	94	1 897	87 346	91
Textiles, leather products	1 072	5 532	97	736	8 814	96	2 340	11 227	99	1 505	12 040	97
Wood and wood products	1 561	15 607	96	1 802	28 801	94	2 609	26 476	97	750	14 766	93
Pulp, paper; publishing and printing	2 536	33 528	95	3 715	71 953	94	2 833	60 889	95	3 320	56 428	95
Petroleum, rubber and plastic products	353	5 317	93	964	25 463	90	674	18 246	90	762	23 939	87
Chemicals and chemical products	184	13 199	74	507	35 128	83	329	16 759	82	385	29 407	86
Other non-metallic mineral products	671	11 006	93	556	14 168	90	873	16 334	94	864	18 013	92
Basic metals	146	11 172	76	294	26 821	78	150	17 482	81	195	5 942	85
Fabricated metals	1 990	19 495	96	5 087	64 085	96	4 483	38 168	97	4 180	46 921	96
Machinery and equipment	2 031	23 959	95	2 938	167 402	91	3 415	57 327	94	2 426	67 777	90
Electrical and optical equipment	1 066	18 846	92	1 172	51 968	92	1 682	65 636	93	2 060	51 453	92
Transport equipment	1 088	36 486	89	1 062	117 982	87	872	16 341	94	596	15 005	91
Other manufacturing, recycling	1 548	12 077	97	1 395	21 338	94	2 618	13 995	98	2 299	30 473	95
ELECTRICITY, GAS AND WATER SUPPLY	453	14 305	73	754	59 605	89	993	10 848	96	4 517	12 736	100
CONSTRUCTION	30 487	154 555	99	20 565	189 243	99	33 423	130 387	99	29 635	172 879	99
WHOLESALE AND RETAIL TRADE; RESTAURANTS AND HOTELS	50 901	412 869	97	50 534	465 401	98	56 640	292 364	99	68 964	523 807	98
Wholesale trade and commission trade	13 270	102 588	94	20 283	201 189	97	15 245	82 332	99	18 207	166 920	97
TRANSPORT AND STORAGE AND COMMUNICATION	18 333	157 192	98	11 706	197 716	96	23 109	149 969	99	15 883	184 319	98
Transport and storage	17 295	119 788	98	11 360	148 036	97	22 513	110 728	99	14 635	130 986	98
Post and telecommunications	1 038	37 404	93	346	49 680	90	596	39 241	91	1 248	53 333	96
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	43 886	281 287	98	75 751	1 933 177	97	51 876	240 065	99	73 662	406 702	99
Financial Services	1 142	45 257	91	4 220	44 707	98	3 461	42 884	97	4 009	81 560	96
Computer and related activities	5 012	36 014	98	8 332	77 413	98	4 602	35 635	97	7 630	40 631	98
Research and development	264	10 892	80	1 243	14 173	97	327	2 474	97	371	12 235	89
Technical consultancy services	6 501	35 531	99	9 707	55 473	99	7 165	32 496	99	12 457	70 585	99
Other business activities	21 186	122 654	99	33 127	1 628 628	96	23 989	98 181	99	23 101	156 774	98
COMMUNITY SOCIAL AND PERSONAL SERVICES**	22 727	775 573	93	8 446	100 932	97	17 066	45 621	99	22 566	961 047	96
Education, health**	21 404	648 241	94	8 429	100 863	97	17 034	42 820	100	22 065	230 147	97
OTHER PUBLIC SERVICES AND ACTIVITIES**	68 487	556 135	99	37 235	311 022	98	73 665	281 618	99	99 265	1 264 116	99
Unknown	746	861	100	33 614	355 319	97				1 139	1 433	100
Totals	243 262	2 244 629	97	217 122	3 947 401	97	236 433	1 328 451	99	319 537	2 948 402	98

* Accountancy data (Amadeus) is used for Sweden and Iceland; 2004 and 2005 respectively

** Public entities are included for Denmark and Norway in Community Social Services and Other Public Services.

The table also indicates the overall level of employment by sector. Identifying the exact number of employees per enterprises provides the basis for differentiating small firms from large: further firm-level information, such as turnover, can be used to fine-tune the categories for firms. The overwhelming majority of small firms is evident in this table. The proportion of small firms varies between 97 and 99 (Finland*)⁹ percent of Nordic firms.

The proportion of small firms (less than 50 employees or equivalent) is also broken down by sector in Table 1. This breakdown indicates that the proportion of small firms varies systematically by sector. Manufacturing firms tend to be larger for example; small firms make up less than 90 percent of enterprises in Chemicals and significantly fewer than average in several other manufacturing sectors, including Basic Metals and Transport Equipment (including shipbuilding). This aspect of industrial structure is a basic first step in understanding the relationship between firm-size and IPR use. Other sector related factors include the degree to which markets are contended and the general propensity to patent in the sectors.

⁹ Which lacks turnover data to adjust the definition according to the EU definition.

The composition of size-classes in the Nordic countries is characterized by the overall high proportion of small firms and, thus, a small number of large firms. Table 2 compares size-classes for the private business sector of the economy (Nace 75 and above are dropped as are those without a Nace), as this is where most patenting takes place.¹⁰ This adjustment reduces the Danish and Norwegian populations in particular.

A good measure of the composition of firm-sizes is the average firm-size. National firm-size averages are provided on the basis of the number of firms and registered employment for these sectors, noting that 'other firms' indicates firms with no registered employment. According to this approach, average firm-size ranges from 6-7 employees per firm to 19 employees per firm in Sweden, where the cohort of smallest firms again is not represented. Employment data for Iceland is not reliable.

Table 2. Business enterprises* by size-class§§

	<i>Norway§§</i>	<i>Finland</i>	<i>Denmark</i>	<i>Sweden</i>	<i>Iceland§§§</i>
Other firms**	4 438	53 111	14 757	39 926	16 074
Micro firms	171 230	131 137	78 331	121 214	791
Small firms	20 021	12 465	15 788	21 391	111
Medium-sized firms	3 500	2 194	2 921	4 468	17
Large firms	848	554	664	1 213	4
Total firms (Nace 1-74)	200 037	199 461	112 461	188 212	16 997
Total employment (Nace 1-74)	1 380 612	1 242 438	1 640 342	3 573 519	8 211
Turnover M Euros (Nace 1-74)	259 376	NA	465 947	841 283	5 088
Average firm-size (Nace 1-74)	6,9	6,2	14,6	19,0	0,5

* Includes private business in Nace 1-74. And excludes Social and Government (Nace 75 and above)

§ the reference year is 2005 except for Denmark (2002) and Sweden (2004)

**The 'Other' category are firms, particularly single-person companies with registered employment. The basis for which these are included in the databases differs from country to country

§§ In Norway single-person companies with registered employment tend to be defined as micro-firms. The EU definition of SMEs is used in Norway, and not in the other countries. This definition, denominating turnover to Euros, is sensitive to strong currencies such as the Norwegian krone. See annex and country reports for further details.

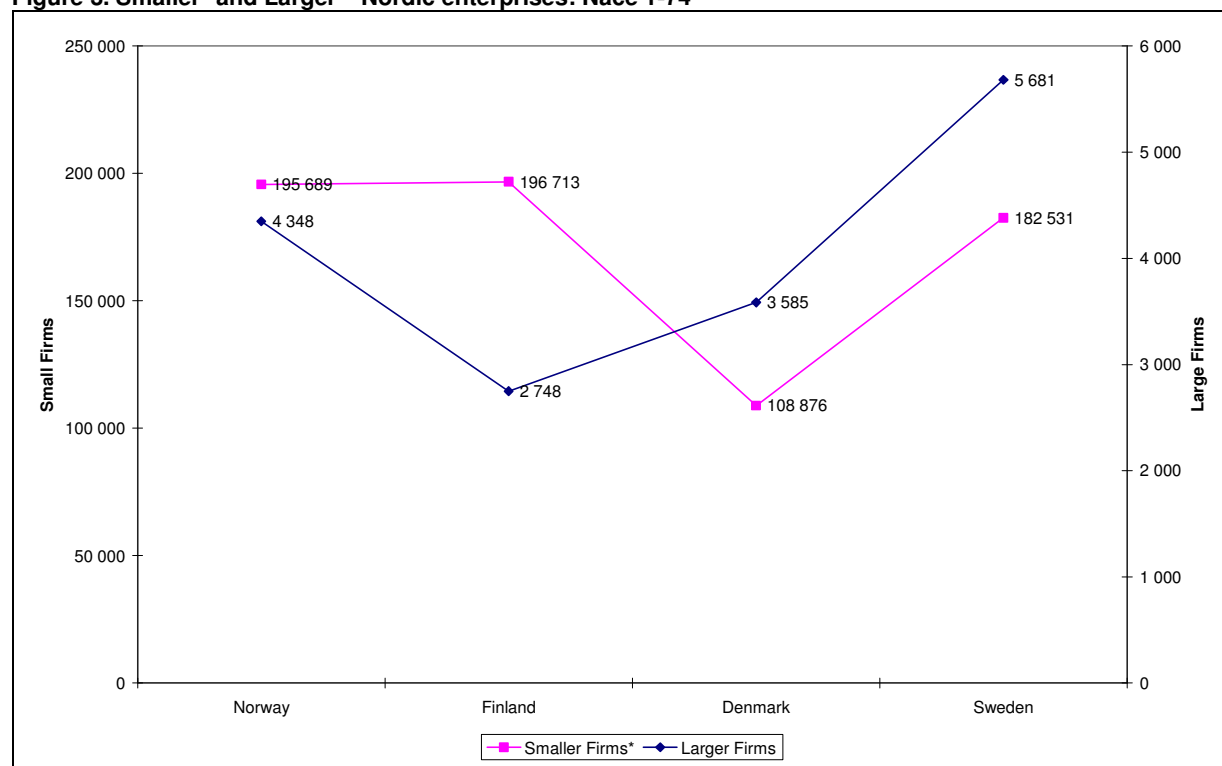
§§§ Employment data for Iceland is characterized by missing values and is not reliable.

