From Regional Development Coalitions to Commercial Innovations

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Nordic co-operation

takes place among the countries of Denmark, Finland, Iceland, Norway and Sweden, as well as the autonomous territories of the Faroe Islands, Greenland and Åland.

The Nordic Council

is a forum for co-operation between the Nordic parliaments and governments. The Council consists of 87 parliamentarians from the Nordic countries. The Nordic Council takes policy initiatives and monitors Nordic co-operation. Founded in 1952.

The Nordic Council of Ministers

is a forum of co-operation between the Nordic governments. The Nordic Council of Ministers implements Nordic co-operation. The prime ministers have the overall responsibility. Its activities are co-ordinated by the Nordic ministers for co-operation, the Nordic Committee for co-operation and portfolio ministers. Founded in 1971.

Nordregio – Nordic Centre for Spatial Development

works in the field of spatial development, which includes physical planning and regional policies, in particular with a Nordic and European comparative perspective. Nordregio is active in research, education and knowledge dissemination and provides policy-relevant data. Nordregio was established in 1997 by the Nordic Council of Ministers. The centre is owned by the five Nordic countries and builds upon more than 30 years of Nordic cooperation in its field.

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Preface

This report is a comparative study of the Nordic innovation systems as they pertain to the business sector. Important national varieties in styles and modes of innovation are described and analysed. These differences are then related to different geographical, historical and political preconditions to deepen the understanding of why national innovation systems differ.

The project takes as a point of departure that the identification of best case policies cannot be done simply by comparing numbers in terms of indicators of innovation. An understanding of indicators depends on an analysis of the processes of innovation, which has produced them. Processes are determined by systems. The report accordingly studies regional innovation systems (RIS) within their national system contexts (NIS). Through the analysis of the NIS and RIS statistics, certain patterns tends to emerge, which makes it possible to improve the analytical understanding on the importance of national systems. Outcomes of the project has been used in several Nordic and international conferences and presentations. It has been used as an analytical basis of the White Book on Innovation commissioned by the Nordic Council of Ministers. Outcomes of the project are currently used as a basis for further analysis of the Norwegian innovation system in projects financed by the KUNI programme in the Norwegian Research Council

The report will be relevant to anyone occupied with innovation and business policies. Senior researcher Åge Mariussen of NIFU STEP Studies in Innovation, Research and Education, Oslo, has led the group responsible for the report within the project 'From Regional Coalitions to Commercial Innovations'. He has been assisted by Lars Coenen at the University of Lund, who has made the analysis of the sectors, and by Morten Fraas, NIFU STEP, who has been responsible for the analysis of regional statistics.

The project is part of the second phase of the Nordic research programme *Future Challenges and Institutional Preconditions for Regional Development Policy*. The programme was commissioned by the Nordic Council of Ministers / Nordic Senior Officials Committee for Regional Policy (NERP). A pilot phase of the project was reported in 2000. The first phase of the programme (2000–2002) was reported through eight published studies in 2002. The reports from six separate projects in the second phase (2003–2004) of the programme was published successively through the autumn of 2004 and the spring of 2005 together with a summary of the programme.

Nordregio wishes to thank the project team as well as the members of the Programme Steering Committee: Bue Nielsen (Denmark), Janne Antikainen (Finland), Kristin Nakken (Norway), Nicklas Liss-Larsson (Sweden), Kjartan Kristiansen (Faroe Islands), Bjarne Lindström (Åland Islands) and Hallgeir Aalbu (Nordregio).

Stockholm, September 2005

Introduction

How can Nordic countries learn from each other in the field of innovation policy? This question begs a second: How different are we – and what does the differences consist of? In terms of possibilities of 'learning' through transferring models of innovation policy between Nordic countries, the question, which remains open, is the relation between the varying *contexts* of innovation, and the potentially transferable 'model' in question. The challenge to policy learning is to understand these differences in context. In contextualizing innovation, we will focus on systems of business and systems of innovation. In doing so, we have to confront a limitation of Nordic innovation studies: the differentiation between qualitative and quantitative studies. This project builds on a long tradition of work on qualitative regional innovation systems in the Nordic countries. We took certain limitations of these studies as a point of departure. Qualitative studies rarely define or measures economic output and input indicators. On the other hand, many quantitative studies do not exploit the potential of qualitative research. This project aimed at overcoming these weaknesses. During the course of the project, we made two discoveries.

- First, it turned out that existing indicators and data fitted pretty well with results from qualitative studies of the National Business System and the Innovation System tradition. This finding opened up for a micro – macro approach, where macro level statistics and micro level case studies could be integrated. The units of this macro level analysis, accordingly, were *nations* and *sectors*.
- Second, it turned out that the CIS data was not representative at the regional level. Instead of using regionalized data, we decided to use regional level estimates, based on regional sector statistics and national sector indicator values. In comparing the outcome of this with regionalized data for Norway, we found that the fit was fairly good. The regional level was defined as NUT2.

These changes of the plan were discussed with the steering committee of the program, through two conferences in Stockholm, where intermediary results of the project were presented. The feedback was to go ahead. The structure of the resulting report is the following:

What are national business and innovation systems, and how can we study them?

Chapter 1 gives an overview of theories of national business and innovation systems, and presents a classification based on the two dimensions of Stein Rokkan:

- *The north – south dimension* reflects the options of either specializing in the exploitation of natural resources (north) or in skills creating market and design driven products (south).
- *The east–west distinction* is specialization in either new product innovations (west) or complex problem solving through specializing in the development of mature products.

The result is the following classification:

- *North West: Iceland and Norway*. These countries are specialized in resource-based industries – and their innovation systems are oriented towards process innovations.
- *North East: Finland.* Technologically oriented resource processing.
- *South West: Denmark*, an industrial district specialized in efficient product innovations.
- *South East: Sweden,* Technologically sophisticated specialization in mature industrial products.

Differences between Nordic countries, regions, and industries

Chapter 2 presents empirical analysis at four levels:

- *The national level:* Input and output of national systems are compared, using selected CIS and GERD indicators. This study broadly confirms the classification presented in chapter 2, with the exception of Finland, which is more westernized than should be expected, given its geo-institutional location, as defined by Rokkan.
- *The sector level: East–West:* The national level study is supplemented with a study of *national differences within sectors* presented in chapter 4. The finding made here is consistent with the national level analysis, and confirms that in looking *within sectors*, the most entrepreneurial countries are Denmark and Finland.
- *The regional level: South-North* (chapter 2, chapter 5). Denmark is not differentiated regionally. Sweden, Norway and Finland have an internal north – south differentiation. In general, southern regions – closest to the European city belt and the large European markets – are more oriented to product innovations, whereas northern regions are oriented to natural resources, and process innovations. The largest differentiation between regions is found in Finland. In looking at the internal structure of the countries, it is found that capital city regions in general have a high score on product innovations. The exception is Norway, where the Oslo region is at a lower level of product innovation than the core regions in the south of Norway.

In addition, chapter 2 makes two general observations relating to the Nordic economy:

- *The significance of resource based industries.* Nordic countries are heavily dependent on natural resources (see also chapter 3). How to solve the competitive challenges of the resource based Nordic industries are important issues, when it comes to a Nordic innovation policy.
- *The varying impact of high tech industries – different approaches to productivity* (see also chapter 4). In Denmark, Sweden and Finland, the high tech industries, and in particular electronics, have a high level of *product innovations*. In looking at differences between sectors, it is obvious that this level of product innovation also is driving *productivity*. In Norway, on the other hand, there is an increasing productivity which is not explained by product innovations. This reflects the significance in the Norwegian innovation system of process innovations.

Policy implications

In terms of policy implications, the report has identified three 'best case achievements' – in terms of systemic capacities.

- The Norwegian/ Icelandic capacity to make processes more efficient.
- The Danish ability to create new design and craft based products efficiently.
- The Finnish way of implementing an entrepreneurial (Anglo-Saxon) science driven innovation system in a Nordic national innovation system.

The policy challenge is how to de-contextualize these capacities from their spatial and institutional (systemic) embedding – and re-contextualize them elsewhere. This could either take place as 'modularization' – or, alternatively, as an *extension* of the national innovation capacities to include more Nordic countries.

Identifying strong clusters

Chapter 3 written by Lars Coenen presents a comparative analysis of sectors through the revealed competitive analysis indicator (RCA). The outcome is an identification of Nordic competitive industries.

This analysis confirms the distinctiveness of the industrial structures of the Nordic countries, and the significance of both old industries based on natural resources, as well as new high tech industries. The chapter also presents and overview of Nordic clusters, as identified in existing cluster studies.

National differences within sectors

In Chapter 4, Lars Coenen identifies differences between countries within sectors. This analysis confirms the *generalized* character of the national systems within sectors. Denmark is the 'most south-western' country in food, wood products, paper and chemicals, whereas Finland is the 'most south western' in machinery, transportation and electrical industries. Similarly, in considering the 'north-eastern' dimension, we find Sweden, Norway and Iceland. The exception is machinery, where Denmark has an 'eastern' profile.

Sector	West	East and north
Food	Denmark	Sweden
Wood	Denmark, Finland	Norway, Sweden
Ppp	Denmark	Sweden, Norway
Metals		Iceland, Norway
Chemicals	Denmark	Iceland, Norway, Sweden
Machinery	Finland	Norway, Sweden, Denmark
Transport	Finland	Norway, Sweden
Electrical	Finland, Denmark	Sweden, Norway Iceland

Regional industrial structures

In Chapter 5, Morten Fraas gives an overview of the industrial structures of Nordic NUT2 regions. The data presented in this chapter is used in the regional analysis in chapter 2.

Micro level case studies

In Chapter 6, an overview and summary analysis is given of micro level case studies, which were used in the analysis.

1. What are national business and innovation systems – and how can we study them?

Innovation is a micro level phenomenon, based on interactive learning. Innovation makes it possible for national economies, regions and firms to enhance competitiveness, productivity, and create new products and new jobs. *Innovation processes* may be more or less structured. In the less structured case, they take place at random. More often, interactive learning tends to be structured. We refer to these structured patterns of interaction as *business*[1] *and innovation*[2] *systems*. The processes of structuring these systems may be seen as determined by three forms of logic:

- Technological or sector specific (technological paradigms or sector innovation systems).
- Institutionalized, nationally specific forms of business organization (national business systems).
- Spatially embedded forms of learning, where interaction is enhanced by proximity (regional clustering, regional innovation systems).

Technological paradigms – as analyzed by Abernathy and Utterbach – force learning into fixed networks involving a limited number of skills, forms of knowledge, and experts. This structuring is the result of the evolution and maturing of products and technologies. The business system literature is concerned with relations between national systems shaping labor relations, and the organization of firms, shaping nationally specific forms of business organization. Regional innovation systems are described in the geographical literature, as the different ways in which proximity influence interactive learning (Asheim and Mariussen, 2003).

There are lengthy debates on the more precise forms of innovation systems. Are they national, regional or sector specific? The simple fact is: business and innovation systems are dynamic and changing, because they are constructed, reproduced and transformed through *human interaction – put under the pressure of a changing global market*. The bottom line is: in this constantly changing world, there is no such thing as a single, best case business and innovation system model – which prevails over all other anywhere and at any time. Instead of taking a *pre-conceived* innovation system concept (national, regional, sector) *as a point of departure*, we will simply assume that business and innovation systems may be seen as *contexts* of innovation – which is leading innovative actions towards a specific *understanding* of the situation, a pattern of micro level interaction – and a unique *output* in terms of innovations.

These dynamic micro level elements may be seen as what Peer Hull Kristensen refers to as 'social spaces in the global system of economic organization.' The business and innovation system taken together is a macro-micro phenomenon. Macro is *contextualizing* micro level actors. The rationality of actors – their strategies, objectives and expectations – are determined by their context.

At the micro level, in the social spaces, actors make sense of their specific situation – defined by their macro surrounding – and embark upon innovative interactions with those who understand the situation in similar ways. These interactions, secondly, determine the macro level *outputs* of the system. Macro determines the context of micro (input) – and micro determines the outputs of macro.

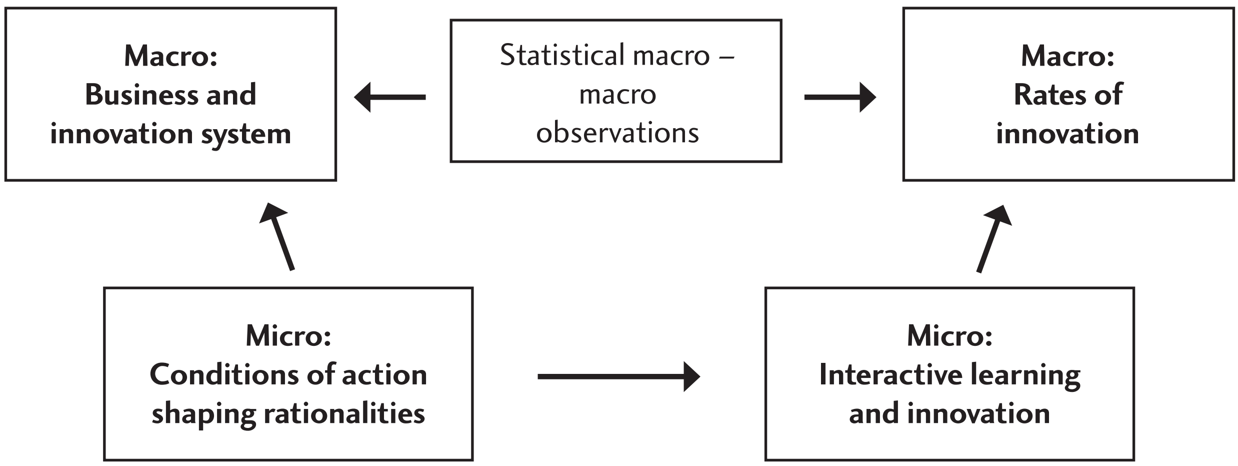
[1]The NBS theory has been developed by institutional theorists, like Hollingsworth, Sosckies – and it is brought to perfection through Richard Whitley and his associates within the EGOS group, Peer Hull Kristensen, Kari Lilja, Glen Morgan, and several others. The EGOS group is explaining national path dependencies, through the national business system concept, which is explaining the emergence of nationally distinct forms of corporate organization, embedded within unique national institutional arrangements. The major achievement of the EGOS group is a *classification* of *national business systems*, which specify sets of relations between national institutions and forms of corporate governance, as well as – importantly – a comprehensive theoretical framework, laying bare the complex chains of causation which links together macro level national institutions and micro level work systems. An important finding is that under different sets of national institutions, different forms of knowledge may be hegemonic as the basis of industrial decision-making. i. a. in entrepreneurial economies, codified knowledge has a hegemonic position, whereas in associative economies, shared forms of knowledge – combining codified and tacit knowledge, may have the hegemony. Another 'deep' institution is the degree of 'systemic trust', typically weather business agreements are made in high-trust un-formalized relations shaped by associative or reciprocal institutions – with little or no use of paper and layers – or weather formalized contracts embedded in contract regulations is the dominant way of achieving trust.

[2]The 'innovation system' concept emerged as a macro level analysis, relating national R&D institutions and policies (input) with output, in terms of innovation rates. A critical and comprehensive review of this macro level approach is presented in a recent publication by Miettinen (Miettinen 2002). Miettinen points out that the NIS approach, as defined by OECD, builds on a theoretically imprecise concept, which is not empirically substantiated. Instead, Miettinen argues, we should focus on technology and sector specific micro level case studies. This report is arguing for a micro – macro approach, taking the interaction between micro and macro as a point of departure, using macro level data as information on micro level strategies.

This has important implications for method, as we may assume that innovation systems become *empirically* observable *through distinct macro level input-output relations*. In this way, a system may be visible when we compare it to other systems. The challenge in a micro – macro analysis becomes how to make an adequate model of the micro – macro relation, including four links:

- *The macro – micro link*: How business and innovation systems determines the context of micro level actors – and their rationalities.
- *The micro – micro link*: How interaction between actors played out in social spaces end up in micro level outcomes (innovations).
- *The micro – macro link*, explaining how micro level innovations are aggregated into observable system level outputs.
- *The macro – macro link* may be discovered ex post by the researcher, as a unique relation between input and output of the system, where a system displays a difference to other systems.

This is illustrated in the figure below. The arrows indicate causal relations.



This micro-macro method is overcoming two weaknesses of micro level studies. First: micro level studies may overlook macro factors, which are taken for granted by micro level observers. The deeper layers of nationally specific institutions are often taken for granted. This problem is solved through cross – national macro – macro comparisons, combined with micro level analysis based on available data, to explain the macro level outcomes.

This method also solves an inherent problem with quantitative studies based on micro level data on firms, where the context is missing. The crucial question in a micro-macro methodology is to construct adequate models of the macro-micro-macro causal chains. The good thing about business and innovation system *theories* is that they provide precisely that. Taken together, these strands of literature provide the bits and pieces, which may fill in the map. The trouble is, micro-macro methods leave the macro level *case definition* wide open. Instead, the adequate macro unit of analysis, capable of contextualizing unique forms of micro-level rationality, is empirically identifiable as *unique relations between macro level input and macro level output*. In this report, three units are tested: sectors, nations, and regions.

Macro level cases are hard to make sense of. They are more or less complex agglomerations – not actors. How do we identify coherent contexts – which make up the systems that contextualize specific rationalities? One approach is looking for outcomes, which are counter-intuitive, from the point of view of micro level assumptions. Paradoxes occur because input-output relations observed at the macro level through the statistical analysis is not what should be assumed as aggregated outputs of individual actions, using the pre-conceived standardized assumptions of micro level actors usually applied by macro level analysis[3]. Instead, we would like to suggest that surprising findings are indicative of systems at work, pulling micro level actors in the direction of different strategies, which generates surprising macro level input-output combinations. The explanation of the paradox may lead us in the direction of understanding of *different* micro level rationalities, and thus to make *distinctions between different systems*.

This approach of making assumptions on micro level actors based on macro level data is not unproblematic. There are several obvious methodological difficulties, like ecological fallacies, made by a researcher overlooking the

[3]As pointed out by Mjøset, the methodology of the late (1970) phase of Stein Rokkan built on the experiences made during his initial European level micro analysis – which was a failure. To compensate for this, Rokkan started working on social system theory, which generated maps of Europe, based on the 'cleavages' generated by different institutional and cultural patterns. Through the institutional analysis, including several variables, he generated 'thick descriptions' capable of explaining national differences.

complexities *within* the collective unit[4]. Macro level statistics of, say, nations, may be generated by some structural composition of the national economy in sectors. As we all know, the information contained in an average figure is contingent upon the properties of the underlying distribution. To 'make sense of' an aggregated level may mean that we are violating realities, *if the aggregation is just a random collection of unrelated entities*. This possibility is pointed out by Whitley, with reference to the classification of Sweden as a coordinated market economy (CME), as opposed to a liberal or entrepreneurial market economy (LME):

> 'the varieties of firm types and innovation strategies within each kinds of market economy are sometimes greater than the contrast between CME and LME would suggest.' (Whitey, 2002, page 499)

This point is also made by Hage and Hollingsworth, who point to the tension between national systems of innovation, and globalization in structuring innovation networks. Hage and Hollingsworth point to a method to explore this possibility, and continue looking for a national system of innovation:

> 'If one finds similar size arenas and similar degrees of connectedness within or among arenas across industrial sectors or market segments within a country, this provides some evidence for the existence of a national system of innovation.' (Hage & Hollingsworh, A strategy of analysis of Idea innovation networks, TUTS-WP-5 2000)

As a point of departure for the construction of business and innovation systems as empirical objects of study[5], we will start by considering three potential units of analysis, the *national*, the *regional* – and the *sector*. This choice has some obvious advantages and disadvantages. First, at these levels, there is available, relevant and fairly reliable *statistics*, both on innovation output – as well as other aspects of economic performance. What is more, nations, sectors and regions are obvious candidates for the evolution of interactive networks, collective learning, and institutions, in short, the *internal* nuts and bolts of innovation systems[6].