Figure 3 divides Nordic enterprises into a group of smaller and a group of larger firms in this sector of the economy. This figure indicates relative populations in the different Nordic countries using two-handed axes: the left axis for the more populous small firms and the right for the larger firms. This presentation is based on the assumption that other Firms (those without employment)

¹⁰ This excludes large non-private entities including universities and hospitals which are increasingly encouraged to patent.

are Micro firms. It indicates that the number of larger firms remains humble at between 2,750 and 5,700 per country even when the bar is lowered to 50 employees and above.¹¹

Figure 3. Smaller* and Larger Nordic enterprises: Nace 1-74**



* The Category 'Smaller firms' includes firms with 0-49 employees (Other, Micro, and Small firms according to the definition)

** The Category 'Larger firms' includes firms 50 employees or more (Medium-sized and Large firms).

5. Enterprise size and patenting

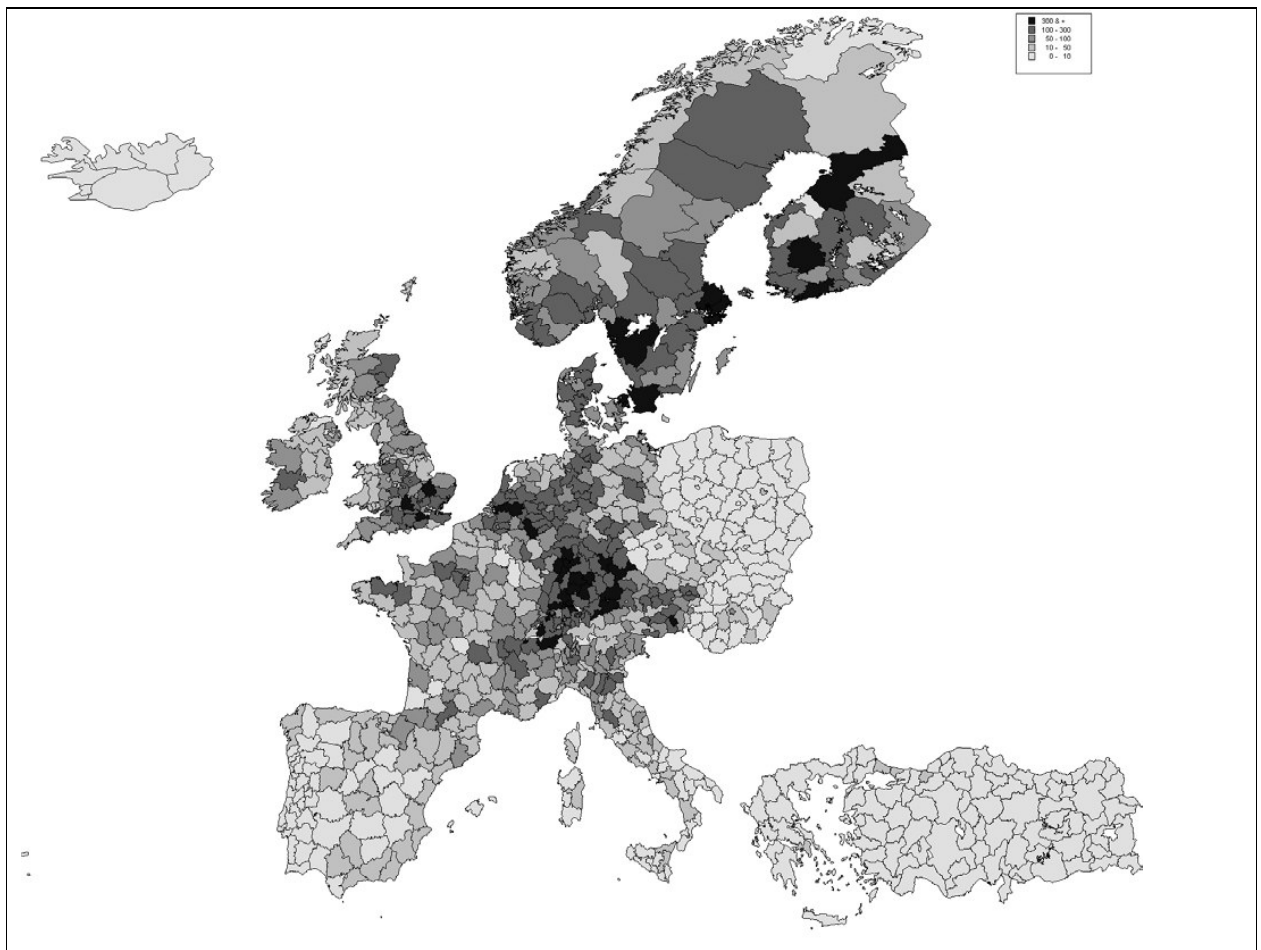
The sketch of industry structure in the Nordic economy presented above lays the basis for a cross-country comparison of patenting by small and large enterprises. A necessary preface to this discussion is that, although all Nordic countries are now members of the European Patent Convention (EPC) which lays the basis for EPO patenting, this was not the case for the period under consideration. As noted above, Iceland and Norway joined the EPC after 2005. This is relevant since EPC Membership makes the cost of applying to EPO cheaper, meaning that enterprises in these two countries faced a different value-proposition than those of the other countries to apply for European patents (see the National Report for Norway for a discussion).

¹¹ Note that large firms in Finland and Denmark are based on raw employee-counts while those in Norway are adjusted according to the EU SME definition, which promotes smaller firms to larger firm status based on turnover. The level of turnover is influenced by the strong Norwegian krone.

5.1. Overview

A more neutral basis for comparison is to consider applicants using the Patent Cooperation Treaty (PCT)—which can subsequently lead to designations in other countries, either in Europe or not. Figure 4 from the OECD illustrates the intensity of applications per capita (M) by the region of the applicant. It underlines another feature of the Nordic area, namely that it is a large but sparsely populated region.

Figure 4. OECD REGPAT: Number of patent applications filed under the PCT per million population, 2004

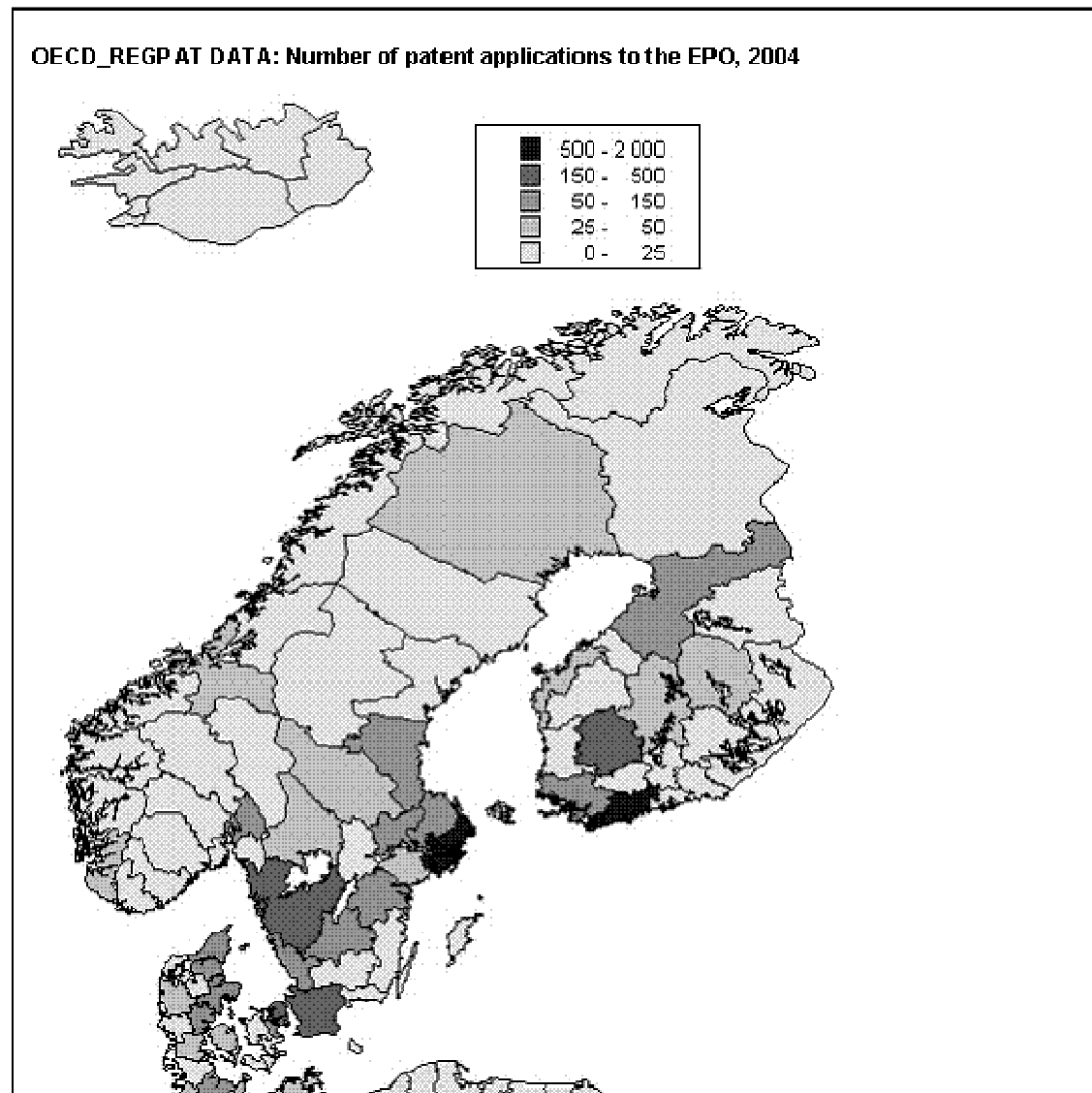


Sources: REGPAT, OECD Patent database and OECD Regional database, February 2008. P. 26

The overall level of patenting in the Nordic area is high relative to that of other European countries. Areas of Sweden, Finland, and Denmark report over 200 PCT applications per million population. The areas of greatest patent intensity tend to be around urban centers. In the Nordic countries—but Sweden in particular—relatively high levels of patent activity spread beyond cities, extending in particular to regions with universities.

The corresponding picture for EPO patents helps to illustrate the effect that the choice of patent office plays. Whereas there was a moderate level of PCT patenting in much of southern Norway (especially Østlandet and Trøndelag), Figure 5 shows that corresponding levels of EPO patents are lower right across the country.

Figure 5 OECD REGPAT: Number of patent applications filed under the EPO per million population, 2004



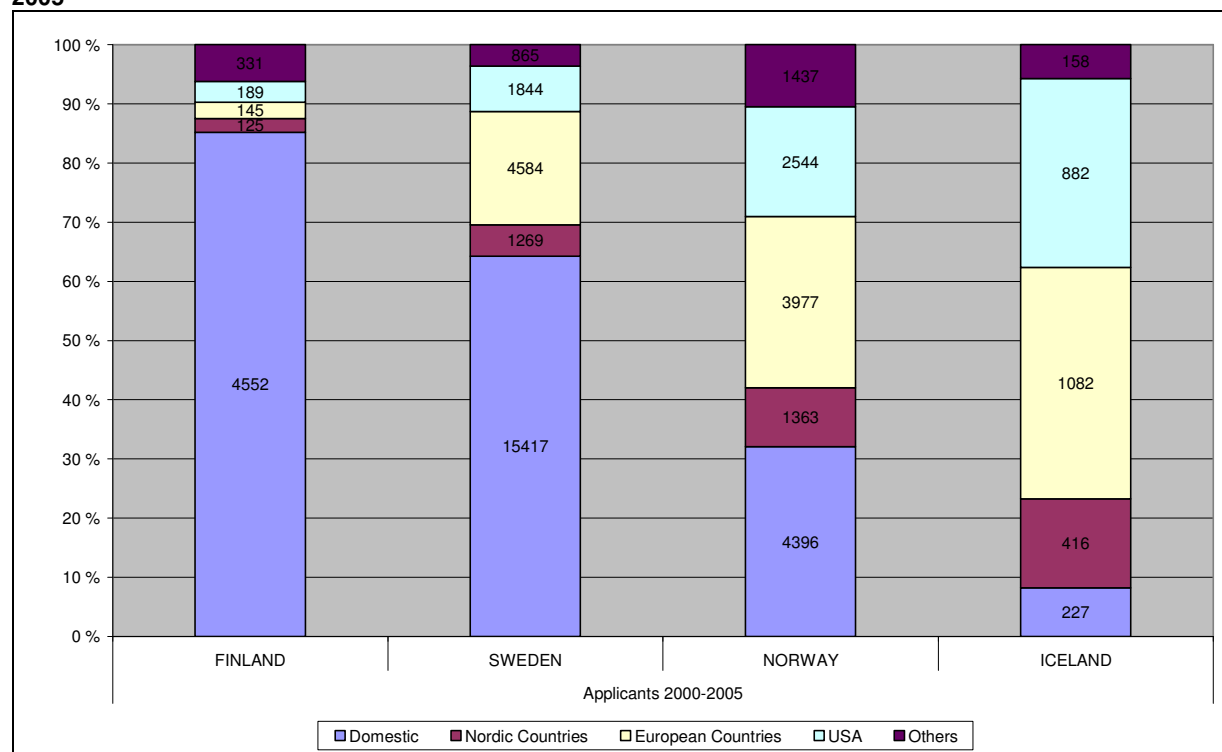
Sources: REGPAT and OECD Patent databases, February 2008. P 28

5.2. Nordic patenting by sector

These introductory figures indicate that there are different modes of ‘patenting’, which involve different avenues to extend one’s rights internationally. The most straight-forward mode—and

thus the one best suited to small firms—is to file domestically only or in conjunction with a PCT application. Figure 6 introduces how ‘demand’ for domestic patents breaks down for the Nordic countries (minus Denmark) for the period 2000-2005. The main picture is that the domestic offices in EPC countries (Sweden and Finland in the period) are used most intensively by domestic applicants and their co-applicants. As indicated in the National Report for Finland, there are clear differences in the types of firms that apply to domestic as opposed to the EPO office.

Figure 6. Distribution of unique entities applying to Nordic national offices* by country of applicant: 2000-2005



*Data is not available for Denmark

**European Countries involve EU25 plus Switzerland.

Figure 6 indicates that the overall level of demand for domestic patenting is similar for Norway and Finland. This impression of similar levels of patenting is dispelled when EPO filings are considered. Table 3 provides a comparison of the European patenting activities of Nordic enterprises. Nearly 30,700 patent applications were filed (and published) in the period 2000-2005 at the EPO by Nordic applicants in the industrial sectors represented (see table notes).

Swedish applicants accounted for 46 percent of these European patent applications, many of which (4340) were filed under Other Business Activities (not telecommunications) which appears to pick up the country's substantial computer and telecom services enterprises. The corresponding activity in Finland appears to be defined differently. Finnish patent activity, making up 27 percent of the Nordic total here, concentrates on the other hand in the area of Electrical and Optical Equipment subarea of the Manufacturing sector. Fully 80 percent of the Finnish applications were filed by firms in that sector, as compared with 43 percent of the Swedish applications.