One difficulty is that regions and sectors often are defined as statistical units of analysis through decisions made in administrative offices with limited understanding of real life phenomena – and with other objectives than ours. In this report we will use the EU definition of NUTs 2 as regions. NUTs 2 regions are not functional or administrative regions; they are simply constructed to provide roughly similar units of analysis at the European level. Never the less, this definition at the same time may fairly easily link into our basic theoretical distinction in terms of regionalization – between North and South. In terms of sectors, we are using the NACE-codes of industrial sectors as adapted by Eurostat in the CIS 2000 survey[7]. We have adjusted this classification to fit with available statistics from national statistical agencies, as well as the OECD STAN database.

The national system, we would like to argue, is important in several respects:

- *National institutional specialization.* National institutions evolve historically. They emerge for specific reasons, develop, and stay put, beyond the rational, which once initiated it. Institutions are the genes of societies, their inner, often hidden codes of behavior and thinking, which determine the empirically observable surface. These genes are mutually adapted to each other – and these forms of mutual adaptation tend to keep the national system in a somewhat stable state through time. We will come back to these institutional specializations below, using Stein Rokkans typology east, west, north and south.
- *National industrial specializations.* Small national economies – like the Nordic countries – are adapting to the global learning economy through specializing on particular industrial clusters. Some Nordic countries have export-oriented economies based on natural resources. National economies are also specialized in different *phases* of knowledge conversion, constituting paths or trajectories of development. As we will see below, the *south-western* Nordic country (Denmark) is specializing in consumer market driven innovations, whereas the *south-eastern* (Sweden) is focusing on R&D-driven improvements of mature products.
- *National business systems.* A national *business* system on the other hand is the institutions and practices which

[4]An ecological fallacy means assigning macro level properties to all micro level units. This does not work if the macro case is too differentiated (heterogeneous).

[5]A further discussion of this approach of constructing the object of research is found in Bourdieu, P., Chamboredon, J.C., and Passeron, J.C: the Craft of Sociology, 1991. They point out that the construction of the object may start with every-day conventional and statistical concepts, to arrive at analytic clarity at a later point in time. The micro – macro methodology is discussed by Alexander, J., Giessen, B., Münch, R.,and Smelser, J. The Micro-Macro Link, University of California Press, 1987.

[6]This micro – macro methodology builds on the assumption of *generalized* systems, which cannot be identified through micro level case studies alone.

[7]The European Commission is responsible for implementing the multiannual program for the development of Community statistics on research, development and innovation in accordance with the provisions set out in the framework program for priority actions in the field of statistical information (Decision 93/464/EEC Official Journal No L 219 of 28.8.1993). The Commission is assisted by the Statistical Program Committee which was established under Decision 93/464/EEC. CIS is a database, which collects extensive data on innovation activity and outputs in manufacturing industry in the European Community – and some other European countries. The CIS provides unique information for policy makers on subjects including inputs and outputs of innovation, the obstacles to innovation at company level, acquisition and transfer of technology, R&D cooperation, the importance of different knowledge sources for innovation, and the relationship between innovation and growth, competitiveness and employment. The database contains information on at least 25000 firms.

determines how firms are organized, what kind of general strategies they follow, including labor relations, and financial markets, determining *nationally specific* forms of business organization[8]. A specialized NBS may be expected to reproduce forms of business organizations in several industries – *also outside the clusters NBS was designed to serve in the first place*. This would trigger a cumulative process of differentiation *between* national systems – and similarly, homogenization *within* the national systems.

- *National innovation systems.* A national *innovation* system is the setup of institutions and practices, which generates knowledge in a country – and leads to the application of knowledge for economic useful purposes. The discourse on national innovation systems which evolved in the OECD in the early 1990s, started among science and technology policy makers. Thus, the concept of national innovation system for a long time was seen as a public – private macro level construction – with universities and schools in one end of the matrix, innovations in private industries in the other, and various forms of intermediate structures in-between.
- *National innovation policy systems***.** Since innovation policy has become a differentiated area of policy discourse in most countries, it also involved a national level of *collective reflection* of the performance of innovation systems. These policy reflections may interfere with the factual operations of the systems. For instance, a sector success story in one sector in one country may be attempted generalized into other sectors.

In looking more specifically at the relations between innovation systems and business systems, one might expect the interchange between these systems to go both ways. At a point of departure, a national business system which determines forms of business organization, labor relations and relations between different forms of knowledge, may be expected to be able to determine the structures and hence the outputs of the innovation systems. To put this differently, the innovation system has the business system as its context. However, as the innovation system may be seen as driven by global market competitive challenges, the innovation system may challenge the national business system. An extreme form of influence would be the development of global sectors outside the national business system context, better known as 'turning around and charging ahead'. These sectors may be seen as integrated in global innovation systems. In the first phase, as was the case of the 'turnaround and charging ahead' of the Finnish ICT success story, this may lead to a differentiation of the national system. In looking, first, at the way business systems determine innovation system performances, we find a basic distinction in the 'varieties of capitalism/ NBS' literature between

- Liberal or entrepreneurial[9] (US, UK) market economies, where codified knowledge has a hegemonic position, while tacit knowledge is marginalized.
- Associative or 'organized' market economies[10] on the other hand have broad-based educational and training systems which recognizes the value of both academic education and vocational training (Lam 2002), conducive to a decentralized mode of work organization, with practical experience as a high social status[11].
- Artisan market economies, which are described in the literature on industrial districts.

These economies have innovation systems with different strengths and weaknesses (Asheim & Mariussen, 2003).

[8]The NBS theory has been developed by institutional theorists, like Hollingsworth and Sosckies – and it is brought to perfection through Richard Whitley and his associates within the EGOS group. The EGOS group is explaining national path dependencies, through the national business system concept, which is explaining the emergence of nationally distinct forms of corporate organization, embedded within unique national institutional arrangements. The major achievement of the EGOS group is a *classification* of *national business systems*, which specify sets of relations between national institutions and forms of corporate governance, as well as – importantly – a comprehensive theoretical framework, laying bare the complex chains of causation which links together macro level national institutions and micro level work systems.

[9]The entrepreneurial model is characterized by co-ordination of the economy on market mechanisms, backed by regulations of competition. Corporate governance is characterized by ownership co-ordination and a low level of alliance co-ordination (Whitley 2000). Few long-term connections between suppliers and customers develop. Banks have a low level of trust and a short-term view on investment. There are strong formal institutions, which encourage rivalry rather than co-operation, facilitates reallocation of resources, and responsiveness to short-term demand changes. The labor market is occupational (Lam 2002), which leads to high labor mobility between firms. Knowledge and skills are owned by individuals, rather than firms. Careers rely on institutional signals (public certification) and/or informal signals (peer group recognition).

[10]Associative economies are characterized by 'public private partnership', where states delegates power to branch level associations, enabling self-organization (Cooke & Morgan 1998), and create institutions, which enhance learning and innovation (Cooke & Morgan 1998, Cooke et al. 2000). Corporate governance is characterized by a combination of high levels of ownership integration with strong inter-firm linkages (Whitley 2000). Within companies there is little social distance between engineers and production workers and there are close linkages between R&D and production. There are strong unions and participation of the work-force in management. The capital market is characterized by close links between banks and companies and strong alliances between capital providers and users.

[11]Labour markets are dominated by large enterprises characterised by long-term stable employment. This encourages company investment in worker training. The corporate governance of the developmental model is characterised by a high level of state-controlled ownership co-ordination combined with a low level of alliance co-ordination (Whitley 2000). The state controls the capital market. Innovation strategies focus on applied R&D projects to promote a cluster of continuous and incremental product innovation. Science-based industries are weakly developed. Linkages between university and industry in R&D collaboration are underdeveloped leading to a lack of academic spin-offs and technology-oriented start-ups (Kim 2000; Bass 1998; Lam 2003; Hane 1999).

Entrepreneurial economies are well known for their superior ability in generating new science based consumer market products, in particular in the new high tech industries. Associative economies on the other hand, are good at complex problem solving – and on improving mature and technologically complex products. Industrial districts are good at low-tech new product creation, based on craft skills.

	Strengths	**Weaknesses**
Entrepreneurial market economies (US, UK)	Commercialization of science based knowledge. Product innovations	Low-trust relations undermine long-term learning. Process innovations
Organized market economies (Japan, Germany, Sweden)	Good at complex problem solving. Incremental innovations, and knowledge diffusion	Commercialization of science based knowledge. Consumer market design
ARTISAN (Northern Italy, Denmark)	Efficient in creating new, design based products for the market (flexible specialization)	Limited ability to access R&D knowledge and do technologically 'deeper' innovations

The core of the distinction between associative and entrepreneurial economies is the position of tacit and codified knowledge. In an entrepreneurial economy, codified knowledge – and the individual carrying codified knowledge – has a privileged position. In associative economies, knowledge is a collective phenomenon, embedded in groups, which share unique combinations of tacit and codified knowledge.

In applying these distinctions to Nordic countries, we have to consider what we already know about Nordic diversities. Seen from the outside, the Nordic countries – Denmark, Finland, Iceland, Norway and Sweden may appear to be a homogenous bloc. In international comparisons Nordic countries are sometimes praised as examples of generous welfare states with a large public sector, high taxes and strong trade unions. Amable (2000) distinguishes the 'social democratic model' as one type of social systems of innovation and production in his institutional analysis of modern economies. An in-depth analysis of Nordic *diversities* was carried out by Stein Rokkan. According to Rokkan, the two basic distinctions between Nordic countries are east – west and north – south.

To explain his map, Rokkan synthesized the last 2000 years of European history. By way of introduction, a brief summary of his story may help us to understand the *diversities* of national business and innovation systems.

It goes like this:

The empire of Rome evolved with one *single* city at the core. The strength of the Empire was the way different tribes, cultures and identities were successfully integrated into a common institutional framework of a single Roman Law, the common language of Latin, later also a common religion, the Church. This policy of integration created a dual structure, *heterogeneity* – in terms of nationalities, ethnicities, cultural identities, and economies, combined within the political, cultural and institutional *unity* of the Empire. After the fall of Rome, Europe fell back into the chaos of competing war-lords, feudalism and a series of wars which lasted for 1 500 years. In this period, several tribes in the outer rim of Europe turned their attention towards empire-building strategies of their own. At the same time, two partly intersecting processes of European *reintegration* were emerging. One process was institutional, the other economic.

Nations at the rim

When Rome fell, tribes and war-lords at the outer rim of Europe which had been resisting the City now were free to reorganize and create new empires all by themselves. Importantly, the institutional setup of these countries diverted from the Roman core. An important institutional distinction was that between a sea based (western), and a land based (eastern) empire. In the North West, Rokkan found Norway – along with Denmark and England – which belonged to the *Seaward Empires.* Similarly, Sweden (along with Prussia, Bavaria and Austria) were *land-based eastern empires.* We will return to this east–west distinction, and the implications for the national innovation systems, below.

The rim empires grew and collapsed, broadly defined, through a period of 1 000 years. The Norwegian Viking empire was an early case of growth and fall at the end of the First Millennium, the Swedish empire fell at the end of the 18th Century, the empire of Britain lasted until the 1950s, with the 'devolution process' of Scotland and Northern Ireland from the core country, England, still pending at the end of the second Millennium. In the south west (Spain, Portugal with links to Latin America) and south east (Austria), which both were 'crusading empires', built on the struggle against the Moslems. The federation of Austria–Hungary was dissolved through the First World War. Like the others, Austria has withdrawn into a medium-sized nation state, with an over-sized city, the former imperial capital Vienna, as its centre.

Importantly, the collapse of the rim empires did not lead to a dissolving of their cores, but rather to a *transfor-*

mation from empires into *nation states*. Through this process of modernization, these nation states again converged towards the European cultural and institutional heritage, as it evolved inside the core.

A core strategy to overcome rivalry between feudal warlords was the development of absolutist nation building projects, with a sovereign King at the centre. The most important and strongest was the monarchy of France, which led to the French revolution. The French revolution transformed the culture of Europe profoundly, through revitalizing the idea of the enlightenment in the direction of a secularized society with universal human rights and liberties. The way to promote this ideal was through democratic nation building, and through institutions promoting the market. These new ideas were diffused throughout Europe through the Napoleonic destruction of the old regimes. The result was a period of generalized development of modern, democratic sovereign and secular nation states all over Europe, built of the ideals of the French revolution. Through the generalized diffusion of these state-building projects, the fallen empires on the rim again 'joined Europe'. This process also opened for institutions, which allowed the different European markets to develop. This was important to the parallel process of European re-integration, the economic.

The new centre

The new economic centre of Europe developed through the increased significance of markets, strongly related to expanding sea-based trade. This centre to replace Rome was the *polycentric city belt,* which today includes the area from Paris in the west to St. Petersburg in the east, London in the north, and Munich in the south. This is today the most densely populated area of Europe, with a network of the major European cities – including the commercial and industrial heartland of the European economy. The evolution of this polycentric belt was *initiated* by the Hanseatic League. This league developed infrastructure, trading routs and markets through their *harbors in the North Sea*. The core dynamics in the evolution of the new Centre of Europe – as well as the European markets – was the trade flows through these North Sea harbors. Trade had many sources, such as the North Sea Region, where it integrated the Nordic countries as suppliers of natural resources (food, timber, tar, and metals) to the continental markets, partly through the emerging global trade through the sea-based links to the colonies. This basic structure underpinning the evolution of the new European Centre was put in place just in time for the industrial revolution, which greatly speeded up the growth of the city belt. In the 20th Century, after the Second World War, the reintegration of Europe was institutionalized through the European Union.

Let us, however, take a glimpse at the *pre-industrial* European innovation system.

The European system of innovation

The *pre-industrial* markets where the Hansa League operated were driven by *distinctions of taste* – through culturally determined preferences made of consumers of craft based products. Accordingly, the logic of the pre-industrial European innovation system was very much driven by *consumer market product differentiation*. Price differences between what was distinguished quality and what was regarded as common and cheap made all the difference, when it came to the bottom line. Within this market context, craft skills, design and knowledge of local market distinctions were the core of the knowledge base. The name of the game was craft based product innovations. Core sectors were this kind of knowledge was important were food, textiles, leather, as well as wood and metal products. Not surprisingly, these product innovation systems were very well developed in the core – as well as in the western rim countries, where the influence from sea based trade – combined with proximity to the city belt, gave optimal conditions for the development of craft based regions specializing in specific products, and sharing regionally embedded craft skills and market understanding. These industrial districts are today primarily found in Denmark, Northern Italy, Spain and Portugal. A high level of product innovations with low innovation costs characterizes these countries. Industrialization did not change this basic structure.

Nordic national distinctions: East–West, North–South

Through sea-based trading routes, Denmark – as well as Southern Sweden, south-eastern Norway and south-western Finland, was attracted to the city belt, today better known as the core of the European market. Never the less, this rim of small nation states at the outer margins north of Europe *diverts from* the centre in many respects. The Nordic countries, Sweden, Denmark, Finland and Norway, were highly internally *homogenous*, in terms of ethnicity, culture, and unique homemade institutions, which evolved outside the influence of Rome. At the same time, the Nordic countries are radically different from each other, as they are diverted by the larger distinctions on the greater map of Europe. This dynamic has resulted in the development of Nordic national innovation systems, which are different from each other – and at the same time stand out as highly specialized, diverting from the heterogeneous core.

Rokkans east – west distinction has certain similarities with the organized (east) vs. entrepreneurial (west) market economy distinction. Broadly speaking, this distinction links very well into the associative – entrepreneurial discussion in the NBS literature, when it comes to the relation between tacit, collective v. s. codified and individualized knowledge. It goes like this: The western countries (US, UK, Denmark, with Norway and Iceland as north-western peripheries) have an organizational culture which – according to Rokkan – evolved from the requirements of communication and administration encountered by the sea-based empires. A sea-based empire (the British or Danish) is administered by sailing ships going for long journeys. Here, the Captain – or the public official sent by the King to the remote colony – was carrying an order from the King. Because of the long sea journey to the colony, communication back into the central level was too slow and infrequent to have any impacts on the actual on-the-ground sequence of events. The official had to be given a general codified text defining the object of his mission, an Order. The official had to be trusted by the King to be able to both stand by his order, and implement an authorized interpretation of it, given the adaptations and adjustment to local realities deemed necessary. This institutional legacy leads to two forms of western industrial entrepreneurialism: (1) The US/UK model of large corporations emerging within a liberal market regulatory regime – and driven by systems which look upon codified knowledge as legitimate basis of decision making. This is the classic R&D driven global best case of 'knowledge economy', with a superior ability to convert codified, new science based knowledge to value added consumer market products (implementing the Captains order). (2) The Northern Italian/ Danish small-scale version, where the emphasis is on flexible specialization adapting to changing consumer market distinctions. This economy is market – not science driven, and the legitimate form of knowledge is craft skills (the Captain is bringing money back to the King). Here, the carriers of craft based knowledge are free to invent anything – as long as he brings money back to the King.

Similarly, the land-based Eastern empires on the other hand (Sweden, Germany, Austria, Russia, with Finland as the northern periphery) had an administrative structure with several hierarchically organized layers. These layers were visible on the map of Europe, as a hierarchy of cities with corresponding regional responsibilities of administration. Within these land-based hierarchies a continuous vertical communication between centers (cities) at different levels of hierarchy *was* possible. This opened up for vertical forms of problem solving, including dialogues where orders were negotiated and interpreted, using the tacit knowledge of the local lower-level implementers and officials, combined with central level top-down decision making.

These deeper structures may be seen in the often incremental innovation processes of the associative corporations, the way they put up work teams, combining engineers and craftsmen, and in their sophistication in improving complex and mature technologies, often combining R&D inputs as well as tacit/ craft based knowledge. Decision-making is slow, expensive, but able to handle extremely complex technologies. Codified knowledge (research) is important, but deeply integrated in industrial processes where collectively shared tacit knowledge is respected.

East–west is an institutional distinction, but south–north is cultural. The south–north distinction made it possible to see the difference between northern peripheral regions (Iceland, Norway, Finland, Northern Sweden) specializing in extraction and processing of natural resources – and more centrally located countries – closer to the central European city belt, where market-driven innovations may emerge more easily (Denmark, Southern Sweden, Southern Finland).

The north–south dimension is discussed with reference to *regionalization* of the Nordic countries, using NUTS2 definitions of regions. An indication of the strength of this distinction is the competitiveness and productivity paradoxes (2.4). The west–east distinction is discussed from the point of departure of the research vs. market driven paradox (2.5).

As a point of departure, this makes the following hypothetical classification of Nordic countries possible:

	West (entrepreneurial)	**East (organized/ associative)**
North (periphery)	Norway, Iceland Entrepreneurial, resource and process oriented	Finland Technologically complex resource processing
South (centre)	Denmark Artisan based, market (design) driven product innovations	Sweden Technologically sophisticated complex problem solving – specialization in mature industrial products

A core finding in the data analysis presented below is the transition of Finland from a North Eastern periphery into a western form of entrepreneurialism, somewhat more in the direction of the US/UK model than the Danish. The literature review, presented in chapter 2, indicates the following broad characteristics of the national systems.