Table 3. Nordic Patenting to the EPO by industrial area of applicant: 2000-2005*

TITLE	Sweden	Finland	Denmark	Norway		Nordic total
	EPO	EPO	EPO	EPO	Domestic	EPO
AGRICULTURE, HUNTING, FORESTRY AND FISHING	8	2	44	36	100	89
MINING AND QUARRYING	10	7	1	83	258	101
MANUFACTURING	6 058	6 695	4 425	788	1 630	17 966
Food products; beverages and tobacco	18	50	285	27	40	379
Textiles, leather products	34	37	19	7	23	97
Wood and wood products	95	5	11	4	21	115
Pulp, paper; publishing and printing	428	120	47	6	19	600
Petroleum, rubber and plastic products	169	66	259	24	56	517
Chemicals and chemical products	1 163	289	1 981	359	466	3 791
Other non-metallic mineral products	41	48	34	11	14	133
Basic metals	109	70	20	2	6	201
Fabricated metals	312	144	136	8	100	600
Machinery and equipment	1 291	976	1 003	107	304	3 377
Electrical and optical equipment	693	4 832	560	155	253	6 240
Transport equipment	1 614	37	28	34	230	1 713
Other manufacturing, recycling	93	22	42	46	101	202
ELECTRICITY, GAS AND WATER SUPPLY	33	9	1	6	18	49
CONSTRUCTION	56	40	24	21	201	141
WHOLESALE AND RETAIL TRADE; RESTAURANTS AND HOTELS	1 165	92	388	60	224	1 705
Wholesale trade and commission trade	1 118	79	366	55	224	1 618
TRANSPORT AND STORAGE AND COMMUNICATION	242	251	14	51	183	559
Transport and storage	201	26	8	25	98	261
Post and telecommunications	41	225	6	26	85	298
FINANCE, INSURANCE, REAL ESTATE AND BUSINESS SERVICES	6 527	1 194	1 826	504	1 481	10 051
Financial Services	65	11	51	6	20	133
Real-estate and business activities	34	8	32	0	0	74
Computer and related activities	257	192	106	80	194	634
Research and development	1 176	266	739	113	269	2 293
Technical consultancy services	652	387	516	175	701	1 731
Other business activities	4 343	330	382	131	297	5 186
SUBTOTAL 1-74	14 099	8 289	6 723	1 550	4 094	30 662

* Fractional counts. This tally only includes patent applications in the relevant industries. A further 2500 applications from Nordic enterprises are excluded. In addition a substantial number of applications from private individuals without apparent affiliations (300 for Norwegian EPO applications) are also excluded.

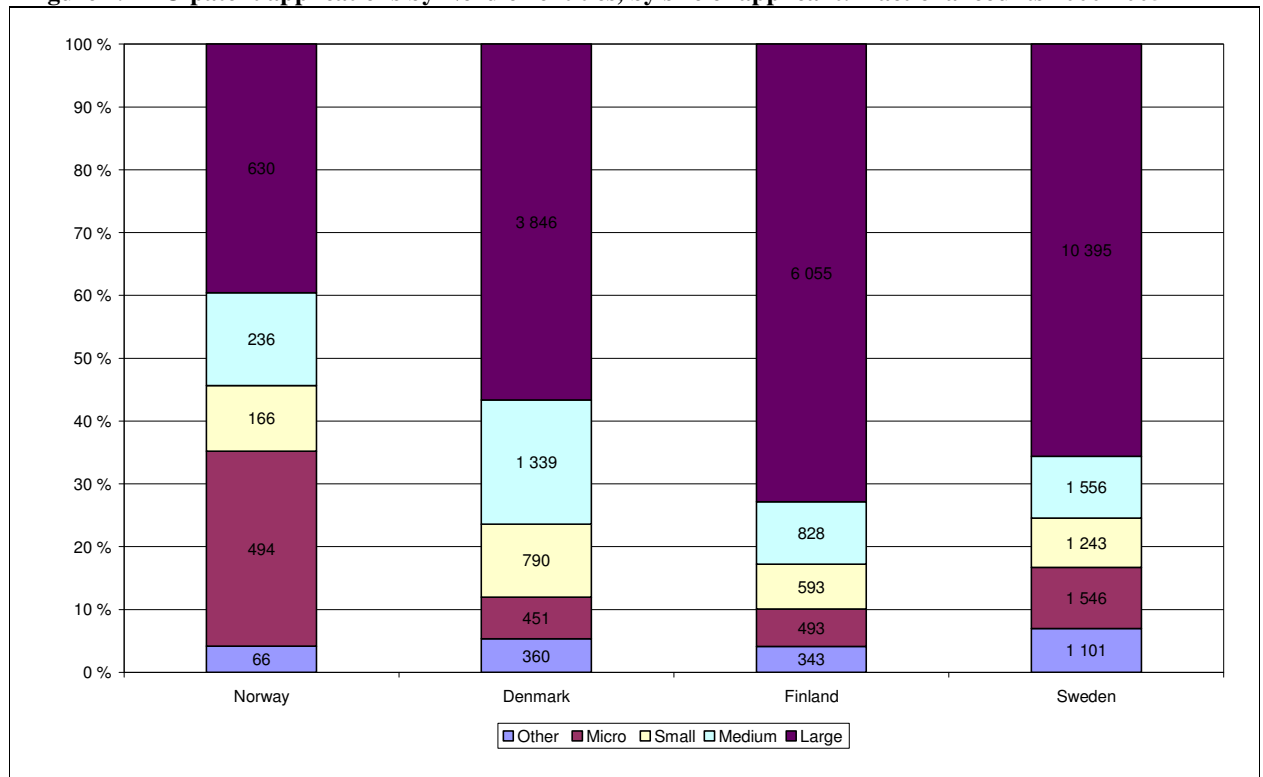
Manufacturing accounted for a large proportion of Danish EPO patenting as well. Almost two-thirds of the Danish filings were filed by Manufacturers. The greatest proportion of these were in the area of Chemicals (Pharmaceuticals), followed by Machinery and Equipment. In addition, R&D Services accounted for a substantial proportion of Danish applications, which together made up 22 percent of the Nordic total.

Norwegian EPO filings were disproportionately lower, in part reflecting Norway's status as a non-EPC signatory during the period. Norwegian firms in these sectors accounted for little over 5 percent of the Nordic total. Half of the Norwegian EPO patents are filed by the Manufacturing Sector. A disproportionate number is spread between Mining (including oil extraction efforts) as in Chemicals (agro-chemicals) which combine the areas of the now joined Statoil Hydro Corporation. Norwegian patenting efforts are however better reflected in the domestic applications also presented here.

5.3. Nordic Enterprise patenting by firm-size

In this way, factors such as EPC membership or the intrinsic patent propensity reflected in sectors where national firms are active can help explain patenting levels. Firm-size is of course another key factor which affects the propensity of enterprises to patent. (see discussion in D03) The expectation—supported by anecdotal evidence—is that large firms patent most despite the fact that small firms dominate the firm-demographics. Figure 7 tests this expectation by breaking down the patent applications filed with the EPO by the size of the applicant and by country: numbers are again fractional counts.

Figure 7. EPO patent applications by Nordic* entities, by size of applicant: fractional counts 2000-2005*



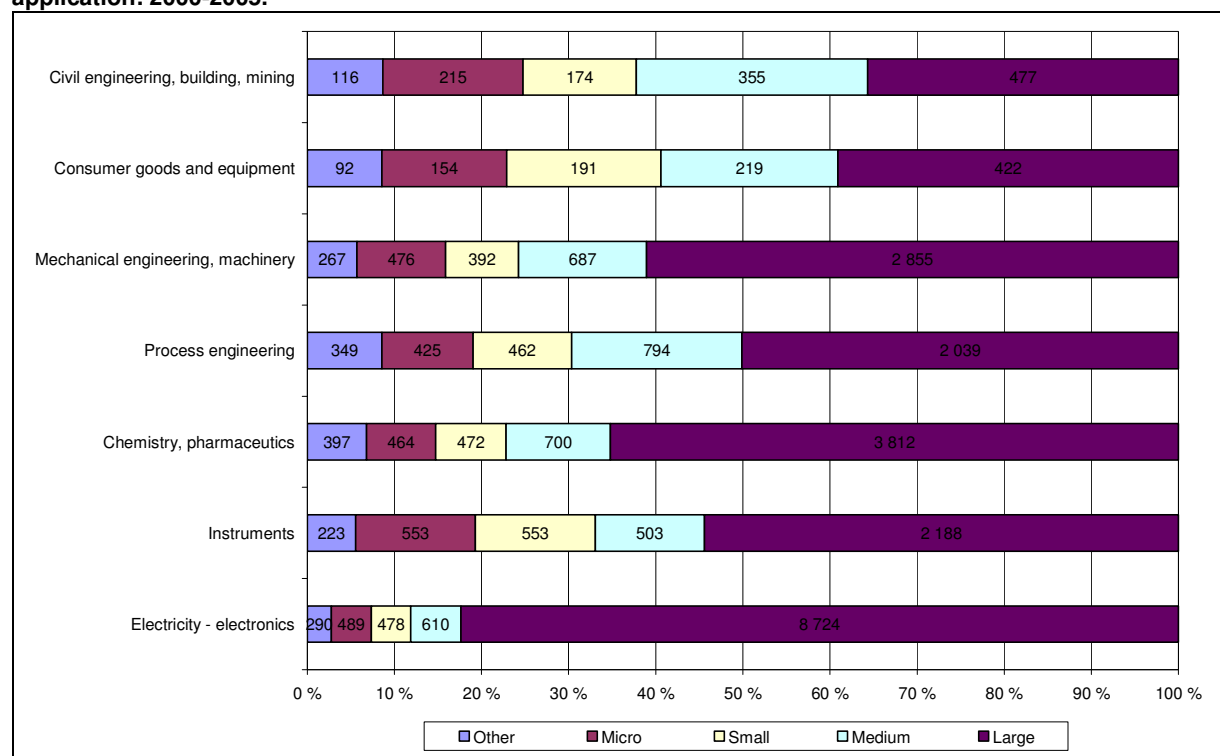
The picture that emerges tends to confirm a general large-firm bias in Nordic patenting: it is however much more nuanced. First it uncovers substantial differences between the Nordic countries, with the large-firm bias particularly strong in Sweden and Finland. While they make up 97 percent of Nordic enterprises, small firms (0-49 employees) account for just under 23 percent of the patent applications filed at the EPO by Nordic enterprises. By country the level varies. At the one end, 16 percent of the Finnish EPO applications of this type are filed by small enterprises or those without employment (the Other category). In Norway, the proportion of small firm patenting is more than double (35 percent small firm patenting). Small firms account for around one quarter of the enterprise filings from Sweden and Denmark.

Individual enterprises can significantly affect the picture. Such an effect is likely to be highest in cases where large Multi-National Companies are headquartered in small country—and operate in patent intensive industries. The combination compounds the firm-size bias and the industry-bias may yield a ‘Nokia effect’ in patenting. The potential effect is especially visible against the landscape of smaller less patent intensive enterprises in Nordic countries.

It is possible to find this effect without identifying individual corporations, while investigating supplementary ways to analyze the patent-activity of different firm populations. The next step compares the size of patent applicants not with their industrial affiliation but with the technological areas of the application.¹² This categorizes patenting activity according to seven main technological areas (or 30 subareas: see below). The resulting figure illustrates the technological areas where large firms are most active, relative to other size-classes (figure 8).

¹² The correspondence between the patent-class (IPC) and a partition of technological areas is generated by the OST-INPI/FhG-ISI key. (see OECD Patent Manual, 2008: 59).

Figure 8: Four-Country profile of EPO applications by firm-size of applicants* and technological area of application: 2000-2005.**



* Norway, Finland, Denmark, Sweden

** The OST-INPI/FhG-ISI correspondence key is used.

***a number of Swedish applications could not be linked to technological areas

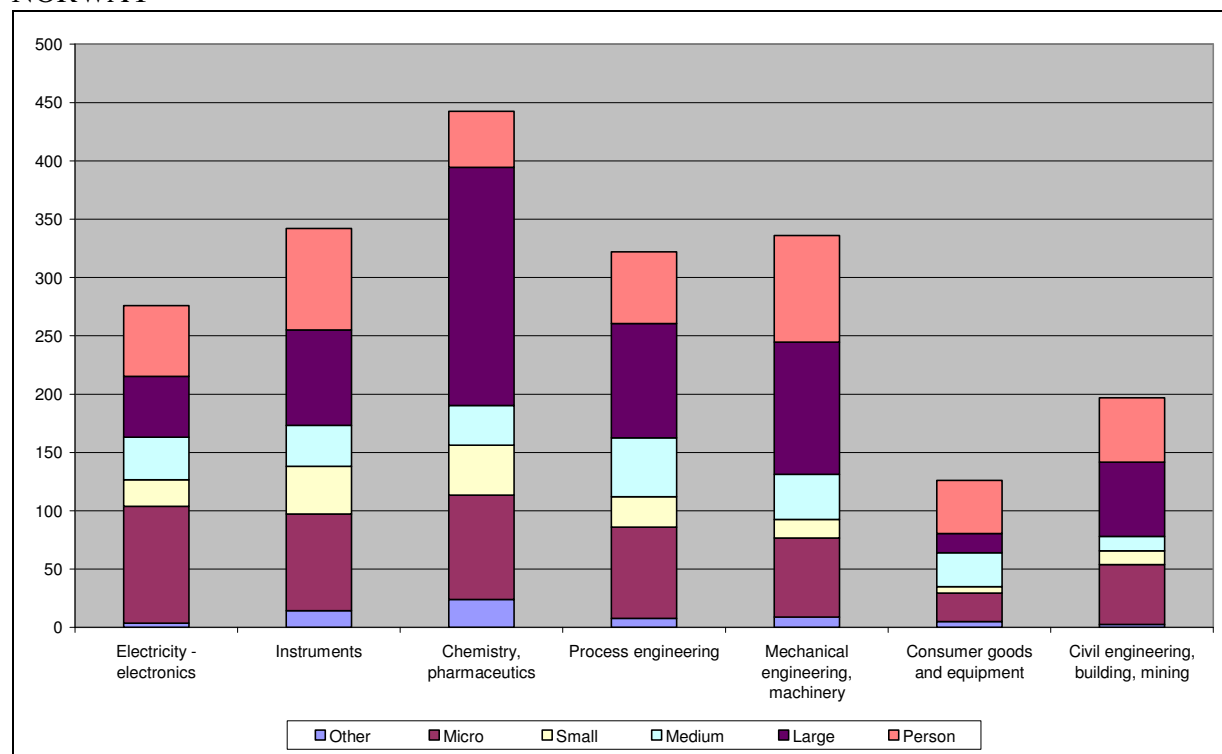
The highest intensity of large firm patenting is found in the Electricity and Electronics field, which includes computer and telecoms. A third of all applications (10,700) filed with the EPO by Nordic applicants involved this technological area. Large firms accounted for over 80 percent of these applications, while a total of 43 percent of large firm application activities went to this area. The majority of these applications are found in the subfield of Telecommunications (see breakdown below), and stem from a small number of applicants in Sweden and Finland: 3000 telecom applications stem from large Swedish firms and 3400 from large Finnish firms.

The area of Chemicals and Pharmaceuticals is the second largest technological area, claiming a further 18 percent (6,000) of Nordic EPO applications. It is also the area where the concentration of large firm applications is second highest: over two-thirds of Nordic Chemicals and Pharmaceuticals patents originate in large firms. Here it is primarily a combination of Danish and Swedish firms that account for the lion's share.

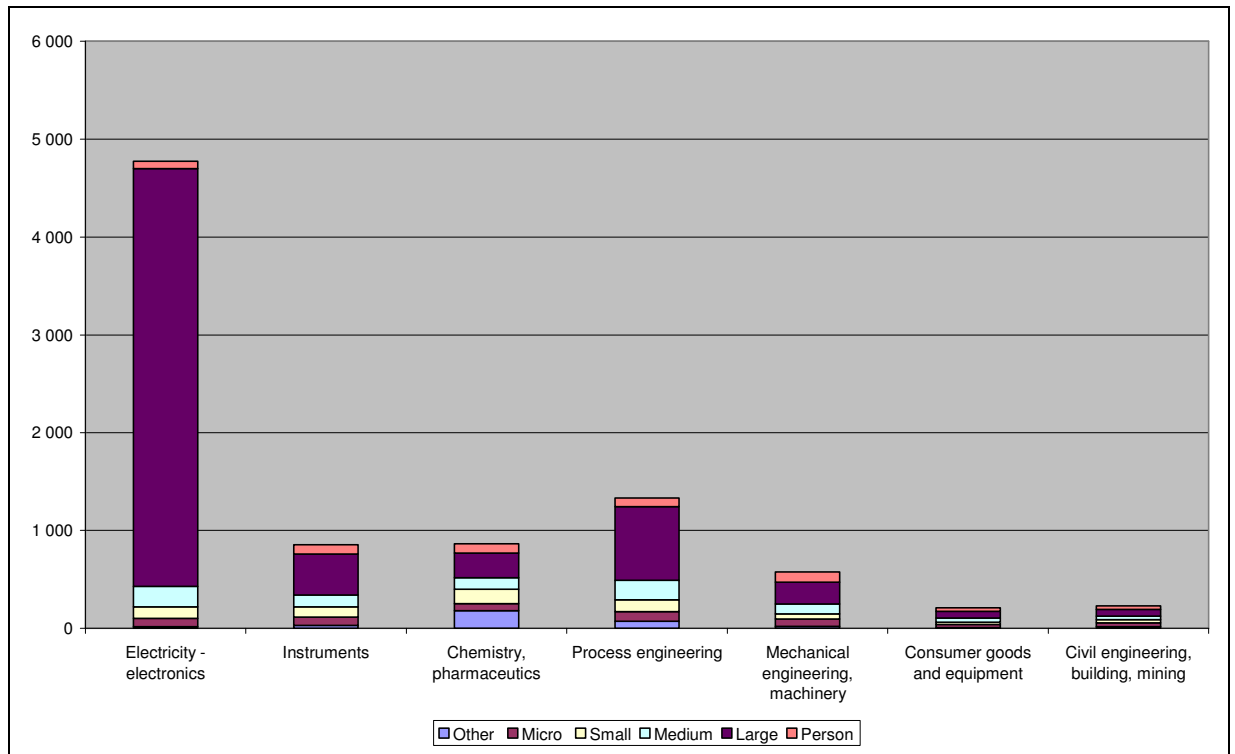
In all, Electronics (particularly Telecommunications) and Chemicals and Pharmaceuticals account for over 51 percent of Nordic applications; three quarters of these being filed by large firms. Large firm patenting is therefore concentrated to a significant degree in these areas characterized by high propensities to patent and by the activities of large multinational companies. The following Figures provide a look at the breakdown by country. (note the patenting activity of private-persons is included for Finland and Norway)

Figures 9-12: Country profiles of EPO applications by firm-size* by technological areas**:2000-2005.