South-West: Denmark

In a European comparison, Denmark has an extremely efficient innovation system, with a low input, in terms of innovation costs for innovative firms, as well as a moderately low investment in R&D, as demonstrated by the GERD index. Danish outputs, in terms of turnover created by new products, is extremely high. Similarly, Denmark has a low level of R&D in the economy, almost as low as Norway. The explanation to this low-tech success story has been documented by Kristensen (1990) and Lundvall (2002). The strength of the Danish innovation system is a high level of skills among process operators in Danish firms. What is more, they share their experiences in locally embedded networks of craftsmen and industrial operators. This is enhanced by training programs, often organized with union – employer cooperation. Another important factor is the deep cultural knowledge of consumer market tastes, which enables Danish firms to maintain a high level of consumer product innovations. Denmark has the same basic characteristics as the industrial districts of southern Europe, like Italy. What is more, the Danish clusters are very well organized, with institutions and several layers of specialized supporting industries. Another strength is proximity and excellent channels of access to the core European consumer market. It is not difficult to understand that Denmark has been going extremely well lately, in terms of economic achievements.

East: Sweden

The NBS literature documents an international division of labor between different national innovation systems, where the entrepreneurial economies are superior in research driven new knowledge creation and radical consumer market innovations, and 'associative' countries, like Japan and Germany are better at copying, improving, and developing sophisticated support industries of mature, technologically complex products. The Swedish economy shares these basic properties with Germany. Unlike the Danish industrial districts, Swedish corporations share more similarities with advanced Japanese and German firms, with sophisticated and advanced knowledge bases, highly developed industrial organizations, owners with a deep interest and commitment to technological development, knowledge-driven strategies, and a superb capability in solving complex problems of technological development. The analysis of Sølvell and Porter, led to a debate which sent Sweden into the 1990s with a high 'second generation OECD' policy profile. The *technology policy* approach got strong support in Sweden, and the Swedish GERD index rose sharply during the 1980s, to reach the US level by 1991. During the 1990s, Sweden demonstrated a high capacity for new path creation, in the areas of biotechnology and information technology. However, the heavy investments made in R&D, not least from the public sector, did not give as much in return as was expected.

North-East: Finland

Historically, the backbone of Sweden, Finland and Norway was process industries based on raw materials. Like Sweden, Finland has a process industrial background with large and sophisticated national clusters in industries such as wood and paper, energy, as well as support industries, in mechanical industry, etc. The Finnish 'success story' of 'turning around and charging ahead' during the 1990s is well documented (Scienstock & Hammalinen, 2002), and reflects the Finnish ability to adapt to new demands when needed, without getting stuck in old industrial traditions. In particular, the Nokia success in taking the leap into a fully-fledged entrepreneurial, US-style corporation is stunning, and a sharp contrast to the 'engineering lead' Ericsson failure to do the same.

North-West: Norway and Iceland

The Norwegian innovation system is in many ways still resting of the early success of the 1980s, in developing a technology policy. The major clusters, the marine, maritime and petroleum industries were injected with a substantial developmental input during the 1980, through an offensive R&D policy. The support industries of these industries, in particular mechanical engineering, have a formidable strength. Importantly, petroleum also benefited from an industrial policy strategy laid down in the 1970s, of 'Norweginization' of the petroleum technology. Most Norwegian corporations are 'process oriented', focusing on incremental process innovations rather than new products. In contrast to the situation in Sweden and Finland, the Norwegian Porter study, published in 1992, was not followed up. The Norwegian R&D performance, seen in a European context, is not very impressive. However, Norwegians do know very well how to run processing industries efficiently.

Iceland, like Norway, has a strong maritime-marine cluster, where the basic strengths are in process innovations. However, as compared to Norway, the Icelandic maritime-marine industry has reached a much higher sophistication in terms of industrial organization, through regulations of the fisheries, which has opened up a dynamic development of new Icelandic corporate sector. This corporate sector is now supported through a brave thrust in the direction of R&D-driven growth.

2. Nordic differences

In this chapter, we further discuss the mapping of the Nordic countries, as presented in chapter 1. Based on Stein Rokkans map of Europe, and the findings of the National Business System (NBS) researchers, the following tentative classification was outlined:

	West	East
North	***Norway, Iceland***	***Finland***
	Innovation trajectory Corporate based process innovations, maximizing efficiency	***Innovation trajectory*** Corporate based science driven resource processing – and science driven new product innovations
	Knowledge base Network (market) interaction between corporate process engineering, science-driven product innovations, and KIBS supporting the process	***Knowledge base*** Corporate integration between process engineering andscience based knowledge
South	***Denmark***	***Sweden***
	Innovation trajectory Market innovations, new products	***Innovation trajectory*** Corporate based science driven mature product improvements
	Knowledge base Consumer market distinctions combined with craft based knowledge	***Knowledge base*** Integration between mature product engineering and science based knowledge

This classification may be tested against *macro level patterns*, which are explained through different assumptions as to *micro level actors* – and the *innovation trajectories* and supporting knowledge bases they are embedded in. The micro level data in this field is rich, but not particularly directed to our area of study. In this report, the macro classification is discussed in relation to qualitative micro level case studies of regional innovation systems, made available through cooperation with Bjorn Terje Asheim at the University of Lund.

The three macro units of analysis referred to in this chapter are *countries*, *sectors* and *regions*. The analysis draws upon data and analysis presented in Chapter 3, written by Lars Coenen, who presents the *strong sectors* in the Nordic countries, based on the *RCA indicator,* Chapter 4, also written by Lars Coenen, discusses national differences within industrial sectors, as well as Chapter 5, where Morten Fraas presents the *regional industrial structure* of the Nordic countries, based on a NUTS 2 level analysis.

This chapter has four sections:

- *National differences.* At the national level, we refer to R&D intensity, as measured through the OECD GERD index, as well as the CIS indicators of product innovations. We make a distinction between new products, improved products, innovations, and innovation efficiency
- *Sectors and national differences.* In looking inside the national systems, we look for national differences within sectors between new product innovation – which we will relate to the west dimension – and product diffusion and upgrading – which is a somewhat more eastern approach inside sectors. We also extend the analysis to a comparison of national industrial structures, and the strong national manufacturing sectors, using the RCA indicator.
- *Regions and national differences.* The result of chapter 5 is used to calculate *regional innovation estimates.* The regional units are NUTS 2. The estimates are based on the regional industrial structure – combined with national level sector specific CIS indicators. This analysis groups the regions along a north–south dimension. The analysis is supplemented with RIS case studies.
- *Summary discussion.* In summarizing these discussions, we will return to the country by country comparison – and discuss how possible micro level explanations to the macro level findings, in terms of appropriate national business models, may be drawn. Do our findings indicate that there are unique, nationally specific forms of business organization, and corresponding knowledge bases, which determines the differences in innovative performance?

National differences

In 2000, total employment in the four Nordic countries, Norway, Finland, Sweden and Denmark was roughly *11.5 million* (11 498 100). Of these, *4 millions* (4 059 300) were working in the private service sector, and some *2 millions* (1 967 400) in manufacturing. The remaining *5.5 millions* were working in agriculture, mining, crude oil and natural gas production, fishing, electrical supply – and in the public sector. In the search for innovation policy tools, the question of appropriate innovation indicators has emerged. One approach to this has become the 'Oslo manual', which has directed a European wide survey, the 'Community Innovation Survey' or CIS. The CIS is carried out in European countries every fourth year, last time in 2000 (2001 in Norway). A sample of firms is asked a set of questions – among them how much of their turnover is created by new or improved products – and how much they have invested in innovation to achieve this result. If we take these answers – and relate them to employment statistics, we get a pretty good estimate of the share of jobs in different industries, which in some way or other are depending upon innovations. Now, the estimate is only 'pretty good' for several important reasons.

First, not all firms are asked. All firms with more than 100 employees are asked, but only a sample of firms with 100–10 employees, and no firms with less than 10 employees. Since we know that innovation rates generally are higher in large firms than in small, this may lead us to expect that the CIS rate is over-estimating innovations. Secondly, of course not all firms, which are asked, actually *answer* surveys – and not all firms give very specific and correct answers. Third, questions may be understood and interpreted in different ways in different firms. Leaving these worries behind, we have to make another assumption: employment in production based on innovative products generates the same employment per unit of production value as employment in other products in the industry. As we all know, this might not be the case, as new products may well be less labor intensive than old.

Job creation

The CIS has several definitions of innovation, both product and process innovations. Sometimes, process innovations may generate new jobs. If, say, the Norwegian metal industry is more efficient than the Swedish metal industry in processing metal, which is available in the global market, the Norwegians may out-compete the Swedes, and increase employment in Norway. The same may take place in the competition between firms. However, in looking at industries, process innovations based on the same products and the same resource base tend to increase productivity through reducing the number of jobs. With a given quantum of fish to catch, increased efficiency will reduce employment in the fishing fleet. An efficient fishing industry, on the other hand, may import raw material from abroad, and thus increase employment through increased efficiency. Product innovations do not always create new jobs. A new product which only replaces an old product may not necessarily mean that the industry is growing in number of employees. There may be fierce competition between new products in industries which are reducing total production and employment.

Never the less, in very general terms, and seen in a large scale perspective, we may agree that

> 'If a country (..) is characterized mainly by process innovations (technological or organizational) this constitutes a tendency to decrease employment. If product innovation dominates, there is an opposite tendency to increasing employment.' (Charles Edquist, Leif Hommen and Maureen McKelvey, 'Product versus process innovation: Inmplications for employment', in Charles Edquist and Maureen McKelvey (eds.) *Systems of Innovation: Growth, Competitiveness and Employment*, Volume II EE)

This means that if a country or a region has an innovation system which is strong on product innovations, innovations generally and in the long run is likely to generate employment. In regions, sectors or countries where process innovations are dominating, innovation generally speaking and in a long-term perspective, are likely to contribute to reduced employment. In these cases, usually, the industry in question is in a competitive position where it may choose between becoming more efficient – or disappear. In looking at *product* innovations, CIS has two definitions, a narrow and a broad. The *narrow* definition is a product, which is *new to the market*[1]. The *broad* definition is an improved product, which may or may not be new to the market – but is new to the firm[2].

In taking the *difference* between these rates, we get a category of improvement of innovation of products, which are not new to the market. This will include both:

- *Diffusion* of existing products to new firms (new to the firm), but also
- *Upgrading* through technologically or market driven improvements of mature products.

As we will see below, improvement of products which are not new to the market may be an important form of innovation, in particular in eastern economies, like Sweden.

[1]The question is 'Has the firm in the period 1999–2001 introduced products in the market which are not jest new or improved for the firm, but also for the market?' If yes, asses how large share of turnover is created by these products.
[2]The question is: Has the firm during the period 1999–2001 introduced products in the market which are new or improved for the firm? If yes, assess how large share of turnover is created by these products.

Table 2.1. Nordic countries, employment and over-all CIS rates in private services and manufacturing

	Private services			Manufacturing		
	Employment	Broad CIS rate	Narrow CIS rate	Employment	Broad CIS rate	Narrow CIS rate
Sweden	2 357 600	16	3	752 200	28	6
Denmark	1 657 200	11	4	455 000	19	11
Finland	1 376 500	7	4	459 100	27	24
Norway	1 305 800	6	3	301 100	13	2

For some products, like planes, cars, oil platforms and ships, this may be a quite sophisticated undertaking, requiring a lot of R&D.

In looking at the *Nordic* level, and using the *broad CIS definition*, some *11%* of employment in private services, and *23%* of employment in manufacturing industries in 2000 were based on or related to *product innovations*. Note that we do not say that these jobs are 'created by' innovations, nor that they are 'new' jobs. These are jobs, which are producing the new or improved products, which were created through innovations. Some of these jobs are new, but some are also 'old' jobs, which used to depend on products, which are no longer profitable. We do not know what would have happened to these jobs without the new products. Perhaps some may have remained, based on old products? Just to illustrate what these figures means, we may relate them to what we know about employment in the Nordic countries.

In 2000, the distribution of employment in business services and manufacturing industries in the Nordic countries – and the corresponding CIS rates – was as follows:

In this way of measuring, the largest country, Sweden, also is the most innovative. Under a more restricted definition of innovation, however, when we ask weather the product really is new to the market, Denmark and in particular Finland stick out. If, as a point of departure, we make the highly unlikely assumption that the productivity of the new products created through innovation equals the average sector productivity, we are talking about roughly *444 000* jobs in private services, and some *460 000* in manufacturing, a total estimate of roughly *900 000* jobs in the Nordic countries (excluding Iceland). Using the *narrow CIS definition* of products which are new to the market, we are down to *170 000* jobs in private services and *190 000* jobs in manufacturing, a total of some *366 000* jobs. Considering estimated jobs related to *new manufacturing products*, Norway had an estimate of just *9 000* in 2000, whereas Denmark had an estimate of *50 000* and Finland *110 000*. Thus, Finland and Denmark *together* takes *84%* of the estimated *manufacturing* jobs related to new products! Somewhat surprisingly, Sweden falls back when it comes to *new products for the market*. The estimated Swedish manufacturing jobs related to new products was surprisingly low, just *23 000*. Instead, the Swedish strength is in *new and improved products*, both in manufacturing and services. Here, the Swedish total estimate is impressing *437 000* jobs, with *211 000* in manufacturing. As a comparison, Norway has *89 000*, Denmark *202 000* and Finland *177 000* estimated jobs related to new or improved products in services and manufacturing. In other words, of the *900 000* total Nordic jobs related to product innovation, Sweden roughly takes half – and Norway just round 10%. Swedes obviously are good at product diffusion and upgrading, as well as innovation in services, whereas Danes and Finns are good at new product innovation, and, hence, they get a lion share of new manufacturing jobs.

The differences between Norway and 'the rest' reflect the northern position of Norway, which, as we will see, is specialized in processing industries where the dominating logic in process innovations. Now, why are the Norwegians creating so few new jobs? And why are the Danes and Finns able to create more jobs in manufacturing than the Swedes?

Parts of the answer lie in the different ways the Nordic countries relate to R&D.

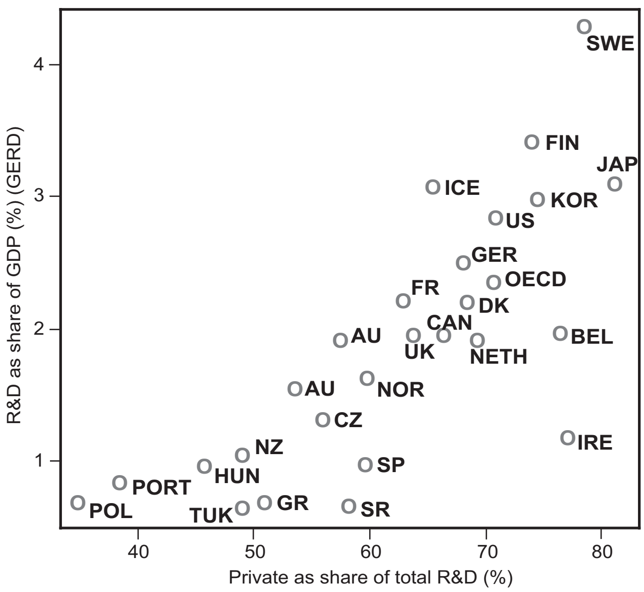
Level of R&D: GERD

GERD is measuring input to the innovation system in terms of science, research and technological development[3] as a share of the gross national product. Figure 2.1 (next page) shows the relation between the level of GERD and the private share of GERD for OECD countries. Here, the vertical axis is GERD and the horizontal axis in the private share of GERD.

Norway (NOR) has the lowest GERD level as well as the lowest private share of GERD. Australia (AU), the Check republic (CZ), Spain (SP), and New Zeeland (NZ) have a lower level than Norway, along with Greece, Hungary, Turkey, Portugal, and Poland. At the top, we find Sweden (SW), with a high private share of research, and a high over-all level of GERD. Right below Sweden is Fin-

[3]The GERD indicator is based on data collected and presented in line with the standard OECD methodology for R&D statistics, entitled The Measurement of Scientific and Technological activities: proposed standard practice for surveys of research and experimental development – Frascati Manual 2002 (OECD). Data are derived from retrospective surveys of units actually carrying out and performing R&D projects. It includes natural science, engineering, social science, and humanities. Data are presented in Main Science and Technology Indicators, OECD, Volume 2003/2.

Figure 2.1. OECD countries: R&D as share of GDP (GERD) v.s. private R&D as share of total R&D



land (FIN), Japan (JAP), Korea (KOR) and the USA. Denmark (DK) has a GERD level, which is higher than Norway, but still slightly below the OECD average.

The level of R&D in an economy may, as we all know, be influenced by government policies. Governments invest in universities, research, as well as in other forms of innovation policy instruments. Most certainly, the public sector may be expected to contribute to a high R&D level in the economy. However, the plot also indicates a strong relation between the national level of R&D and the decisions to invest in R&D made by private firms. The horizontal axis is the private share of R&D. As is quite obvious, a rising share of GERD depends on public investments, but it also is highly depending on a high level of R&D investments from private economic actors. Countries who are actively following the OECD innovation policy advice – of stimulating R&D through public investments, like Sweden, Finland, and Iceland, has a somewhat higher level of GERD than should be expected, looking at the investment decisions made by their industries, given the 'mainstream', defined by Japan, Korea, and USA. With one exception, Ireland, countries with an over all low level of GERD (in this case mostly countries of eastern and southern Europe), also has a relatively low level of *private* R&D investments. The plot does indicate that the rule seems to be that a country must have a high level of public R&D investments in order to be attractive for foreign investments from corporations with research driven strategies – and large R&D investments. Countries with a high level of public R&D are likely to have a high output of engineers and researchers, enabling domestic corporations to invest in R&D. This logic is differentiating: Some countries, which get high levels on both private and public investments – and some countries, which get low levels on both. There is, in other words, a strong relation between the national business system, which determines the strategies of private industry, and the national GERD level. A major factor in explaining GERD leadership is the existence of a sector of firms – including some large firms – which has high R&D investments as a core business strategy.

R&D (GERD) and innovation

Based on the discussion in Chapter 1, we will make a distinction between four different relations between R&D and innovation.

1) Western research driven strategies

The most usual relation is the western success stories, where USA and UK has a hegemonic position, between a high level of R&D investment and a high turnout of new, science driven consumer market products.

This phenomenon, which is well known from the literature of the late 1990s, primarily occurs within high tech sectors, such as ICT and bio-technology.

2) South west: Flexible specialization

In some national business systems, we find a combination of a high level of product innovations and a low or moderately low GERD level. This points in the direction of a differentiation between countries specialized in science driven product innovations – and countries specialized in market driven product innovations. In many cases, creating a 'new product' is taking place in design – intensive industries, where novelty is based on a new combination of existing components, in innovation processes often involving craft or design skills. Design-oriented product innovations may involve deep forms of market knowledge, along with the craft skills needed to know how to make the product differently. The novelty of the product more often than not may be seen as a distinction in design to the old product. In markets where consumers place a heavy emphasis on product differentiation – and new products are short lived, being able to turn out new designs all the time may be the only way to survive. These forms of innovation were particularly celebrated in the 'industrial district' literature of the 1980s, in regions and countries at the rim of the European core city belt – and outside the old manufacturing core of US – the 'rust belt'. The 'industrial district' mode of innovation – often referred to as flexible specialization – is based on design and craft skills – and increasingly differentiated consumer markets. Craft based, market driven flexible specialization may thrive and prosper very well indeed without R&D. Indeed, the craft based specialist may be too busy finding the latest design that they have no time to consider new technologies or scientific achievements. In that way, they may become locked into a quite narrow trap when it comes to radical – science-driven – product innovations. Industrial districts are not tapping into the sources of science-based growth.

Instead, they are creating lots and lots of products, which have a high value precisely because they are new to the market.