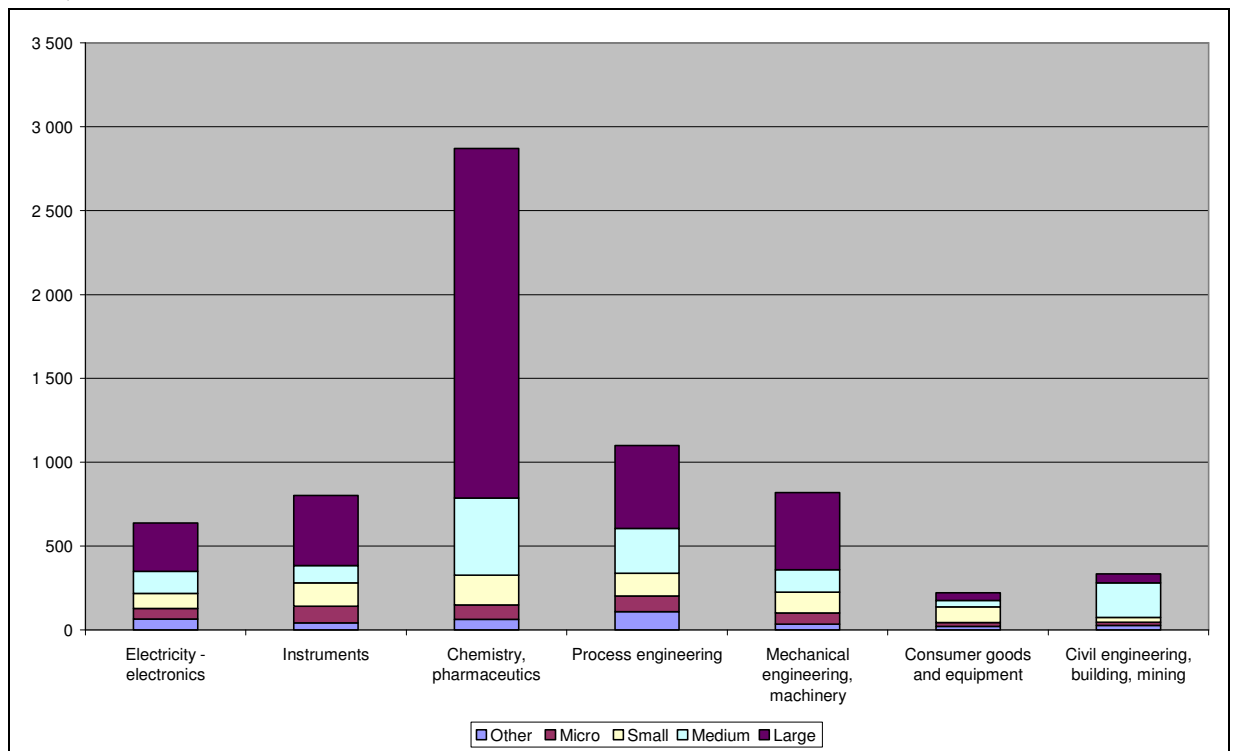
NORWAY



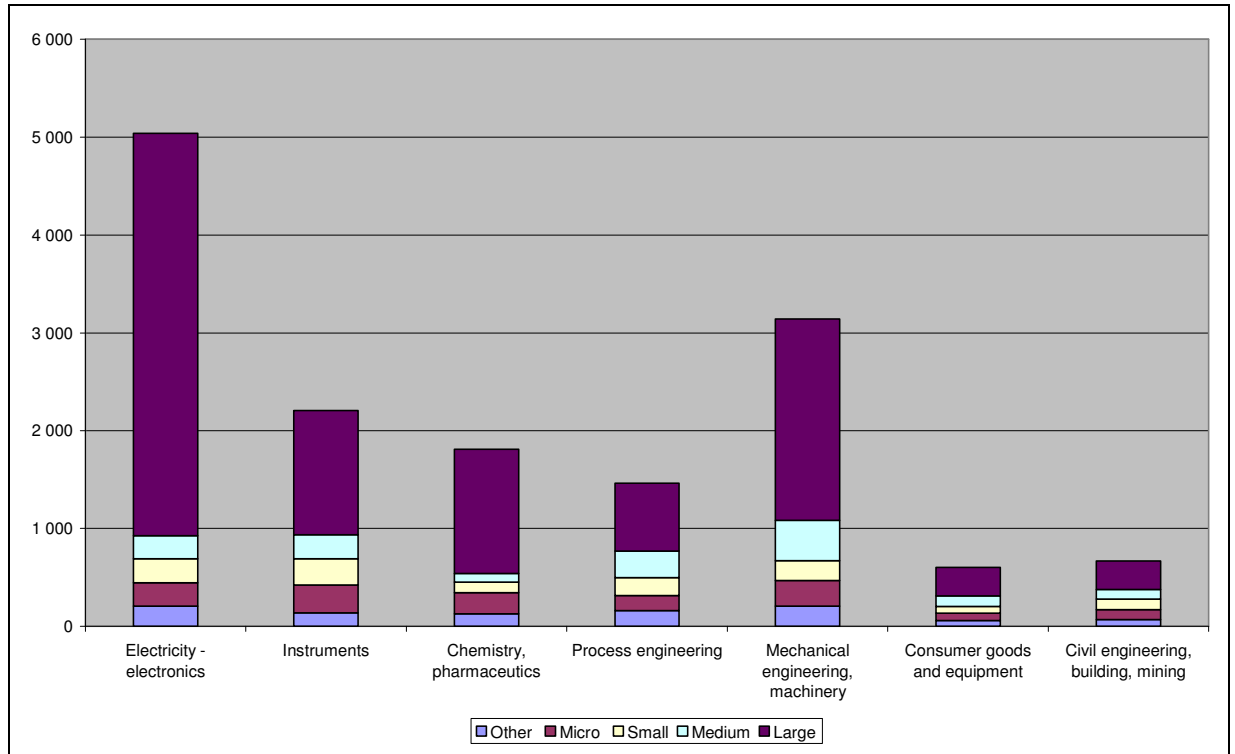
FINLAND



DENMARK



SWEDEN



This rather simple presentation demonstrates that the role and degree to which firm-size plays in patenting activity differs by the industry and technological area of the applicant, and that this differs from country to country.

5.4. RTA- index

One way to visualize the relative intensities of small firm patenting in different technological areas is to use a specialization index. The "Revealed Technological Advantage" (RTA)¹³ is here used to indicate technological areas where small firm patenting in each country specialize relative to the overall level of small firm patenting in each country. This allows a comparison between small-firm patenting across countries.

The RTA is based on and is defined as the share of a country (i) in patents in a particular field of technology (d) divided by the share of small firms in all patents. The logarithm of the index is used here in accordance with the OECD Patent Manual 2008. The indicator ranges from -1 to +1.

¹³
$$RTA = \frac{\left(\frac{P_{d,i}}{\sum_d P_{d,i}} \right)}{\left(\frac{\sum_d P_{d,s}}{\sum_d P_{d,i}} \right)}$$
 Where the share of small firm patenting (i) in a particular field of technology (d) is divided by the small-firm share in all patents.

Values below 0 indicate a relative overrepresentation of large-firm patenting in the EPO applications from that country: In turn, values in positive territory indicate technological subareas where small firm patenting is overrepresented. Values close to zero indicate the distribution of small firm patenting for the subarea is close to the overall distribution of small-firm patenting for that country.

Figure 13 Specialization index for small firms for technological subareas: Log10

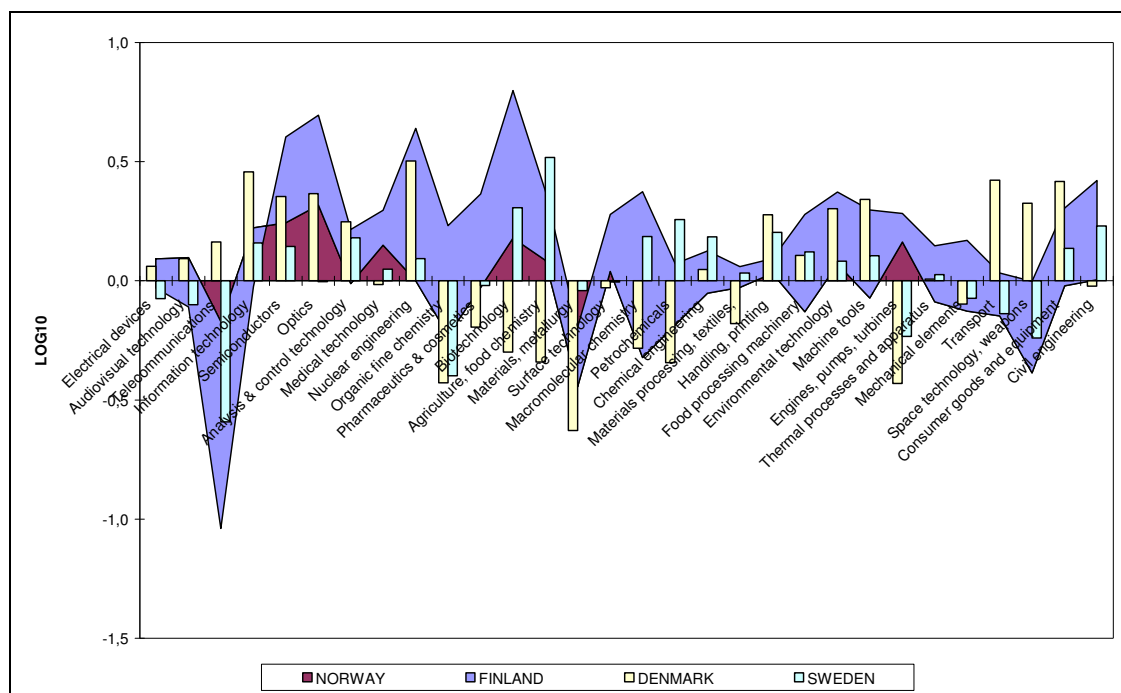


Figure 13 illustrates that the weight of small firm patenting differs in the four Nordic countries under consideration here. Nordic small firm patenting is relatively concentrated in areas of Consumer Goods, Process industries and Mechanical Engineering. In addition, small firm patenting is generally overrepresented in the narrower subareas of biotechnology, Environmental Technology, Information Technology, Semiconductors, and Optics.

The high level of Finnish large-firm patenting in the area of telecom technologies is evident in the blue area extending well below the line in the figure. The figure makes clear that, with the exception of Denmark, Nordic patenting in this subsection is dominated by large firms. The profile of small firm patenting in Finland is influenced by the large-firm bias in telecoms area¹⁴.

¹⁴ the peaks of Finnish small-firm patenting are accentuated as they compensate for the telecom patenting of large firms

Small firm patenting in Finland is relatively intense in the area of Macromolecular technologies and Biotech.

The profile of Swedish patenting is also influenced by the disproportionately high number of large-firm patents in the Telecoms area. In addition large firm patenting dominates the area of organic fine chemicals. Small Swedish firms are disproportionately more active in Biotech patents, as well as food chemicals.

The profile of Danish patenting is relatively balanced with a disproportionate number of large firm patents particularly in four or five subareas (metallurgy, organic fine chemistry, agro-food, engines and pumps) and that of small firm patents in four or five (information technology, consumer goods, optics, machine tools).

The profile of Norwegian patenting—which is far lower than the other countries for reasons discussed—is more evenly spread. Small firms are somewhat more involved in optics, information technology, medical tools, and engines and pumps than the overall distribution would suggest: large firms are more active in fields of chemicals and metallurgy.

5.5. Beyond patent counts

There are many other ways in which this analytical approach might shed needed empirical light on the complicated relationship between firm-size and IPR use. The national reports present some initial directions to look. These include looking at size-distributions of Grants (Norway, Sweden, Finland), the occurrence of early withdrawals of applications by different applicants (Norway), as well as the question of how long the patent was in force and whether it faced opposition (Norway).

Other more formal analytical approaches can be adapted using this approach. Efforts have gone furthest in Sweden where methodologies were adapted to study productivity growth in manufacturing firms. Further work been funded for Sweden to explore further possibilities opened up by this approach.

Withdrawals¹⁵

¹⁵ This section relies on the national report for Norway.

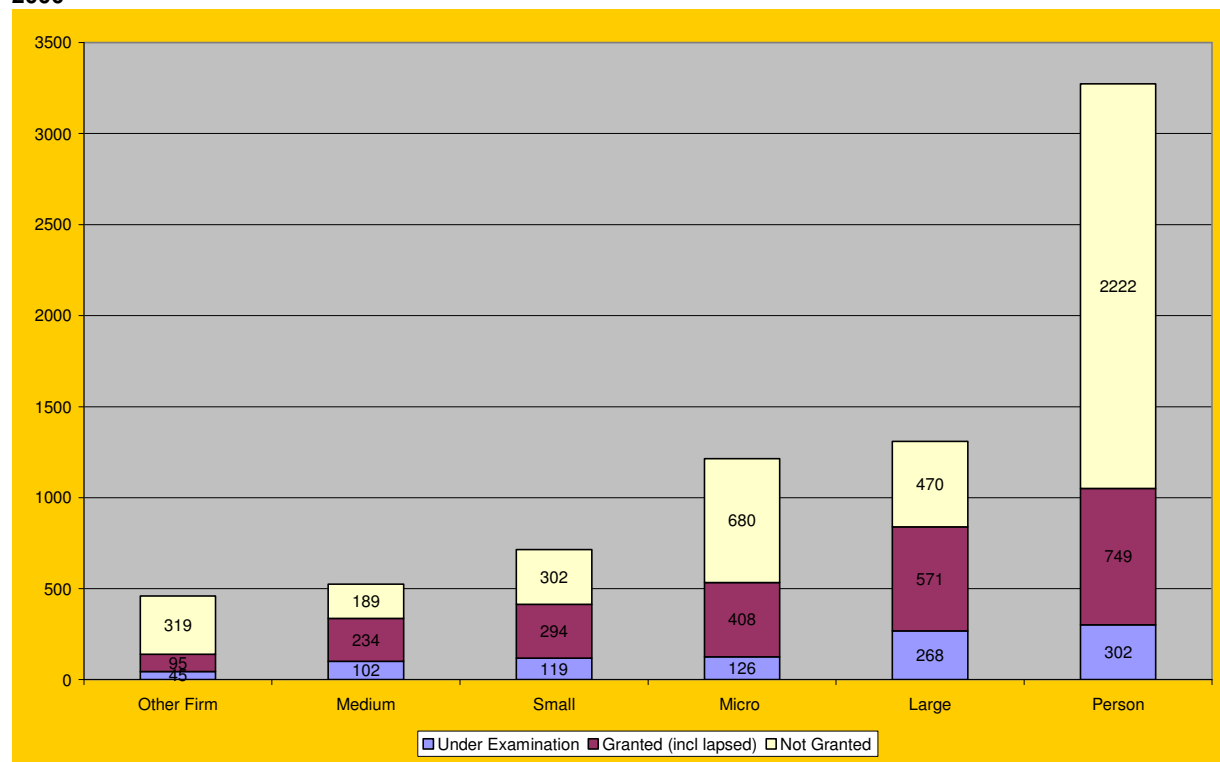
One main reason for patents not to proceed to grant is that they are abandoned by the applicant at a stage during the application and examination process. A question is whether smaller firms tend to withdraw their patent applications to a larger degree than larger applicants. This last section looks into this question as it is seen as important to the question not only of whether small firms apply for IPRs but what problems are subsequently faced.

The primary question to explore is whether this is the case and, in that case, what factors are responsible for withdrawal of applications. Indications on small-firm withdrawals are still not unequivocal. On the one hand, results on domestic patenting (WIPO, 2003) suggest that the incidence of withdrawal is size-related, when all applications are considered. On the other hand, recent work on withdrawals at the EPO involving Italian inventors however fails to show a significant size-effect (see Schettino & Sterlacchini, 2007) at the regional level.

This last section follows up the case of Norwegian domestic patenting. It compiles evidence from the current (2006) status of domestic patent applications filed in the period 1996-2000¹⁶. It differentiates between applications still under examination, those that have been granted (including those that have subsequently lapsed), and those that have died without being granted.

¹⁶ It includes all patents applied for in Norway, including those withdrawn before the 18 months.