3) Eastern R&D strategies: improving mature products

There is another option as well: improving mature products. Just improving existing products may sound as 'less innovative' than creating products, which are new to the market. Some product improvements may be quite modest – like reducing the milk fat level in yoghurt. However, a lot of technologically sophisticated products, like planes, cars, ships, and oil production facilities, are not new – instead, they are improved through deep, expensive and long-lasting technological processes, decade after decade. These products tend to grow in technological complexity. Specializing on how to improve complex and mature products may be a highly research-intensive undertaking. As compared to the industrial district, where new products come cheaply, improving complex products is an expensive undertaking, with a long-term time perspective. This form of specialization is associated with the heroes of the 1980s, Germany, Japan, and Sweden. In these countries, huge corporations started pouring out better cars, cameras, consumer electronics etc which left their US and UK competitors bleeding. What is more, these countries invest heavily in R&D in their *product improvement* processes. More often than not, they are not the first to hit the market with a new science based product, but once they catch up – they take a lion share, thanks to their sophistication in the complex problem solving implicit in mature product improvements. At the core of the innovation systems of these countries, we find corporations, which integrate, combine and recombine tacit and scientific knowledge.

4) Northern strategies

In the Northern case, we would expect moderate industrial demands for R&D investments, combined with low levels of new product innovations. This is the situation where operation and improvement of existing processes combined with strategies of a 'late follower' is predominant. This strategy makes sense in low-tech economies with a high dependence of natural resources.

Mapping of Europe

Considering the relation between GERD input (R&D) and the share of turnover created by new products, as measured by CIS, we get the following paradoxical picture (Figure 2.2).

The core

The countries in the core of Europe, Germany, France and Belgium, have pretty similar outcomes in terms of innovation and GERD. Given the highly heterogeneous structure of the European core, a convergence towards the mean is what should be expected. The countries at the rim of Europe, both in the south and in the north, stand out of this crowd in the middle. In chapter 1, some of the reasons for this were outlined.

The southern rim

The southern European countries, Italy, Portugal, and Spain, all have low levels, generally below 1% of GDP invested in R&D. At the same time, as we would expect from the industrial district literature, they are highly innovative.

The northern rim

Denmark belongs to the core countries – but it is in the direction of the southern. This is again as should be expected, given the classification of Denmark as an industrial district. The two northern countries, Norway and Iceland, are different in terms of GERD, but they both score low when it comes to new product innovations. They are instead in the process innovation business. Iceland has a high R&D score, mainly because some of the major corporations are following research driven strategies in processing industries.

The eastern rim

The eastern country, Sweden, has a high *input* of R&D, and a low *output* in terms of new products. This is as should be expected from a former land-based empire.

Finland, however, sharply diverts from the hypothesis through combining a high level of GERD and a high level of product innovations. This is what should be expected of a western, entrepreneurial market economy. As a former colony of two land-based empires, Sweden and Russia, Finland is going west.

If we include *improved* products – or products, which

Figure 2.2. *GERD index v. s. share of turnover created by new products*

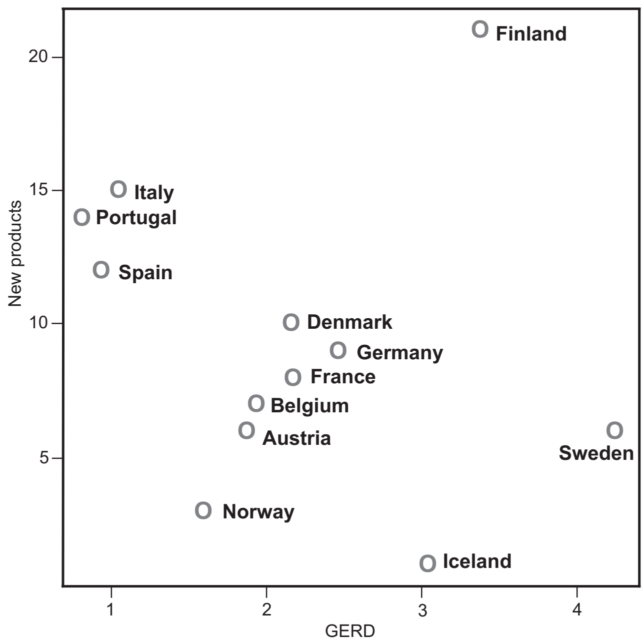
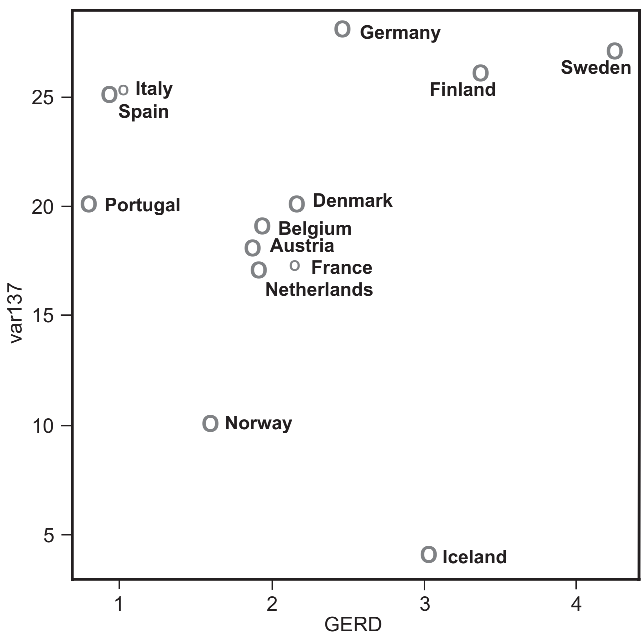


Figure 2.3. *Production (turnover) based on new or improved products as share of total turnover of innovative firms vs GERD*



are new to the firm but not to the market – we get a different picture. The most dramatic change is the high scores of the former land based empires, Germany and Sweden. Given the hypothesis presented in chapter 1, that the innovation systems of these countries are focusing on mature products, this makes sense. Here, also, Germany is achieving high, along with Finland.

Innovation efficiencies

In the following analysis, we have computed an indicator showing efficiency of the innovation system in creating products, which are *new to the market*. As specified above, this is just one of several ways of measuring national innovation system efficiency. The indicator is calculated the following way:

> Product Innovation Efficiency = Turnover created by new products to the market/Innovation Costs
>
> Upgrade Innovation Efficiency = Turnover created by improved products/ Innovation Costs

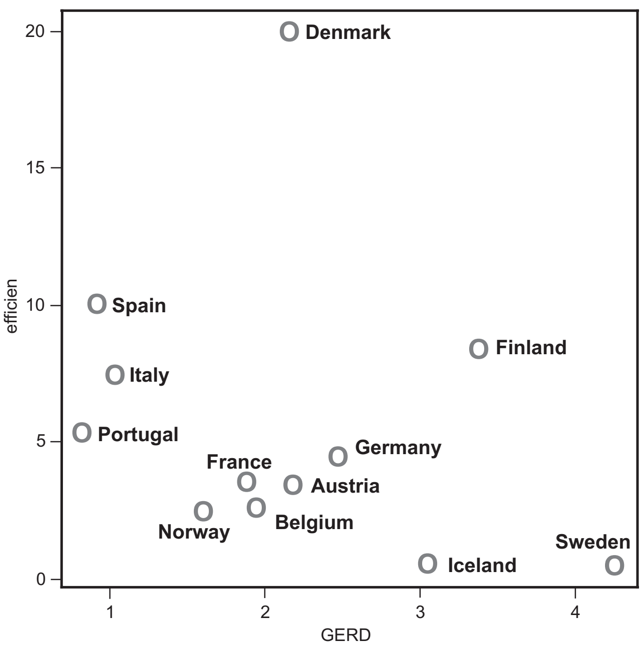
This means that if efficiency = 1, annual innovation costs in the three year period 1997–2000 basically equals the annual value of the production generated by the new products in 2000. Given the fact that the value of the production is not a net profit, this may not seem to be a good investment. However, if you expect to go on producing the product for some years to come, it may pay off in the long run.

What should also be taken into consideration here is that total innovation costs also include investments in product improvements and process innovations. This means that countries with a low score on this indicator may have highly efficient and profitable innovation systems, because they are investing in profitable improvements of their processes.

Not surprisingly, this results in a distribution where Denmark is extremely efficient, with a score of 20. This means that the investments in innovation in innovative Danish firms during the last three years before 2000 resulted in a volume of production, which was 20 times higher than the investment.

With a moderate national investment in R&D, and in a European context, extremely small investments from the innovative firms themselves, Danes are able to produce a high output of new products. At a somewhat lower over all level of product innovation efficiency, the Southern European countries – and Finland, has a high score. The difference is of course the GERD level. Whereas Finland has invested heavily in R&D, the Southern European countries do not. Sweden has high investments and a low turnout of new products, because they are specializing in R&D intensive mature product improvements, like planes and cars.

Figure 2.4. *GERD index v. s. product innovation efficiency*



Sectors and national differences

Are there nationally specific forms of business organization, to be found across several sectors? One approach to this is to consider *national differences within sectors*. In looking at sectors, we will relate to the two dimensions, east – west and north – south. 'East' means that improvement or diffusion of existing products is a dominating innovation trajectory. 'West' on the other hand reflects a market driven innovation strategy, where the creation of products, which are *new to the market* is more important.

East–west: New or improved products?

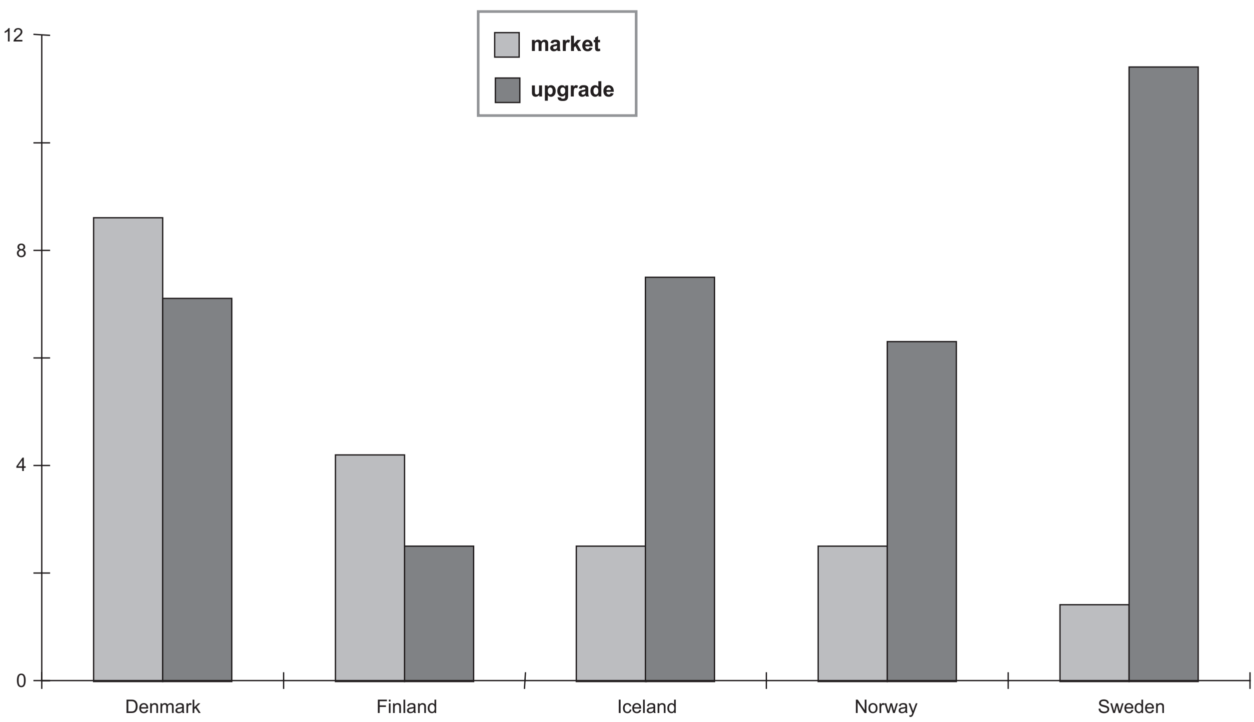
In chapter 4 Lars Coenen compares innovation efficiencies, from the point of view of efficiency in creating *new products* for the market (west) – v. s. upgrade efficiency in improving of diffusing existing products (east). The general pattern, which emerge in most manufacturing sectors, is illustrated by the food sector below. Here blue is upgrade innovation efficiency, and red is efficiency in creating new products. A striking feature of the tables presented in this analysis is the consistent pattern of national specialization across several sectors. Some countries are consistently more in the direction of blue (upgrade efficiency, or eastern) – some more in the direction of red (western new product innovation).

There are consistent differences between countries in the same sectors, where Finland and Denmark are creating new products, while Sweden, Norway and Iceland are improving mature products. For one sector there are no national industries where new products are more important than product improvements: metals. Here, Iceland is the most efficient case, in terms of innovations based on product improvements. Using the west – east classification on differences between countries within the same sectors, we get the following table. Here, western countries are efficient in new product creation, whereas the eastern are efficient in product improvement and diffusion.

Sector	**West** (New products to the market most important)	**East and north** (Improved products/ diffusion of existing products most important)
Food	Denmark	Sweden
Wood	Denmark, Finland	Norway, Sweden
PPP	Denmark	Sweden, Norway
Metals		Iceland, Norway
Chemicals	Denmark	Iceland, Norway, Sweden
Machinery	Finland	Norway, Sweden, Denmark
Transport	Finland	Norway, Sweden
Electrical	Finland, Denmark	Sweden, Norway Iceland

The table indicates that Finland and Denmark are entrepreneurial, western countries, with a high capacity in several sectors to create products, which are new to the market. On the other hand there is Sweden as an 'eastern' country, with huge R&D investments and an orientation

Figure 2.5. *Innovation efficiency in the food sector*



towards mature product improvements, which cut across several sectors. There is an interesting difference between Denmark and Finland. The Danish inclination towards new product creation is particularly strong in manufacturing sectors like food, wood products, pulp and paper and chemicals. The entrepreneurial Finnish industries are particularly to be found in chemicals, machinery, transport, and – of course – electronics/ ICT. This finding obviously indicates the successful move in the direction of south – west as far as Finland is concerned. Importantly, as we see, Finnish western style entrepreneurialism is not just an isolated ICT phenomenon – it also includes other technologically complex sectors, like machinery and transportation.

North – south: products or processes?

The north–south dimension on the other hand relates to processing industries based on natural resources v. s. industries specializing in consumer market products. All Nordic countries are *northern* in the way that resource based processing industries are important in all of them. Figure 2.6 illustrates *manufacturing* sectors in the Nordic countries, as a share of *total manufacturing*. Whereas Sweden has a relatively diversified industrial base, with no manufacturing sectors with more than 20% of total manufacturing, the high level of specialization in certain sectors based on natural resources, like food and pulp and paper, in Iceland, Denmark, Norway and Finland, is quite obvious from the figure.

In calculating competitiveness for industrial sectors of the Nordic countries (see chapter 3), Lars Coenen – using the RCA indicator – arrived at the following list of the most *competitive* Nordic manufacturing industries (RCA index in parenthesis):

- Petroleum (oil and gas), Norway (68.9)
- Food, Iceland (27.3)
- Pulp and paper, Finland (8.9)
- Metals, Iceland (8.5)
- Food, Denmark (5.9)
- Pulp and paper, Sweden (4.5)
- Refined petroleum and gas, Norway (4.0)
- Metals, Norway (4.0)
- Food, Norway (3.1)
- Radio, television and communication equipment, Finland (2.6)

The idea of the RCA index, as presented by Lars Coenen in chapter 5, is that a high export rate signifies global market competitiveness. However, this factor tends to reward small countries with industries based on natural resources. Here, a high RCA rate may also be seen as a result of advantages gained through national *control* of scarce resources, like timber, fish, oil, and gas. This does not imply that this advantage may be taken for granted. On the contrary, the

Figure 2.6. *Gross Product of manufacturing sectors in Nordic countries, in share (%) of total national manufacturing*

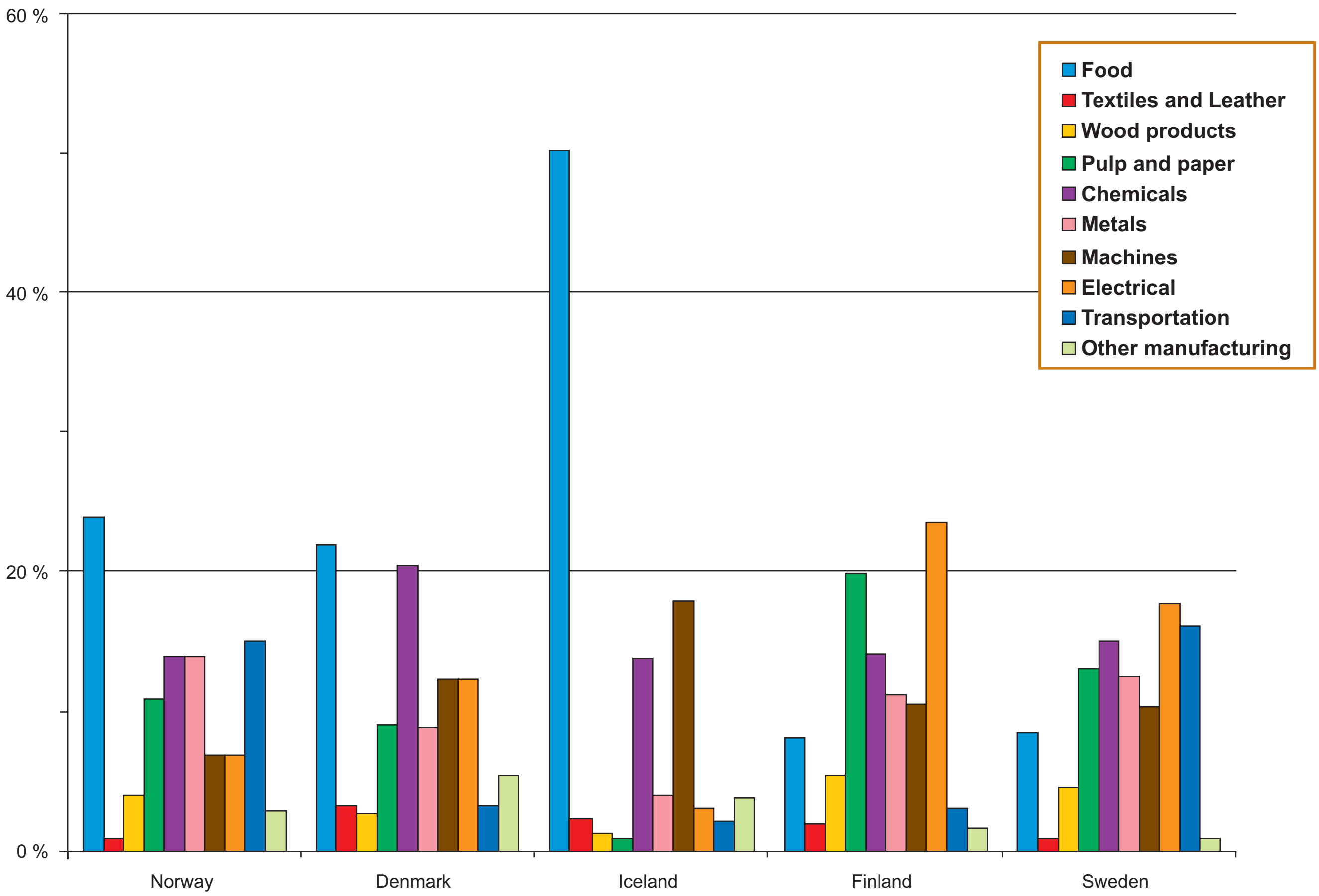
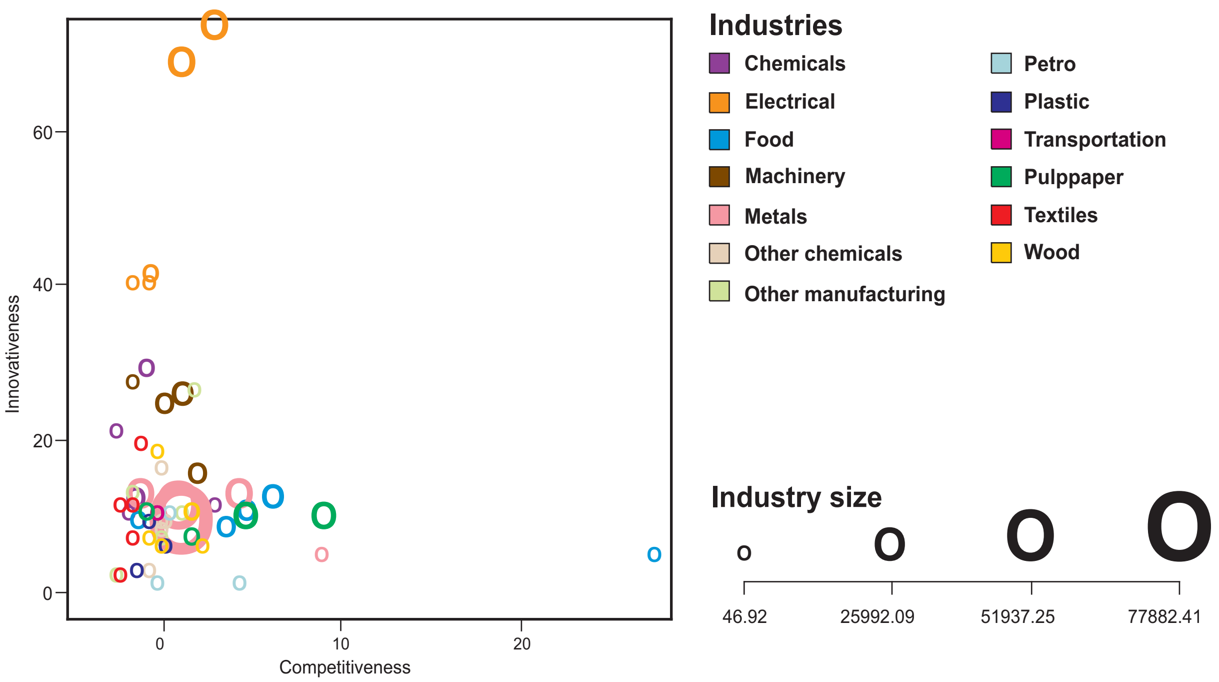


Figure 2.7. Rate of innovation (new and changed products) v.s. competitiveness (RCA indicator) in Nordic manufacturing sectors



food industries in Iceland and as the list illustrates in looking at the *general* picture of Nordic global market strengths, industries closely related to natural resources dominates. This dominance is particularly strong in the northern Nordic countries Iceland, Norway and Finland, which has 8 out of the 10 'most competitive industries'.