Figure 14. Domestic Patents filed with the Norwegian Patent Office by size-class and Status (2006): 1996-2000



Note: "Not Granted" includes rejection, patents withdrawn by the applicants or other failure to pay fees

The category of Not Granted includes applications for which fees were not paid during the application period or were otherwise withdrawn by the applicant. In a very small number of cases, the patent was rejected outright. Figure 7 demonstrates that the incidence of Non-Grant is skewed, with the highest proportions found among the smallest applicants. It is especially the falling number of applications filed by private persons which do not proceed to grant. However, the proportion of non-grant among micro-firms is disproportionate to the overall level of application. This appears to be an area where the potential for improvement as policy attempts to improve IPR use among small and medium-size enterprises.

Indications that small firms withdraw their patent applications may indicate that the patent-system is not suited to their needs. If true, a follow-up question is whether other rights types, such as Design or of 'petty patents' (brugsmønster, Gebrauchsmunster)—which are designed for small firms and available in some countries (e.g. Denmark)—are better suited to certain small-firm

needs and should be extended. Further work directed at the question of small-firm withdrawal could be built onto the approach presented here.

6. Conclusions

Linking the national enterprise registries (and accountancy data) with the application information from patents and other intellectual property rights provides a unique lens through which to gain a better understanding of the complex relationship between firm-size and IPR use. But there are many issues and concerns to address in doing so, especially across different countries.

This report—and the national reports from the five Nordic countries that it builds upon—present a concerted attempt to apply such an approach. Several aspects of the relationship between Nordic SMEs and patent use have been explored here. The presentation serves to illustrate the extent to which SMEs dominate the Nordic population, with small firms (less than 50 employees or the equivalent) making up more than 97 percent of Nordic entities. And it shows that most applications filed by Nordic firms at the EPO involve large firms, but that also a large group of applications originate in the region's smallest firms.

This pilot-study demonstrates how this approach can help address the Nordic policymaker's need to access high-quality knowledge-bases on which to make informed policy decisions about how to improve SME use of IPR. Furthermore it provides vistas for future refinement and extensions of the analysis into other modes of analysis and to other intellectual property rights. More effective, knowledge-driven policymaking on this front must build on an understanding of the defining dimensions of this relationship. In turn, more effective and more coordinated policymaking stands to improve the climate for the relationship between SMEs and IPRs.

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APPENDIX 1: Name harmonization, data merging and Data

The overall empirical strategy merges two types of data: the firm-level registry data and patent databases. Four general steps were taken to merge the patent data with the enterprise data:

(1) Name harmonization and identification of private persons

In order to assign business IDs to patent applicants, a list of enterprise names with the corresponding business IDs was extracted from national register data of different descriptions (see national reports). To improve upon the simple match of applicant names in the patent data to enterprise and public corporation names, the applicant names and the enterprise and public corporation names were harmonized before executing the match. Loosely following the name harmonization procedure of Magerman et al. (2006), the following operations were carried out for applicant names (both the raw names and the standardized names available in PATSTAT) and enterprise and public corporation names:

- I. All letters were converted to upper case and double spaces and special characters (., : ; ` ´ ' () / \ & + -) were replaced by single spaces.
- II. Accented characters were replaced by unaccented ones (Version 1: Ä → A, Ö → O, Å → AA, É → E, Ü → U; Version 2: Ä → AE, Ö → OE, Å → AA, É → E, Ü → UE).
- III. Legal form indicators (OY, OYJ, AB, ABP, LTD, INC, CO, CORP, etc.) were removed.
- IV. All spaces were removed.
- V. Appearance of umlauts was harmonized (AE → A, OE → O, UE → U).

(2) Name match

After harmonizing the applicant names and the enterprise and public corporation names, business IDs were assigned to patent applicants with a corresponding harmonized name in the enterprise or public corporation name list. In case more than one business IDs were matched to a single patent applicant, a sequential procedure was used, generally involving manual confirmation during the merge.

(3) Manual name changes and identification of private persons

In order to assign business IDs to patent applicants that were not identified as private persons but were left without a match in step (2), these applicants were manually checked. The main reasons for the existence of such cases were:

- Enterprises had changed their names (the data used for the match contained only the most recent name corresponding to a given business ID).
- Typographical errors and foreign language versions of the enterprise name appeared in the applicant names.
- Enterprises had become inactive or had merged with other enterprises.

In the course of the manual check, the applicants were assigned a business ID or classified as private persons. Using national enterprise data, only small minority of applicants did not link with a business ID or classification as a private person.

(4) Data merge and final modifications

Once business IDs had been assigned to patent applicants, business register data on the applicants was merged with the patent data. In case more than one business ID remained to be matched to the applicant, the one that appeared in the business register for a given year was used as a match for that year. If an applicant had more than one business ID appearing in the business register for a given year, the one to be used was manually chosen on a case by case basis. In case a business ID that had been assigned to an applicant did not appear in the business register, the business ID was manually updated when possible.

Overview of Patent--Data

Source: EPO Worldwide Statistical Database (PATSTAT) based on applications filed with the national office but primarily on those filed with the European Patent Office (EPO). These include filings originally submitted through the Patent Cooperation Treaty (PCT) procedure. This data is supplemented in certain cases (Norway) to include EPO and EuroPCT data from Questel (which includes Opposition data) and from the Norwegian Patent Office (which includes patent withdrawals)

Time-span: 2000-2005. EPO by publication Date

Key-dimensions: only

A common extraction was performed by ETLA on behalf of the project.

Overview of Registry--Data

1. Finland

Source: Statistics Finland, Register of Enterprises and Establishments

Time-span: 2001-2006

Key-dimensions: Private Enterprises. Public corporations and non-profit organizations are not included.

Special Conditions: In order to be included in the statistics, the enterprise must also employ more than half a person (in full time equivalents) or reach a certain threshold value in turnover. In 2004, the threshold value was EUR 9187.

2. Norway

Source: NAV Aa-register (Employer-Employee database) and Enhetsregisteret (ER) SSB

Time-span: 2000-2005

Key-dimensions: All economic entities including public organizations

Special Conditions: Number of entities expanded in 2001-2002 as the minimum number of employment was lowered. Presentation of the Industry structure relies on the Employer-Employee database (excluding many sleeping entities). Merging procedure involves the wider ER to include links with entities without employment.

3. Denmark

Source: FIDA

Time-span: 1999-2002

Key-dimensions: FIDA builds on several national registries: Purchases and Sales by Firms, Industrial Accounts Statistics, Establishment Related Employment Statistics, and The Statistical Business Register

Special Conditions: Unit of analysis changed in 2001

4. Sweden

Source: AMADEUS (Bureau Van Dyke)

Time-span: 2000-2004

Key-dimensions: financial statements of companies

Special Conditions: Only private enterprises

5. Iceland

Source: AMADEUS (Bureau Van Dyke)

Time-span: 2000-2005

Key-dimensions: financial statements of companies

Special Conditions: The number of unique companies employing more than 1 employee among matched companies in 2005 is only three! Since employing statistical methodologies to fill in omitted values in AMADEUS might show distorted business activities with such a small amount of a valid data set, it is nearly impossible to analyze companies' activity by means of any econometric approaches.

APPENDIX 2: Industry (NACE) aggregation

0	AREA	NACENUMBER	TITLE
1	A	01-02 + 05	Agriculture, hunting and forestry
2	C	10_14	Mining and quarrying
3	DA	15_16	Food products; beverages and tobacco
4	DB,DC	17_19	Textiles, leather products
5	DD	20	Wood and wood products
6	DE	21-22	Pulp, paper; publishing and printing
7	DF, DH	23, 25	Petroleum, rubber and plastic products
8	DG	24	Chemicals and chemical products
9	DI	26	Other non-metallic mineral products
10	DJ1	27	Basic metals
11	DJ2	28	Fabricated metals
12	DK	29	Machinery and equipment
13	DL	30-33	Electrical and optical equipment
14	DM	34-35	Transport equipment
15	DN	36-37	Other manufacturing, recycling
16	E	40-41	Electricity, gas and water supply
17	F	45	Construction
18	G2	51	Wholesale trade and commission trade
19	I1	60-63	Transport and storage
20	I2	64	Post and telecommunications
21	J	65-67	Financial Services
22	K	72	Computer and related activities
23	K1	73	Research and development
24	K2	742,743	Technical consultancy services
25	K3	741, 744-749	Other business activities
26	M-N	80-85	Education, health**
27	L, O-Q	50, 52-55, 70-71, 75, 90-99	Other Activities**



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Nordic Innovation Centre

Nordic Innovation Centre

The Nordic Innovation Centre initiates and finances activities that enhance innovation collaboration and develop and maintain a smoothly functioning market in the Nordic region.

The Centre works primarily with small and medium-sized companies (SMEs) in the Nordic countries. Other important partners are those most closely involved with innovation and market surveillance, such as industrial organisations and interest groups, research institutions and public authorities.

The Nordic Innovation Centre is an institution under the Nordic Council of Ministers. Its secretariat is in Oslo.

For more information: www.nordicinnovation.net