This dominance reflects the northern character of the small Nordic countries, as exporters of natural resources.

It is often assumed that a high level of product *innovations* (creating new and changed products) is a pre-condition for *competitiveness*. This is typically the case for the so-called new economy high tech products, like medicine (bio-tech) and mobile phones (electronics). Also, in the case of some medium tech industries, like cars and other forms of transportation, this clearly is the case. Here, new innovative or improved products have a higher value than old products – and they have large global market potentials. Customers pay a lot for Swedish cars, because they are safer than Japanese cars. Thus, product innovation improving cars generates higher value, higher profits, and a higher competitiveness on the global market.

In comparing Nordic industries, however, the relation is the opposite: the most competitive industries – in terms of export – are not very active in creating new products. Instead, they are specializing deeper and deeper in producing the same mature products more efficiently for the global market. This is illustrated by the plot m below, which shows competitiveness (horizontal axis) and innovativeness (vertical axis). Here, innovativeness is the broad CIS definition, whereas competitiveness is the RCA indicator calculated by Lars Coenen in chapter 4.

The most innovative industries, in terms of new and changed products, are the electronic industries in Sweden and Finland. At the same time, the level of competitiveness measured through the RCA indicator is much higher in the resource-based industries (oil, food, and paper), where the rate of new or improved product innovation is moderate.

This would suggest an alternative micro level strategy of innovation: to maintain focus on the old product, and become more efficient in producing it. To actors who are living in an economy based on natural resource extraction, their daily experiences would teach them that they should focus on efficiency improvements, or, to put this differently, labor saving innovations.

> … sectors in which there is a strong emphasis on process innovation tend to be characterized by labor-saving trajectories, while sectors with high levels of product innovation tend to have employment-generating trajectories. (Edquist, Hommen and Mc Kelvey, opt cit)

Are such trajectories sector or national specific? One way of measuring process innovations is to look at *productivity*, which is the output of an industry divided by number of people working in the industry. The calculation of productivity is based on the OECD STAN database. Here, we used

Productivity of sector = Gross product of sector/ employment in sector

Norway, unlike the other countries, lacks industrial sectors in the upper-right square, with a combination of a high level of product innovation and a high level of productivity increase. Norway has several industries, which have a *high* level of productivity increase and a *low* level of product innovation. This explains why there is no positive relation – measured through regression analysis – between the level of product innovation and the productivity of the sector in Norway.

For the three countries Denmark, Sweden and Finland, there is such a *positive* relation between *innovativeness* in terms of new and improved products, and *productivity*. The case in point is the high tech industries of these countries. The regression analysis indicates that sector specific product innovation turnover leads to increased productivity, with a coefficient between *0.51* for Denmark, *0.42* for Sweden and *0.37* for Finland. This linear relation explains *53%* of the variation in Denmark, *78%* of the variation in Sweden, and *75%* in Finland.

This seems to indicate that in comparing sectors in Norway, there is no positive relation between sector productivity and sector innovations. This macro level finding strengthen an hypothesis of a micro level strategy: *most* Norwegian corporations were *not* involved in a race for new high tech products, but *rather* in a race to *improve productivity, given existing products*. This is consistent with our hypothesis concerning the over-all position of the Norwegian innovation system as compared to other European innovation systems. Norway has a Northern Nordic innovation system – where the main strategy is to reduce costs in production of given products, rather than to create new industries based on new products. The only country which comes out at an even weaker position in terms of product innovation is Iceland, which is another Northern country specialized in raw material extraction[4].

In looking closer at the competitiveness index in different sectors, the balance between on one hand high and medium high tech sectors – and on the other low-tech sectors, may illustrate this difference. This is investigated by Lars Coenen in chapter 3. RCA index values over +0.5 are shown in table 2.2.

The table illustrates the specialization of Norway and Iceland in medium and low-tech industries where process, not new high technology products, is the name of the game. High tech industries, which are characterized through a high level of product innovation which creates new and high value products are strong in Sweden, Denmark, and Finland. Within this comparison, Norway emerges as a country not only specialized in low and medium tech industries, but also with a highly *diversified* low and medium tech industrial sector, with 8 strong low and medium tech manufacturing industries.

Table 2.2. *Strong manufacturing sectors in Nordic countries by high tech – low tech*

	High and medium high tech	Low and medium low tech
Sweden	Machinery Motor vehicles Radio, TV and communication Pharmaceuticals	Pulp and paper Wood products
Finland	Radio, TV and communication	Pulp and paper Wood Ship building
Denmark	Medical instruments Pharmaceuticals Machinery Electrical	Oil and gas Food
Iceland		Food Metals
Norway	Chemicals excluding pharmaceuticals	Oil and gas Fishing Food Pulp and paper Basic metals Ship building Refined petroleum

National profiles

In using national sectors as cases, we may calculate correlations between rates of new product innovation, rate of changed products, and innovation costs. The result is illustrated in the correlation matrix below.

Denmark has a negative correlation of *–.305* between new products and innovation costs. This illustrates what has been said above of the strength of the Danish innovation system, which is specialized on low cost innovations of new design based products. At the same time, Denmark has a slightly positive correlation between costs and improved products (*+0.179*). There is also a positive correlation between new and changed products, implying that these activities basically go on in the same sectors (*+0.813*). There is in other words no differentiation in Denmark between new product innovating sectors and product improving sectors.

The pattern in *Finland* is the opposite. Here, we find a clearly negative correlation between new and changed products (*–0.446*), implying that product innovations and product improvements go on in different sectors. Similarly, there is a strong positive correlation between new products and costs *(+0.942)*, which reflects the science driven character of the Finnish innovation system, as well as a negative correlation between costs and changed products *(–0.286)*, reflecting that the big money is going to the product innovative sectors, leaving the product improving industries behind.

The general direction of correlations in *Iceland, Norway and Sweden* are similar. For quite obvious reasons, the strengths vary. The general direction indicates that everything is correlated. New product innovations and changed product innovations are positively related, with *+0.649* in

[4]Due to the lack of Icelandic employment statistics, we cannot compute productivity for Iceland.

Sweden, *+0.842* in Norway and *+0.659* in Iceland. Both new and changed products are positively correlated with costs, and the correlation coefficients are fairly strong (table 2.3).

Table 2.3. *Nordic manufacturing sectors, Pearson correlations between new product rate, improved product rate and innovation costs by Nordic countries*

			new	changed	costs
DK	new	Pearson Correlation	1	.813*	–.305*
		Sig. (2-tailed)		.000	.000
		N	91 819	91 819	91 819
	changed	Pearson Correlation	.813*	1	.179*
		Sig. (2-tailed)	.000		.000
		N	91 819	91 819	91 819
	costs	Pearson Correlation	–.305*	.179*	1
		Sig. (2-tailed)	.000	.000	
		N	91 819	91 819	91 819
FI	new	Pearson Correlation	1	–.446*	.942*
		Sig. (2-tailed)		.000	.000
		N	137 454	137 454	137 454
	changed	Pearson Correlation	–.446*	1	–.286*
		Sig. (2-tailed)	.000		.000
		N	137 454	137 454	137 454
	costs	Pearson Correlation	.942*	–.286*	1
		Sig. (2-tailed)	.000	.000	
		N	137 454	137 454	137 454
ICE	new	Pearson Correlation	1	.659*	.819*
		Sig. (2-tailed)		.000	.000
		N	3 214	3 214	3 214
	changed	Pearson Correlation	.659*	1	.926*
		Sig. (2-tailed)	.000		.000
		N	3 214	3 214	3 214
	costs	Pearson Correlation	.819*	.926*	1
		Sig. (2-tailed)	.000	.000	
		N	3 214	3 214	3 214
NO	new	Pearson Correlation	1	.842*	.898*
		Sig. (2-tailed)		.000	.000
		N	78 480	78 480	78 480
	changed	Pearson Correlation	.842*	1	.934*
		Sig. (2-tailed)	.000		.000
		N	78 480	78 480	78 480
	costs	Pearson Correlation	.898*	.934*	1
		Sig. (2-tailed)	.000	.000	
		N	78 480	78 480	78 480
SW	new	Pearson Correlation	1	.649*	.728*
		Sig. (2-tailed)		.000	.000
		N	209 479	209 479	209 479
	changed	Pearson Correlation	.649*	1	.974*
		Sig. (2-tailed)	.000		.000
		N	209 479	209 479	209 479
	costs	Pearson Correlation	.728*	.974*	1
		Sig. (2-tailed)	.000	.000	
		N	209 479	209 479	209 479

*Correlation is significant at the 0.01 level (2-tailed).

Regions: north–south dimension inside the countries

The north–south distinction *between* countries may also be observed *within* the countries, *between* regions. Our approach to regional indicators is based on regional manufacturing structures, as presented in chapter 4, and the national CIS rates of innovation within the sectors. These figures makes it possible to calculate *estimated* regional rates of innovation, given the assumption that sectors in regions displays innovation rates which are the same as the national average. This assumption is not realistic for all sectors. An analysis of the Norwegian CIS statistic indicates that there are impacts of regional agglomeration effects – leading to higher than national rates of innovation in certain regions and sectors. This is especially the case when it comes to services, which is excluded from this study.

The estimates presented in this chapter may not be seen as some kind of measurement of actual regional rates of innovation, but rather as regional innovative potentials, given the assumptions. If there are regional effects influencing rates of innovation, say, from regional innovation systems, one might expect that the variation between core regions and more peripheral regions are higher than presented here. Instead of measuring actual micro level innovative action, the estimates presented here are macro – level.

However, as macro level patterns, a differentiation between regions may be seen as indicative of regionally embedded conditions, which favors certain forms of innovation. When, as we will show, there are north–south differences in terms on rates of product innovation within Sweden, Norway and Finland, this indicates that product innovators enjoys more favorable conditions in the south than in the north. These conditions, again, may explain some of the structural differences, as superior micro level conditions for a specific innovative trajectory also leads to the structural industrial division of labor we document in this section.

What we expect to find is a north–south dimension, leading to a concentration of industries with a high level of product innovation in the south – and a concentration of industries with a high level of process innovation – hence a low level of product innovation – in the north. It is reasonable to assume that the *Northern* regions will include the entire Norway, Iceland, the Northern part of Sweden and the northern part of Finland. Within these areas, we expect to find a concentration of forms of knowledge,

Figure 2.8. *Nordic NUT2 regions by rate of innovation (new and changed products) and rate of private R&D (BERD/industrial GDP)*

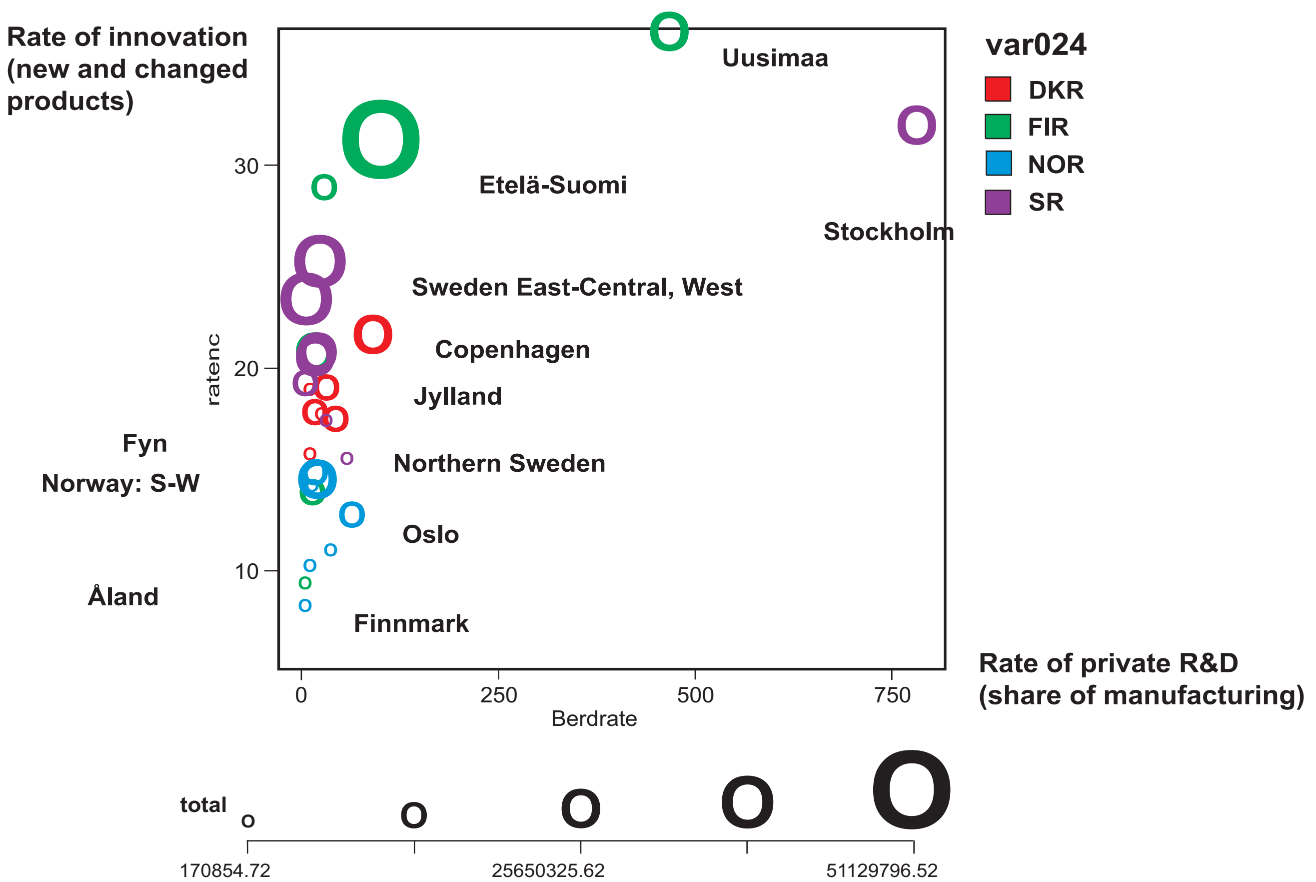


Table 2.4. Nordic NUT2 regions by rate of innovation (new and changed products) and rate of private R&D (BERD/ industrial GDP)

Country	Region	Innovation rate (broad CIS)	Private R&D rate
Norway	Oslo (larger region)	12.13	756
	Vestviken	14.27	257
	Sørvest	13.95	101
	Nordvest	13.61	272
	Trøndelag	10.72	202
	Nordland/ Troms	9.96	53
	Finnmark	7.94	2
Denmark	København (larger)	20.73	1 828
	Øst for Storebelt	18.68	87
	Fyn	15.43	64
	SydJylland	17.21	244
	VestJylland	18.45	239
	ØstJylland	16.93	281
	NordJylland	17.43	192
Iceland	Island	6.34	NA
Finland	Etelä Suomi	29.51	390
	Helsinki (Uusimaa)	35.76	749
	Länsi Suomi	19.94	89
	Itä Suomi	13.33	89
	Keski Suomi	16.98	NA
	Pohjois Suomi	28.34	534
	Åland	9.03	8
Sweden	Stockholm	31.13	1 256
	Ôstra Mellansverige	24.12	498
	Småland	19.90	156
	Sydsverige	18.63	608
	Vestsverige	17.12	911
	Norra Mellansverige	15.27	213
	Mellersta Norrlad	19.66	176
	Ôvre Norrland	22.20	205

which are optimal in terms of enhancing process industry efficiency. Here, increased competitiveness through process innovations is achieved through *employment reductions*.

On the other hand, there is the *southern Nordic regions* specialization in product innovations, which includes Denmark, southern Sweden and Southern Finland. Here, proximity to the core European markets has lead to an embedding of forms of knowledge, which is *enhancing consumer market product innovations*. This is an innovation trajectory, which *creates new jobs*.

The industrial structures of the regions are presented by Morten Fraas in chapter 4. Figure 2.8 shows *regions* at the NUTS 2 level in the Nordic countries.

In looking at the regional differences when it comes to product innovation potential, it may be a good idea to regard the scope of variation, or the difference between the highest and the lowest values.

North East: Finland

The regional differences in Finland are extreme, with *26.7* percentage points in difference between the highest (The larger Helsinki region) and the lowest value.[5]

The factor driving this internal differentiation inside Finland is the high performance of Southern Finland (Etelä Suomi) and the larger Helsinki region (Uusimaa). If we exclude Åland, we are left with Eastern Finland at the lower end, with a difference to Helsinki of *19.61* points.

Northern Finland Pohois Suomi, is at a surprisingly high level, almost similar to Southern Finland. The explanation to this is the Oulo success story, of a city with an unusually successful triple helix alliance between ICT industry, the local university, and the local municipality. Moreover this model of regional development is currently

[5]Åland comes, not surprisingly, on a level, which is quite similar to certain regions in Norway, as well as Iceland. The economy of Åland is widely known as being highly innovative in the service industries, but the island has a weakly developed manufacturing industry, which is discussed here.

Otaniemi (Helsinki)

was the first innovation cluster in Finland, housing both a wide variety of businesses and research facilities (including the Technical Research Centre (VTT), and the Helsinki University of Technology). Though the 'innovation network' has expanded geographically (for instance through the university campus's new locations such as Viikki, Meilahti or Arabianranta), Otaniemi is undoubtedly still the most central location in Helsinki region's innovation network. Technology Park is also institutionally an important core location, as it houses both Innopoli (the meeting-point and business generator for institutions of higher education and research in the Helsinki metropolitan area, incl. Spinno, providing support services including venture capital investments for businesses) and Culminatum (Helsinki Region Centre of Expertise).

Jyväskylä

is one of the most interesting cases in terms of innovation based regional policies in Finland. The fields of expertise in Jyväskylä region Centre of Expertise are a) information technology (especially linking to so called wellness technology), b) control of paper production and c) energy and environmental technology. Jyväskylä is one of the few regions, that have successfully gone through structural change from a traditional industry based region into an information economy based region. However, Jyväskylä's focus is not only on the R&D of ICT-technology, but also in so called 'wellness technology', which refers to business activity and technology related to the maintenance of health, medical treatment and rehabilitation as well as independently managing of one's life. Private business activity in the sector of social and health care has started to develop quickly during the last few years. The research and education of health, both mental and physical, is strong in this region. However, the traditional paper cluster is not forgotten, but also linked to other field of expertise (ICT and energy and environmental technology). Another notable feature of Jyväskylä region is the successful regional co-operation, which has reflected positively to the overall strategy.

the backbone of the Finnish Centre of Expertise program (see box). The centre of expertise program seeks to generalize the regional level successes of commercializing science-based knowledge in city regions all over Finland. So far, one outcome of this attempt is the favorable position of Northern Finland. This analysis indicates that central Finland (Etelä Suomi and Uusimaa) no longer is located in the north–east. Instead, it is moving south and west, with a high level of science-driven new product innovation in electronics, forcefully combined with several medium tech, but weaker, manufacturing sectors with a high level of product innovations. This development in a south–western direction has, as wee see, left the rest of Finland lagging behind, seen in a national perspective.

Norway: Lean processing of raw materials

Norway and Iceland are specializing in low tech processing industries. Here, the basic competitive challenges are to enhance efficiency, with a given product. The Norwegian low-tech industries are – as we have seen in the previous section – highly diversified, with 7 relatively strong manufacturing sectors. Not surprisingly, given this point of departure, the level of product innovation is very low. Firms are not investing very much in R&D. The Icelandic high GERD figure is due to a few firms, mostly in the metal sector. Private R&D in Norway is concentrated to two cities, Trondheim and Oslo.

An important factor in the national innovation system is the KIBS sector in Oslo, which drives the learning processes in the Norwegian corporate sector. Through the well-developed KIBS sector, Norwegian corporations share the core knowledge of the Norwegian innovation system, and the key to their success, how to become more efficient.

The Norwegian business system definitely has 'western' properties. However, whereas Finnish corporations copies the high tech US firms, Norway copies low tech US organizational solutions. Norway is moving to the west by copying neo-fordist US manufacturing models well adapted to the 'low-tech' manufacturing sector. The micro level implications of this are that Norwegian corporations are specialized in 'lean' and highly efficient processing, resulting in high productivity. The knowledge base of the firms is highly specialized – in the direction of process control and coordination. Everything else may be put out to subcontractors in the KIBS sector. This orientation of the Norwegian corporate sector explains the absence of high tech manufacturing industries. Instead, Norwegian high tech is service oriented. The rate of innovation in ICT *services* – a part of the dynamic KIBS sector in Oslo, is high.

At the same time, paradoxically, Oslo has a relatively

KIBS in Oslo

The 'knowledge intensive business service' (KIBS) sector makes a special contribution to competitiveness and innovation in other industries. KIBS are in particular seen as bridging institutions in innovation systems as producers of intermediate inputs, i.e. bridging the knowledge infrastructure of universities, R&D-institutes etc. and firms. Co-location of business service firms and other firms may stimulate knowledge flows and collaboration between KIBS and other industrial sectors. Business service is clearly overrepresented in the Oslo area (Oslo and Akershus county). Areas like Oslo that are overrepresented by business service may have better prospects for industrial development than areas that are underrepresented, although firms may of course co-operate with more distant firms and organizations. The more informal knowledge flow is, however, stimulated by geographical proximity. The case examines the role of KIBS for innovative activity in particular in the 'new economy' sectors in the Oslo area, as well as the potential role of business service in the Oslo area as a node in the national innovation system. In addition, the study also looks into the financial system for promoting the establishment and growth of SMEs. In spite of a widespread recognition of the financial system as a very important element in an innovation system, the study of the system of finance is often neglected in innovation studies.

Horten

The electronics industry in Horten comprises about 1 900 jobs and 25 firms, thus constituting one of the largest electronics clusters in Norway. Five of the firms have more than 100 employees. Business relations in Horten are historically integrated in national, and increasingly in international, rather than local economic structures. System houses and OEM-suppliers mainly collaborate with national and international partners when innovating. Nevertheless, the local level has revealed increasing significance for some parts of the innovation activity in the electronics industry in Horten since the 1980s. Thus, the subcontractors ever more use the regional innovation system. Policy efforts to strengthen the regional innovation system have been introduced.

The Rogaland food RIS

is one of the most complete RIS in Norway. The case analyses how a 'mature' agglomeration, over the last decades gradually has changed to a more dynamic agglomeration stimulated by a FRIS with many new institutions and innovation networks stimulating new growth of SMEs and enhanced competitiveness of firms. The historical conditions for the development of FRIS seem partly to be the scale and scope of the food cluster (producers and subcontractors based on many different raw materials as agro, aqua and fish), supporting industries and institutions, and partly socio-cultural traditions for cooperation inside and between the food sector and other sectors. Contingent conditions which have activated FRIS-strategies are connected to a combination of deregulation and liberalization of food production and trade, local industrial crises and the oil industry as a demanding food market. It is only during the last 10–15 years that the FRIS has been developed in a systematic manner, primarily by proactive horizontal strategies for innovation between local and regional actors in the private and public sectors. In the last years the FRIS has also to an increasing extent been integrated in global innovation networks, both by international R&D-networks but also by investments in the cluster by transnational firms. As such it seems that the food cluster is going to be stronger integrated in a multilevel innovation system, but where the regional and the global systems seems to strengthen their role. In light of the challenges facing the food cluster in Rogaland, an innovation policy needs to be tailored to avert system failures and overcome hurdles to innovation in areas such as capital requirement in the pre and post phases of development work, need for expertise, distribution and market hurdles, interaction between firms and knowledge organisations, information and competence sharing and confidence building, and the need of innovation service.

low rate of innovation, as compared to the core national industrial regions, which are – broadly speaking – Vestviken, Nordvest and Sørvest. This reflects the differentiation in the Norwegian innovation system, between on one hand a concentration of large-scale corporations located to Oslo. These large- scale corporations have a low level of product innovation. They are supplemented by the highly innovative small scale KIBS sector. Even so, the net balance gives a low regional rate of product innovation in the capital city. The scope of variation between the core regions, which also includes Trøndelag and Oslo, is small, with Vestviken on the highest level (14.27) and Trøndelag at the bottom, with 10.72. The difference between Vestviken and Finnmark is just *6.33* points. This is substantially lower than the regional differences inside Finland, which is *26.7*.

This low variation between Norwegian regions is explained by the low level of the core Norwegian regions in the south. This indicates that there is a weak dynamic in the core industrial regions in the south in the direction of triple helix science driven regional alliances – or an emphasis on craft based product innovations. In applying a 'Nordic best case' analysis on Norwegian regions, using Finnish and Danish sector innovation indicators, shows that the Norwegian regions with the largest *potential for improvement* are the core regions in the south, Vestviken – Nordvest – Sørvest.

The three case studies presented illustrate advanced cases within the core industrial regions of Norway of innovative regional networks.

Denmark: The southern industrial district

Denmark enjoys a high level of product innovations, and has an extremely efficient innovation system, with low costs. This is the case for all manufacturing industries, except metals.

This is also reflected in a fairly low level of variation between Danish regions. The larger Copenhagen region is at the top (20.73) and the small and – in a Danish context – isolated island of Fyn is at the bottom. But the difference

The Salling cluster

comprises 7 Danish municipalities. Throughout the latest 15 years, outputs of and occupation within furniture production in the Salling district have grown considerably (especially in connection to the penetration of Danish furniture exports into new markets, e.g. Germany). The reason is that its economic and institutional structures are well-matched, with patterns of social trust and communication lowering co-ordination costs and allowing for flexible inter-firm relations. Salling has demonstrated a remarkable ability to change its economic as well as institutional structures according to external market conditions, in a process of localized learning.

Salling firms have explored new markets, branded products, and developed new designs. This has not only meant growth of some existing producers, it has also encompassed numerous startups of new small firms. Today, in spite of some firms that have grown to a considerable size, the average size of Salling furniture firms is still small. The small size of most firms seems not to hinder their economic development, which is to a large degree independent of the larger firms. Recent downturns in international furniture markets have lead to some decline of the district, and local firms now struggle to reorient themselves to new markets, preserving the decentralised cluster structure. Many firms now engage in strategic alliances in order to compete with integrated competitors abroad.

Wireless communication in Aalborg, Denmark

In the region of North Jutland a cluster of firms specialised in wireless telecommunications has emerged in the most recent 25–30 years closely connected to the buildup of Aalborg University from 1974, as well as the Aalborg Science Park, NOVI, from 1989. The cluster consists of around 40 firms with an employment of 4 000 persons and has since 1997 been organised in the cluster association NorCOM (www.norcom.dk). The NorCOM cluster forms the core of the broader ICT sector of North Jutland with 800–900 employees.

The success of the NorCOM cluster, in terms of co-operation between the private sector, Aalborg University and the science park, NOVI, has been a central background behind a government decision in 1999 to launch a major project on Digital North Jutland (DDN) during 2000–2004. The county council of North Jutland has been appointed as the major responsible actor for the DDN project, which basically is set up to facilitate the further diffusion of IT in the region and to create a broader competence in the IT service and software development industries.

Another part of DDN concentrates on the IT-infrastructure of the region.

is just *5.3* points. The differences within the core industrial regions outside Copenhagen (Øst for Storebelt, Jylland) are small. The characterization as 'industrial district' covers Denmark as a whole. The two Danish case-studies included in boxes: Salling and Aalborg, illustrates state of the art in the core industrial regions.

Sweden

The Swedish problems of developing design-driven consumer market products are well known. Sweden has a highly diversified industrial base, which includes both several mature industries, as well as several science-driven high tech sectors.

The success story of Kista, Stockholm

The success story of the Kista cluster evolved from one large telephone and computer company, Ericsson, enjoying extremely favourable national and regional conditions. The Nordic countries host the most advanced users of mobile telephony and the Internet. Stockholm is considered the leading market in wireless access to the Internet. Sweden hosts several regional IT-clusters, with Stockholm-Kista being the largest one. The Kista IT cluster is a part of the new NUTEK strategy of cluster development in Sweden. It also gets attention at the regional level, as Stockholm is trying to become a more competitive city in Northern Europe.

The ICT university and the industry has a highly advanced form of co-operation through the 'Kista Integral', as well as the test-bed for new wireless applications, in the Campus Network, to be developed into a city – wide open access wireless broad-band (Stockholm Open) to be used in University research on new wireless applications.

The case study discusses that after the ICT boom-bust, large-scale corporations are no longer able to organise the highly skilled local workforce, and bind them to the corporate mast. As a result, more knowledge is now increasingly territorially embedded, and available as a basis of new firm creation, based on innovations. The study suggests that the entrepreneurial firms which emerge under these circumstances start off as small temporary organisations, most of them with short life spans – to be deleted after the test of the basic idea – but some with a genuine expectancy and potential to grow through industrial up-scaling and global market interpenetration. They typically are initiated as project teams, composed of partners with different, and complimentary skills, who share the same idea, framed within the core set of different knowledge and expertise partners are able to bring along. The study shows that the institutional embedding of these fragile project groups is in the case of Kista organized within the framework of a formalized innovation system, called KIG (Kista Innovation and Growth).

Gothenburg

The Gothenburg region is characterised by a heavy specialisation in traditional industries, e.g machinery and automotive production. This specialisation may present a growth problem if renewal does not take place. However, there are signs that the economy of the region is being developed also towards other fields, especially IT, which provide opportunities and challenges for SMEs. These processes of regional renewal and transformation are studied in two ways. Knowledge production in the Gothenburg region often draws on the traditional regional industries. While Sweden in the traditional fields of biotechnology and bio-science seems to be rapidly developing in Stockholm/Uppsala and Malmö/Lund, the Gothenburg region seems to be falling behind. The reason is that the region lacks a 'critical mass' of activities in the traditional knowledge base of biotechnology. However, new fields seem to emerge which draws on a number of formerly unrelated knowledge fields, which in turn may assist in transforming the traditional regional industry structure. This process of regional renewal and the creation of a new regional innovation system may be particularly true in the bio-sciences.

Technology-based SMEs in the Gothenburg region are usually born in the form of spin-offs from large firms and universities. Spin-offs from large firms often demonstrate substantial growth, while spin-offs from universities in general stay small. Instead of exploiting innovative ideas to expand their own operations, university spin-offs are often found to sell these ideas to larger firms. Large firms' acquisition of innovative ideas, i.e. often from university spin-offs, may also form a basis from which additional corporate spin-offs may be formed. Thus, both kinds of spin-offs have important but different roles to play in the regional innovation system.

East Gothia

The region of East Gothia is located in the south–eastern part of Sweden. The region has a somewhat higher proportion of employees within manufacturing and mining than does Sweden as a whole. It also has a higher percentage of employment in the sector producing Research and Development (R&D) intensive products. This is particularly true for the city of Linköping, where we find the region's university and the Mjärdevi Science Park. Electronics and computer science activities dominate both of them.

The case study sets out to examine and describe the innovation system of East Gothia. It focuses on the industrial and organisational structure, including the knowledge infrastructure, of the regional innovation system, together with the processes and practices that have shaped its nature and its dynamics. Drawing on a variety of both primary and secondary sources, the case maps the core elements and actors that have contributed to the recent development of the region, examining the relations among firm strategy and performance, trajectories of innovation, the availability and use of technological resources, and patterns of relationships among actors.

The results reveal that the East Gothia innovation system is more well- developed in some places than in others. The region also has parts of its industrial structure and knowledge infrastructure that are more closely integrated into national or even international systems. This is especially the case with regard to manufacturing linkages in innovation processes involving partners from outside the region, but also with respect to large firms, which are more integrated within their own productive systems. The main challenge for East Gothia is to develop structures and policies that can combine and co-ordinate disparate elements and actors within a coherent regional system of innovation.

Scania

The province of Scania, located by the Øresund in the most southern part of Sweden, is by tradition an important centre for agricultural production. The strong agricultural sector in the region, implying strong historical links and occurrence of path-dependency tendencies, is likely to be one of the reasons why several of the largest and most successful food processing industries in Sweden are located in Scania.

The total growth within the food cluster in Scania, however, is quite low, even though parts of the Scanian food cluster are expected to show a substantial growth rate during the coming years. Some of the activities in the cluster are mainly based on 'low-tech' labor intensive production. In the light of severe future competition on agricultural bulk products, partly due to the entrance of new members in the EU, it is regarded as crucial by many actors within the cluster to increase the value added in the food production. Functional food is frequently regarded as an area of high future growth. A handful of SMEs in this emerging field are located in and around Lund, where the largest university in the Nordic countries is located. The study begins with analysis of three knowledge-intensive companies in the functional food area, and then works outwards to other actors and factors that are important in the region, on the national level and internationally. The companies work together with traditional food companies on regional, national, and international scales, as well as with research groups and organisations on all these scales. Still, three companies in the new field of functional foods are located in the Lund region. Regional characteristics with close proximity to major food companies and Lund University (with many researchers in fields such as food technology, medicine, nutrition and a tradition of firm-university co-operation in the food biotechnology field), makes it not so surprising to find these functional foods SMEs there. The case study shows that location matter, but perhaps relationships to researchers at Lund University are more important than the firm-interactions.

Summary discussion

The study shows that there are nationally different profiles across several sectors in different countries, which broadly correspond to the east – west distinction presented in chapter 1. Denmark and Norway in this respect presents two different forms of 'western' orientation, with Norway as a neo-fordist processor emphasizing efficiency through process innovations – and Denmark as a craft based industrial district – deeply integrated in the innovation system of the European core, and focusing on product innovations. Similarly, Southern Finland represents a third form of 'western' strategy, but then again based on a high tech trajectory embedded in Finnish 'eastern' roots, in large corporations integrating R&D and industrial manufacturing. Sweden is characterized through an 'eastern' pattern, with firms and regions with a high ability to solve complex problems of mature product improvements, with southern Sweden and Stockholm as the most advanced regions.

At the same time, inside Sweden, Finland, and Norway, there are clear south – north distinctions between regions within the countries.

Dimensions like east – west and north – south should be regarded as 'master variables' defining certain long term and large space contexts. These generalizing master variables must be seen as contexts within which more specific trajectories based on specific national configurations of factors are blending into diverse and highly specific paths of development.

3. Comparative analysis by sectors

In our analysis of the industrial specialisation patterns of Denmark, Finland, Iceland, Norway and Sweden we draw on previous national cluster studies which have been analysing the competitive advantage of different countries. The cluster approach builds consistently on the theoretical framework and methodology first developed by Michael Porter (1990), allowing for cross-national comparisons. An important indicator to identify competitive national industries in a globalising economy is the 'Revealed Comparative Advantage' (RCA) index (Balassa, 1965; Dalum, 1992). National industry specialisation profiles can be drafted based on the composition of international trade flows under the assumption that the relative export structure is a relevant proxy for domestic production structures. This assumption is specifically valid in our context because export markets are indeed very important for the typically open economies of the Nordic countries. Moreover, such specialisation indices tend to change little over time, which can be seen as a reflection of the importance of path-dependency. As an indicator for the RCA index we make use of the 'contribution to the trade balance' indicator presented in the OECD (2003) Science, Technology and Industry scoreboard[I]. It takes into account not only exports, but also imports and aims to rule out business cycle variations by comparing an industry's trade balance with the overall trade balance.

Table 3.1 (next page) confirms that the Nordic countries hold distinct industrial profiles. A positive RCA index suggests that an industry has developed specialised competences. This means that the Nordic countries have the following industrial specialisation profiles (between brackets the RCA index for 2001):

Denmark

- Food products, beverages and tobacco (5.9)
- Pharmaceuticals (2.4)
- Machinery and equipment n.e.c. (1.4)
- Electrical machinery and apparatus n.e.c. (0.8)
- Manufacturing, n.e.c. and recycling (0.9)
- Medical, precision and optical instruments (0.9)
- Agriculture, hunting and forestry (0.3)
- Mining and quarrying of energy producing materials (1.9)

Finland

- Pulp, paper, paper products, printing and publishing (8.9)
- Radio, television and communication equipment (2.6)
- Wood and products of wood and cork (2.0)
- Building and repairing of ships and boats (1.4)
- Basic metals (0.3)

Iceland

- Food products, beverages and tobacco (27.3)
- Basic metals (8.5)

Norway

- Mining and quarrying of energy producing materials (68.9)
- Coke, refined petroleum products and nuclear fuel (4.0)
- Basic metals (4.0)
- Food products, beverages and tobacco (3.1)
- Chemicals excluding pharmaceuticals (2.6)
- Fishing (1.6)
- Building and repairing of ships and boats (1.4)
- Pulp, paper, paper products, printing and publishing (1.3)

Sweden

- Pulp, paper, paper products, printing and publishing (4.5)
- Pharmaceuticals (1.6)
- Wood and products of wood and cork (1.2)
- Machinery and equipment, n.e.c. (0.9)
- Radio, television and communication equipment (0.8)
- Motor vehicles, trailers and semi-trailers (0.6)
- Basic metals (0.3)
- Building and repairing of ships and boats (0.2)
- Coke, refined petroleum products and nuclear fuel (0.1)

Below, a discussion of the most competitive industrial sectors is given per country. Firstly, two figures show the RCA indicators for all industries as differentiated by the OECD (2003). Information on the size of these sectors is

[I] $(X_i - M_i) - (X - M)\frac{(X_i + M_i)}{(X + M)}$ where $(X_i - M_i)$ = observed industry trade balance and $(X - M)\frac{(X_i + M_i)}{(X + M)}$ = theoretical trade balance. X = export, M = import, i = industry. A positive value for an industry indicates a structural surplus and a negative one a structural deficit. The actual index is expressed in hundreds of manufacturing trade.

Table 3.1. RCA indices for all the Nordic countries (OECD, 2003; STAN database)*

	Denmark		Finland		Iceland		Norway		Sweden	
	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001
Agriculture, hunting and forestry	0.7	0.3	–2.1	–1.4			–1.2	–1.1	–1.6	–1.2
Fishing	0.2	0.0	0.0	–0.1			1.9	1.6	0.0	0.0
Mining and quarrying of energy producing materials	–1.1	1.9	–4.9	–5.1			41.8	68.9	–2.8	–3.7
Food products, beverages and tobacco	7.7	5.9	–1.3	–1.6	36.9	27.3	3.0	3.1	–2.1	–1.8
Textiles, textile products, leather and footwear	–1.4	–1.3	–2.8	–2.0	–3.5	–2.6	–3.8	–2.7	–3.8	–2.0
Wood and products of wood and cork	–0.5	–0.5	2.9	2.0	–1.4	–1.0	0.2	–0.4	1.8	1.2
Pulp, paper, paper products, printing and publishing	–1.5	–1.1	13.2	8.9	–2.7	–1.7	0.9	1.3	5.9	4.5
Coke, refined petroleum products and nuclear fuel	–0.4	–0.5	–0.7	–0.2	–4.1	–4.2	3.5	4.0	–0.4	0.1
Chemicals excluding pharmaceuticals	–2.7	–1.2	–3.1	–2.3	–2.9	–3.0	2.6	2.6	–2.0	–1.9
Pharmaceuticals	1.0	2.4	–1.0	–1.1	–1.1	–0.6	0.0	–0.2	1.0	1.6
Rubber and plastic products	–0.1	–0.1	–0.7	–0.6	–1.9	–1.6	–1.1	–0.9	–0.6	–0.5
Other non-metallic mineral products	0.1	–0.2	–0.3	–0.1	–0.9	–0.9	–0.3	–0.4	–0.5	–0.3
Basic metals, metal products, except machinery and equipment	–2.3	–1.4	1.6	0.3	3.6	8.5	3.4	4.0	0.9	0.3
Machinery and equipment, n.e.c.	1.7	1.4	–1.7	–0.2	–4.0	–2.9	–3.3	–1.9	1.0	0.9
Office, accounting and computing machinery	–1.7	–1.6	–1.3	–2.0	–1.3	–1.8	–1.4	–2.0	–1.7	–2.0
Electrical machinery and apparatus, n.e.c.	–0.4	0.8	–0.6	–0.9	–2.8	–3.1	–1.2	–0.7	–0.8	–0.6
Radio, television and communication equipment	–0.5	–1.0	–0.8	2.6	–1.6	–1.8	–0.8	–0.8	0.4	0.8
Medical, precision and optical instruments	0.6	0.9	–0.7	–0.3	–1.2	–0.8	–0.7	–0.2	–0.2	–0.3
Motor vehicles, trailers and semi-trailers	–1.9	–2.1	–1.7	–2.4	–3.6	–3.0	–2.1	–3.2	2.2	0.6
Building and repairing of ships and boats	0.8	–0.1	0.5	1.4	–3.3	–0.7	3.5	1.4	0.0	0.2
Aircraft and spacecraft	0.0	0.0	–0.4	–0.5	–0.4	–1.8	–0.7	–1.1	–0.3	–0.2
Railroad equipment and transport equipment	–0.9	–0.9	–0.2	–0.2	–0.1	–2.9	–0.2	–1.9	–0.1	–0.1
Manufacturing n.e.c., recycling	1.6	1.4	–0.6	–0.2	–2.0	–2.9	–1	–1.9	–0.6	0.9

*The indices for 'agriculture, hunting and forestry', 'fishing' and 'mining and quarrying of energy producing materials' were calculated manually based on the STAN database. The results for Sweden and Finland are based on year 2000.

presented in a separate subsequent table. Finally, we have calculated product innovation efficiency indicators[2] for various NACE base sectors based on the Community Innovation Survey 3 (Eurostat, 2003). Unfortunately, the sector classification used in the CIS defines industries on a higher level of aggregation. But as the two datasets both use NACE codes, careful comparison can be conducted. These results are presented in the final two tables. Here, a differentiation is made between product innovations new to market and product innovations not new to market. The latter can be interpreted as upgrading processes.

Of course, numbers alone do not provide an entirely nuanced picture. It needs to be noted that a positive RCA index does not necessarily pertain to the existence of a national cluster for two reasons. Firstly, a high RCA index for one industrial classification can be explained by generally low export numbers in other industries. This is clearly the case for Iceland. Secondly, the classification framework designed by the OECD is based on product-groups. As such it mainly identifies horizontal linkages between firms producing similar products. From a cluster perspective, sev-

[2] See introduction for an explanation of this indicator.

eral of the industrial classifications overlap as the boundaries of a cluster potentially cut across a range of interdependent firms in similar and adjacent sectors (Isaksen and Hauge, 2002). By definition a cluster includes suppliers of specialised inputs, components, machinery and services. This can be illustrated by the pulp and paper sector. Here, the supply of wood plays a naturally essential role for the production of paper. The interdependencies between the wood industry and paper and pulp industry make a strong case to regard firm in both industries as part of the same cluster (Sölvell et al., 1991). Traditional industrial classifications can also obscure clusters, which evolve around a particular activity. It is problematic to simply assume clusters solely based on RCA indices for strongly aggregated industrial classifications. Therefore we have related and compared these statistical results with previously conducted 'Porter studies' on national competitive industries/clusters.

Unfortunately no Nordic Porter study has been conducted so far (at least to the knowledge of the authors) taking a comparative perspective truly at heart. Oxford Research (2002) has drafted a Nordic cluster map under commission of the Nordic Council. For this, the study mainly builds on previously conducted cluster analyses conducted within each country's national framework as a secondary source of information. Even though own substantial empirical work based on a coherent theoretical and methodological frame is lacking which makes a cross-Nordic comparison troublesome, it provides a rich source of literature. We follow Brandt's (2001) approach and mainly look at the Porter studies in the early 90s and the national cluster studies conducted through the large international OECD project on national innovation systems (OECD, 1999). Unfortunately this entails that no previous work has been found on Iceland. Below you find a brief overview of the studies that have been surveyed after the tables and figures.

Country based comparative analysis

Denmark

When we compare the competitiveness rates in figures 3.1 and 3.2 versus the innovation rates in figures 3.3 and 3.4, we find some striking results. Highly surprising is the magnificently high rate in innovation efficiency in both the wood and paper sectors, while having negative competitiveness rates. Moreover, it needs to be noted that in the classification of the wood sector, furniture is actually left out. The reliability of the CIS data can be questioned here. More in line with what can be expected we found that electronics as well as chemicals score considerably above the national industry average. In the classification of the chemical industry, pharmaceuticals, one of the most competitive Danish industries, is included. Corresponding with the

Figure 3.1. *RCA Denmark high tech and medium high tech. Source: OECD (2003)*

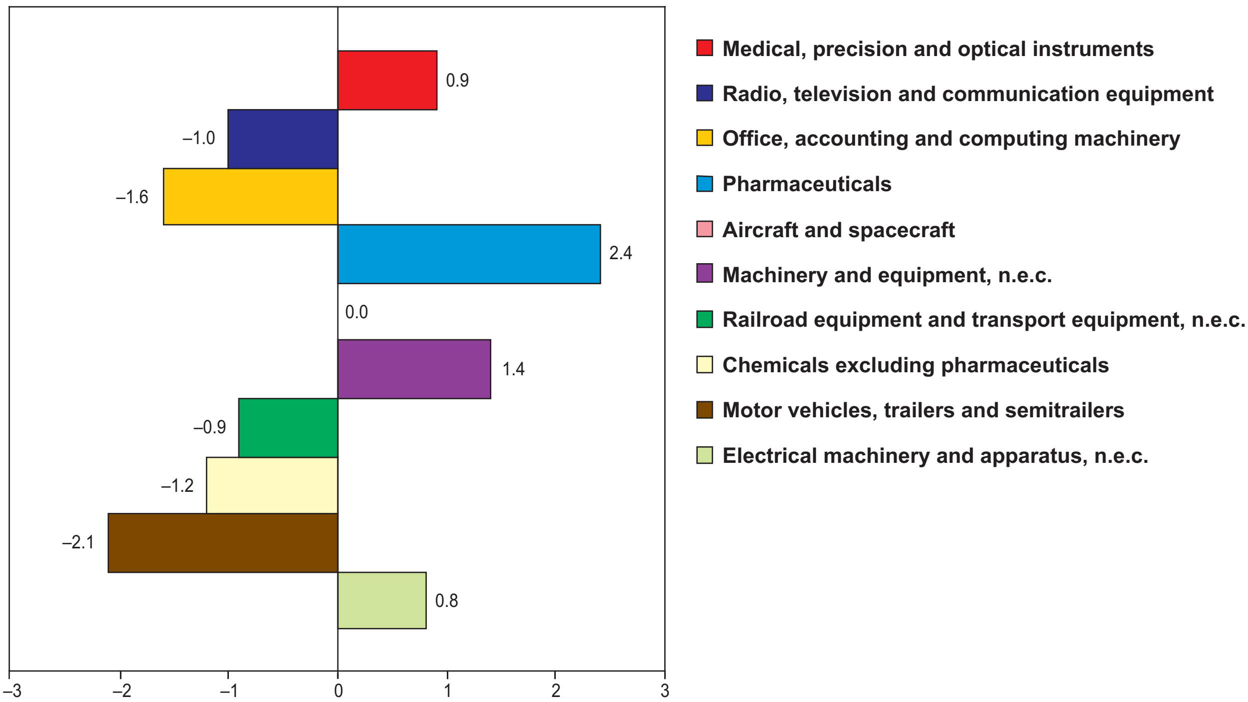


Figure 3.2. RCA Denmark medium low tech and low tech. Source: OECD (2003)

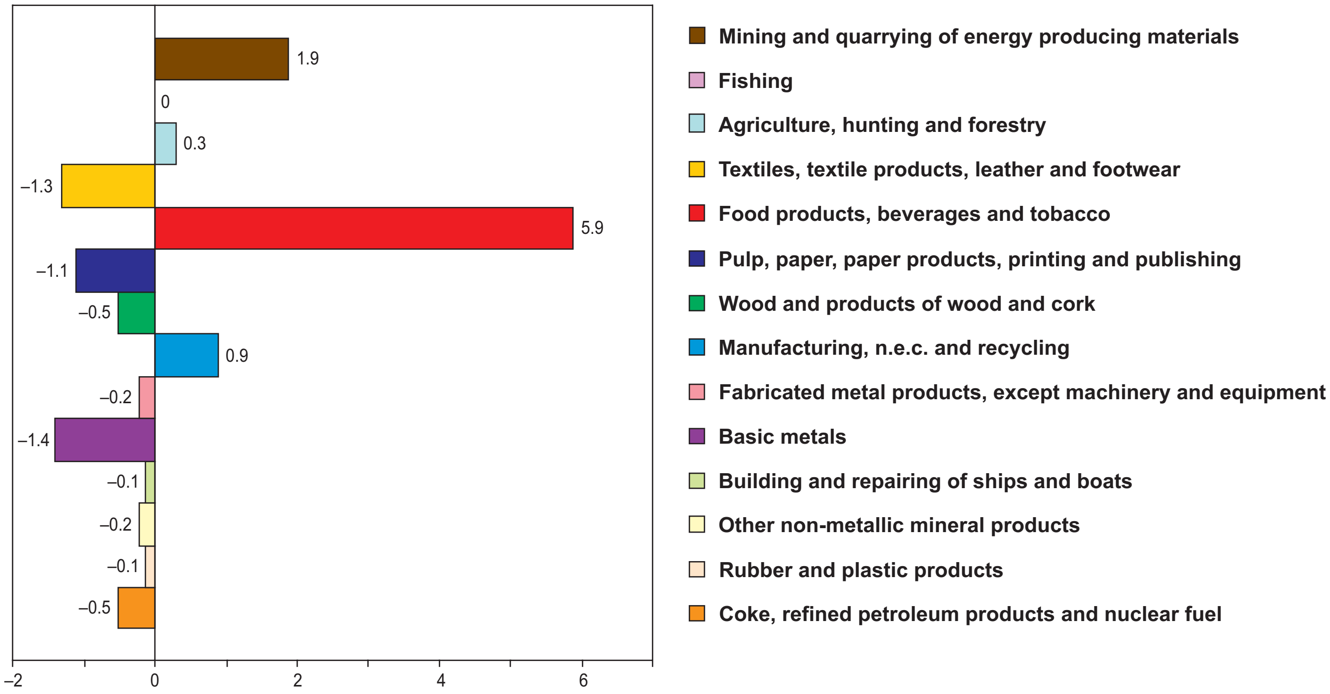


Table 3.2. Competitive Danish industries

	RCA index		Employment (hundreds)		As share of grand total (%)		Gross production value (DKK millions)		As share of grand total (%)	
	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001
Food products, beverages and tobacco	7.7	5.9	880	743	3.7	2.9	116 382	125 900	7.9	5.6
Pharmaceutical	1.0	2.4	91	138	0.4	0.5	11 043	28 415	0.8	1.3
Mining and quarrying of energy producing materials	–1.1	1.9	10	13	0.1	0.1	9 075	31 406	0.6	1.4
Machinery and equipment nec	1.7	1.4	706	692	3.0	2.7	42 391	67 058	2.9	3.0
Medical, precision and optical instruments	0.6	0.9	144	144	0.6	0.6	8 463	15 825	0.6	0.7
Manufacturing and recycling nec	1.6	0.9	317	298	1.3	1.2	20 618	29 170	1.4	1.3
Electrical machinery and apparatus	–0.4	0.8	136	171	0.6	0.7	10 052	26 559	0.7	1.2
Agriculture, hunting and forestry	0.7	0.3	507	402	2.2	1.6	58 313	69 155	4.0	3.1

Source: OECD (2003) (2001)

national profile, electronics and chemicals perform particularly well in product innovations new to the market.

This fits with the characteristics of these industries where product competition is of crucial importance. Moreover the CIS findings confirm the RCA results in the sense that Danish pharmaceuticals are more innovative and competitive than electrical machinery. Finally a comment can be made on the food sector. This large and important sector for the Danish economy seems to be lagging behind with regard to innovative behaviour compared to other

Figure 3.3. Danish market innovation efficiency. Source: Eurostat (2003)

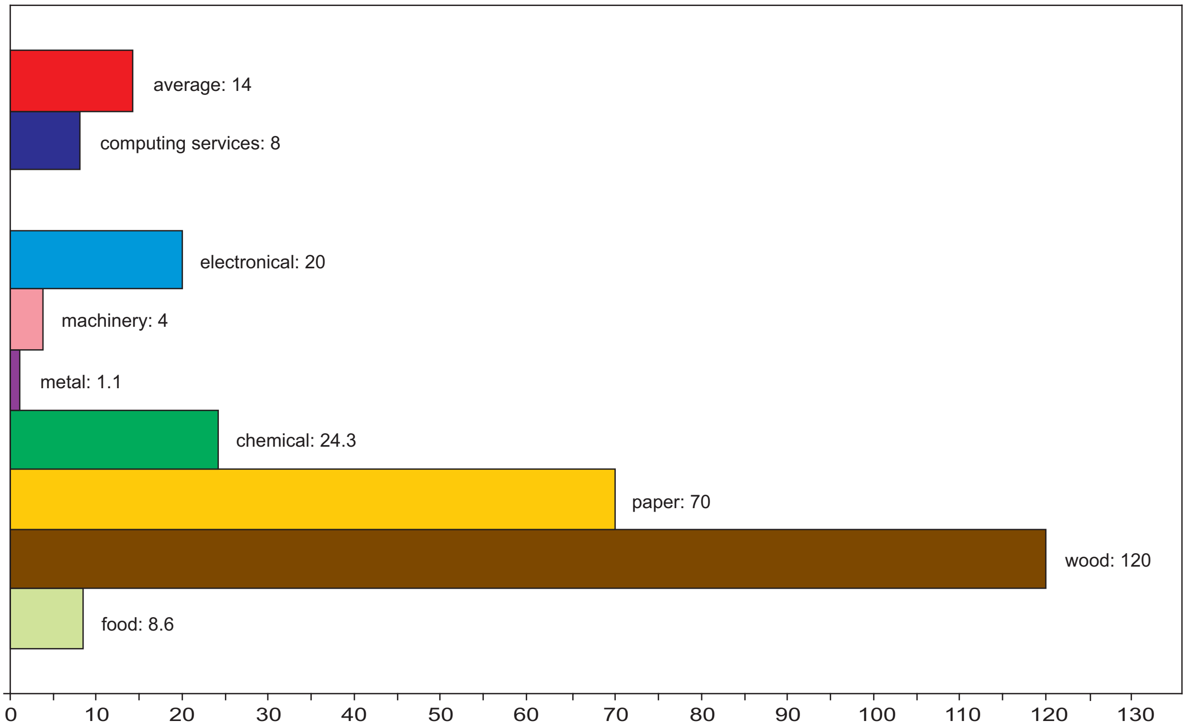
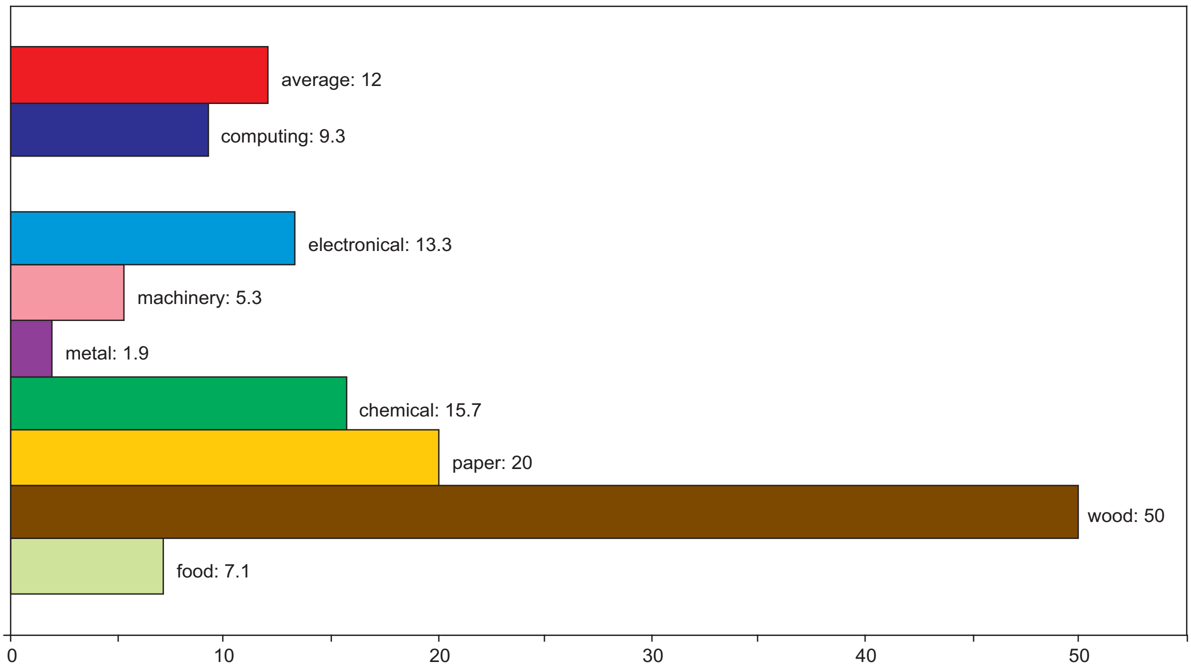


Figure 3.4. Danish upgrade innovation efficiency. Source: Eurostat (2003)



sectors. However, it should be kept in mind that the industry in general is considered to be rather traditional (see also the subsequent cross-country sector based discussion).

In terms of previous national cluster analysis, various contributions have been made. A historical overview can be found in the Danish contribution to the OECD's innovative cluster project (Drejer et al., 1999). Here it is argued that the cluster approach was already implied in the early 1980s studies on complexes of industrial interrelations in the tradition of the Swedish Schumpeterian economist Dahmén (1988). These studies, financed by the Danish Technology Council, primarily dealt with the agro-industrial complex[3]. Also Lundvall and Edquist's (1993)

[3]The other complexes, which are dealt with on a less elaborate level, are: textile, environmental and office machinery.

analysis of the Danish and Swedish national system of innovation concludes that the agro-industrial complex has been key to Denmark's industrial development trajectory, strongly integrated in the rest of the economy. Characteristic for the agro-industrial complex is the important role of user-producer interaction in the development of new technology. Such learning processes typically occur between firms and organisations in different sectors (e.g. machinery and food manufacturing). A too narrow sector-based approach is thus regarded not to catch all the important linkages. Subsequently, a set of micro-based cluster studies was conducted in three sectors in which Denmark is seen to have developed a strong specialisation, electro-medical instruments, furniture and pharmaceuticals. We can see that two of these sectors are found in table 3.3, displaying increasing competitiveness indicators. Unfortunately, furniture is not classified under its own category in the employed NACE classification. However the above studies did not intend to cover the complete industrial structure of Denmark and should not be considered as exhaustive.

A comprehensive overview of all national clusters was first delivered by the Porter studies carried out between 1988 and 1990 (Pade, 1991). A set of fifteen sectors were analysed that were suggested to be internationally competitive: the dairy sector, slaughterhouses, mink producers, the consumer fish industry, agricultural machinery industry, biotech industry, pharmaceutical industry, electro-medico equipment, telecommunications, engineering, the environmental industry, furniture, shipping (sea), cleaning services and the mobile phone industry. On the basis of this, five competitive Danish clusters were identified: the agro-food cluster, the shipping cluster, the technical cluster, the pharmaceutical/biotech and medico cluster, and the mink cluster. Here we partly find a confirmation of our own results. Furthermore, an important illustration is made of the point we made previously that clusters often transcend traditional sector boundaries (pharmaceutical/ biotech and medico cluster). Nonetheless, the shipping cluster, technical cluster and mink cluster remain unaccounted for in the OECD data. These Porter studies also dealt with a set of strengths and weaknesses in the clusters and Danish industry in general. The small size of the companies and small home market was considered as a problem as it was argued that the small firms faced difficulties in reaching export markets. On the other hand, small firms have in comparison to larger firms advantages in terms of flexibility. In fact, this flexibility can be seen as a competitive advantage in especially low-tech industries (such as food and furniture) as it facilitates non-R&D based innovative behaviour. Also the relatively high quality of the workforce, as identified by the Porter studies, should be seen in this light.

More recently, on-going studies on clusters have become quite common among several Danish ministries and agencies, in particular the Danish Agency for Development of Trade and Industry (Erhvervsfremme Styrelsen). Heavily inspired by the Porter studies, an initial study was conducted to identify 'resource areas' mainly based on consultations with participants in the Porter studies. It is however explicitly stated that these resource areas differ from the Porter studies by its focus on end products and a widening of the scope of included industries. In total, eight resource areas were identified (Drejer et al., 1999, p. 305).

- *Food:* similar to the previously mentioned agro-food complex this includes agriculture, fishery, dairy, slaughterhouses, production of agricultural machines, fishing boat yards, dairy factories as well their suppliers of cooling machinery, thermostats, etc. This is the second largest resource area terms of employment and value added (in 1995).
- *Consumer goods and leisure:* this diverse and heterogeneous resource area includes clothing, furniture, electrical equipment, retailing, etc. The strong focus on end products in the identification of the resource areas probably caters for its inclusion. It can however be questioned how manufacturing firms of furniture are related to those producing clothing.
- *Construction/housing:* this is the largest of all the resource areas and includes construction engineering, construction materials, retail of construction materials, cleaning, etc.
- *Communication:* printing, printing material, media and communication equipment, communication services as well as the mobile phone industry are included in this area.
- *Transport and supplying industries:* a wide selection of industries are covered by this resource area as it includes shipyards and other transport equipment and machinery as well as energy equipment producers and suppliers and the environmental sector.
- *Medico/health:* here we find the medico-technical sector and pharmaceuticals. Surprisingly this is the smallest of the resource areas.
- *General supplier businesses:* this should generally be seen as the rest-category where sectors are included that do not fit into any of the previous categories.

As Drejer et al. (1999) also conclude, the categories suggested by the resource areas are very broad in scope and its internal coherence can rightfully be questioned. One of the reasons why this categorization is employed is probably not because of analytical sharpness but rather because of the desire to include the entire Danish economy for the sake of pragmatic policy making. Possibly as a reaction on the broad approach in the resource areas, the subsequent cluster study by the Danish Agency for Development of Trade and Industry (Erhvervsfremme Styrelsen, 2001) is more circumscribed in its identification of 'clusters of competence' (*kompetenceklynger*). Competence is defined as qualified labour force and its tacit knowledge. 'Compe-

Table 3.3. Danish clusters of competence

	National	Regional
Existing	1. 'Det blå Danmark': shipbuilding	1. Mobile and satellite communication in Northern Jutland
	2. Wind-energy	2. Tourism in Copenhagen
	3. Hearing aids	3. Stainless steel in Kolding
	4. Technical aids for disabled	4. Gardening in Funen
	5. Electronics used in energy (effect electronics)	5. Medico/ health in the Öresund region
	6. Seeds	6. Textiles in Herning-Ikast
	7. Fur	7. Offshore industry in Esbjerg
	8. Water management	8. Furniture industry in Salling
	9. Coal/heat technology	9. Transport facilities and services in Eastern Jutland
	10. Pork meat	
	11. Dairy products	
Potential	1. Bio-informatics	1. Media in Copenhagen
	2. Sensor technology	2. Öresund food network
	3. Ecological food	3. PR/communication in Copenhagen
	4. Waste management	4. Pervasive computing in Copenhagen and Århus
	5. Children's toys and education	

Source: Erhvervsfremme Styrelsen (2001)

tence is the unique way to combine, use and develop given resources within the industry's supply of products and services'[4] (Erhvervsfremme Styrelsen, 2001, p. 43). As for the resource areas, the identification of the clusters of competence is mainly based on interviews with key persons in Danish industry. A differentiation is made between national (i.e. not specifically concentrated in a certain region) and regional clusters and between existing and potential clusters.

When we look at the existing clusters we find a considerable match with our findings on the RCA indicators:

- 'Food, beverages and tobacco' and 'agriculture, hunting and forestry' cover 'seeds', 'pork meat', 'dairy products', 'gardening in Funen'.
- 'Pharmaceuticals' covers 'medico/health in the Öresund'.
- 'Energy producing materials' covers 'coal/ heat technology' and 'offshore industry in Esbjerg'.
- 'Machinery and equipment n.e.c.' covers 'wind-energy' and 'water management'.
- 'Medical, precision and optical instruments' covers 'hearing aids' and 'technical aid for disabled'.
- 'Electrical machinery and apparatus' covers 'electronics used in energy' and partly 'mobile and satellite communication in Northern Jutland'.

Thus, this leaves 4 regional clusters and 2 national clusters unaccounted for while the majority seems to overlap with the competitive Danish industries based on the RCA index. Of course, this match should only be regarded as a rough check. The methodologies used for studies are too different to connect these findings in a consistent way. Similar to the resource areas, it remains problematic to conduct systematic comparative analysis between the various clusters of competence given that the approach that has been used can not be regarded as analytically rigorous and conceptually clear (see Drejer et al. (1999) for a critical discussion of the research methods used in cluster and cluster policy analysis). Nonetheless it provides interesting insight in the industrial profile, which Denmark is considered to have.

Finland

In figures 3.7 and 3.8 (page 53), the most surprising result is the very high innovation efficiency for products new to market in the Finnish transportation sector, which includes the competitive shipbuilding sub-sector. Even though shipbuilding is probably in part responsible for the high score, it needs to be noted that the extremely high value can also be ascribed to the reliability of the statistics. The good results in the electronics sector (in products new to market) confirm that particularly Finnish radio, television and communication equipment is a highly innovative and competitive industry successfully launching new products on the market. In table 3.4 (page 53) we can also see that this industry has contributed to a very large extent to the growth in the Finnish economy, both in employment as well as gross production value. A poor result in innovation is found for the important and large paper industry, while the relatively smaller wood sector scores considerably better. This is the case for product innovations in both categories. It is surprising to find such a difference between these related and rather similar sectors of the Finnish economy. Finally, it is worth mentioning the relatively high score of the metal industry for product innovations not new to market which, on the other hand, scores below the national average in product innovation new to market. This is especially surprising given the tendency for the Finnish sectors as a whole to perform better in market innovation than in upgrade innovation.

For Finland, a comprehensive overview of national clusters, in a Porterian tradition, is given by Hernesniemi et al.'s (1996) 'Advantage Finland' coordinated by ETLA (The Research Institute of the Finnish Economy). Also the Finnish contribution to the OECD project builds on this major study (Rouvinen and Ylä-Anttila, 1999). In their

[4] Own translation.

Figure 3.5. RCA Finland high tech and medium high tech. Source: OECD (2003)

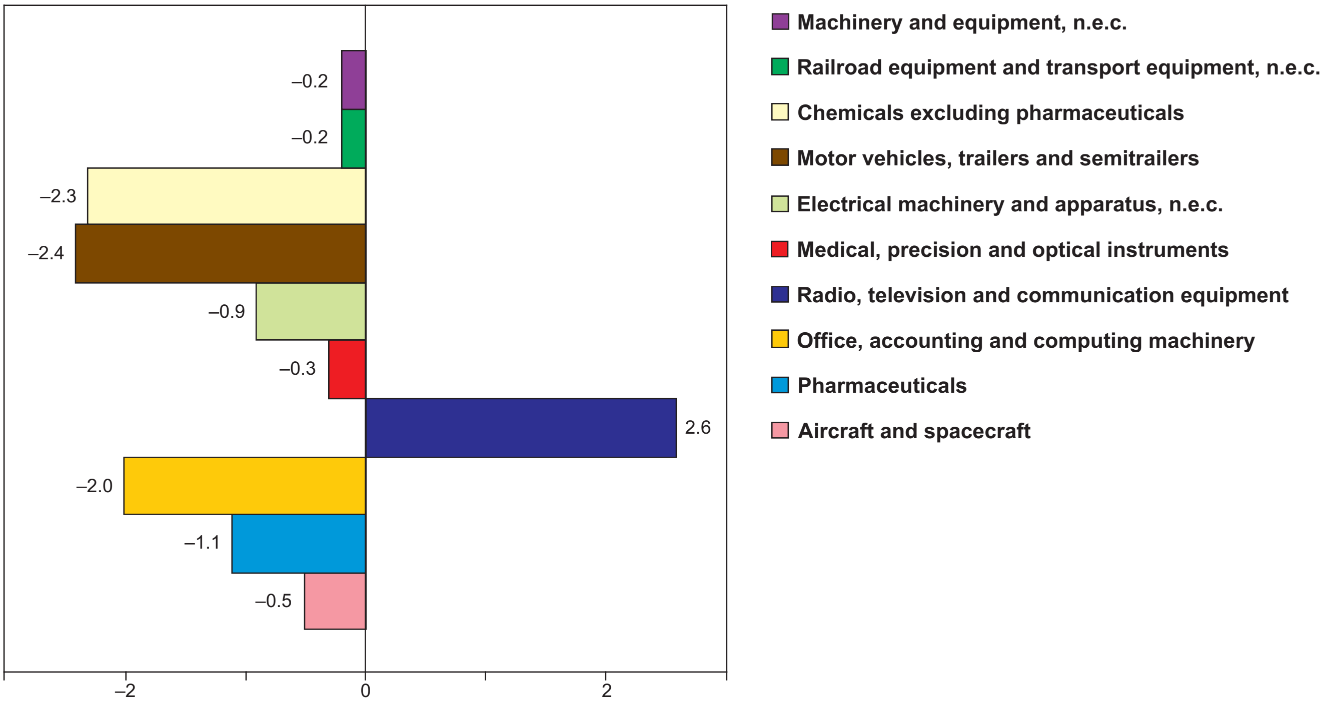
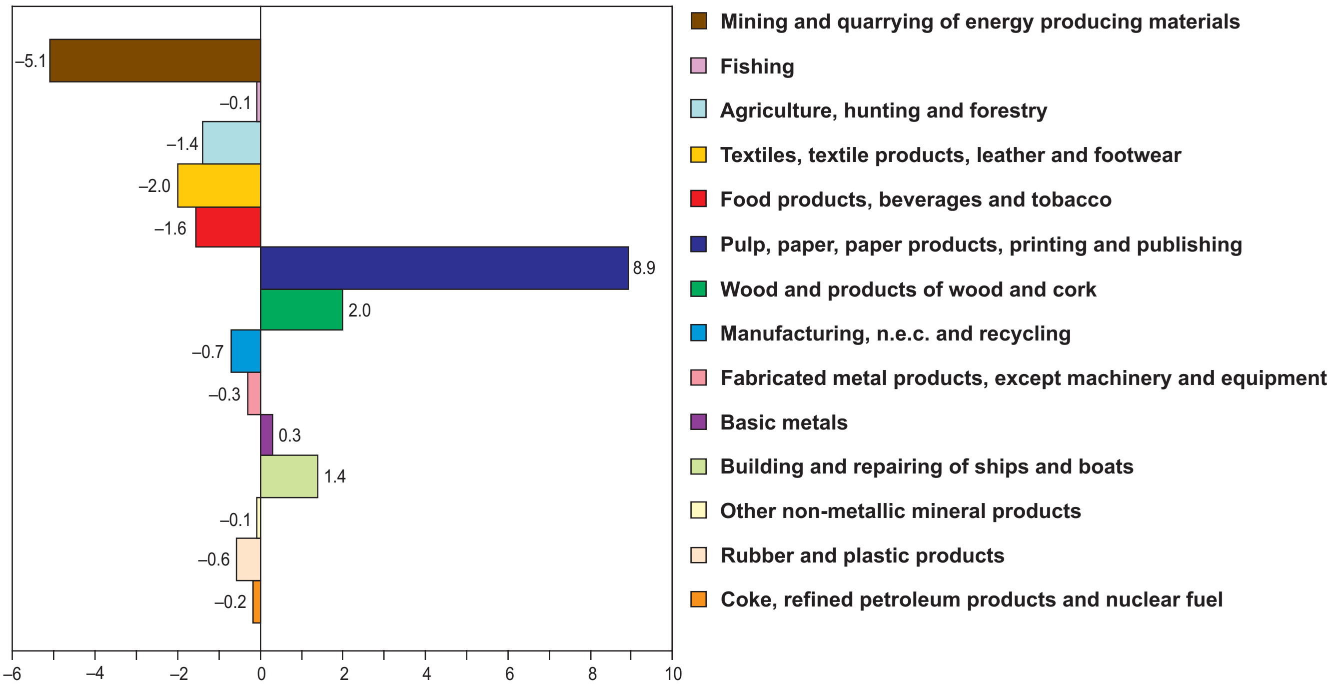


Figure 3.6. RCA Finland low tech and medium low tech. Source: OECD (2003)



analysis, these studies differentiate between strong clusters, semi-strong clusters, potential clusters and latent (defensive) clusters. Only the forest cluster manages to achieve the title of strong cluster while the base metal and energy clusters are considered semi-strong. Telecommunications, environment, well-being, transportation and the chemical cluster have potential growth significance. Construction and foodstuffs are seen as the losers of the Finnish national clusters. These results concur in part with our RCA indices. Especially the dominance of the forest-related industry is important for the Finnish industry (wood and paper account together for 10.9 % of the Finnish trade surplus) as well as, of course, the presence of a strong telecommunications sector tightly linked with the multinational Nokia.

Table 3.4. Competitive Finnish industries

	RCA index		Employment (hundreds)		As share of grand total (%)		Gross production value (DKK millions)		As share of grand total (%)	
	1992	2000	1992	2000	1992	2000	1992	2000	1992	2000
Pulp, paper, paper products, printing and publishing	13.2	8.9	784	715	4.2	3.5	63 063	120 340	7.3	8.1
Radio, television and communication equipment	–0.8	2.6	116	390	0.6	1.9	7 071	113 731	0.8	7.6
Wood and products of wood and cork	2.9	2.0	270	294	1.4	1.5	14 782	31 976	1.7	2.1
Building and repairing of ships and boats	0.5	1.4	96	108	0.5	0.5	5 397	9 702	0.6	0.7
Basic metals	1.6	0.3	417	566	2.2	2.8	33 216	67 472	3.9	4.5

Source: OECD (2003) (2001)

Figure 3.7. Finnish market innovation efficiency. Source: Eurostat (2003)

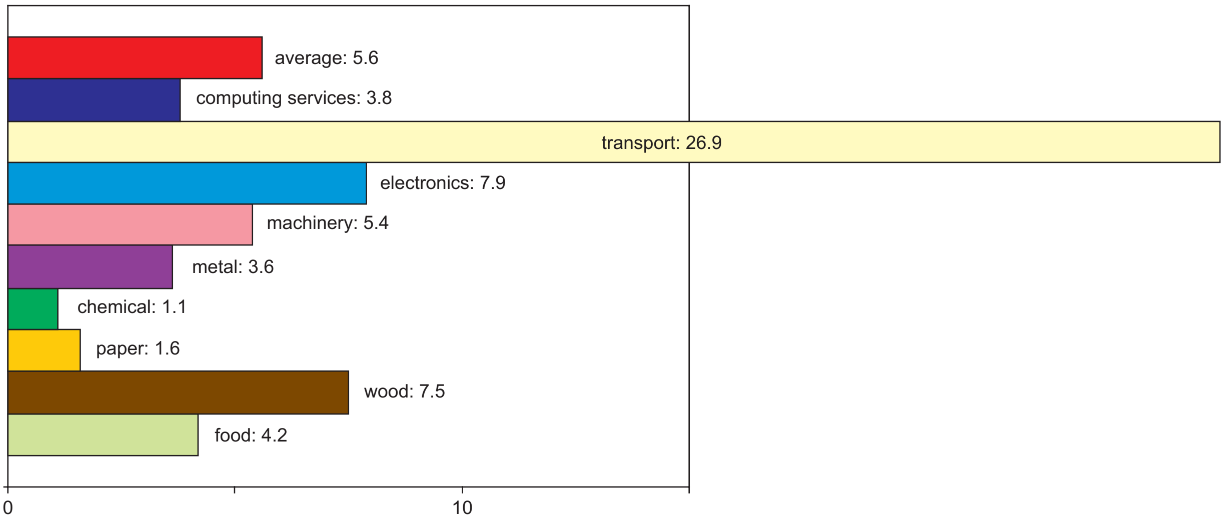
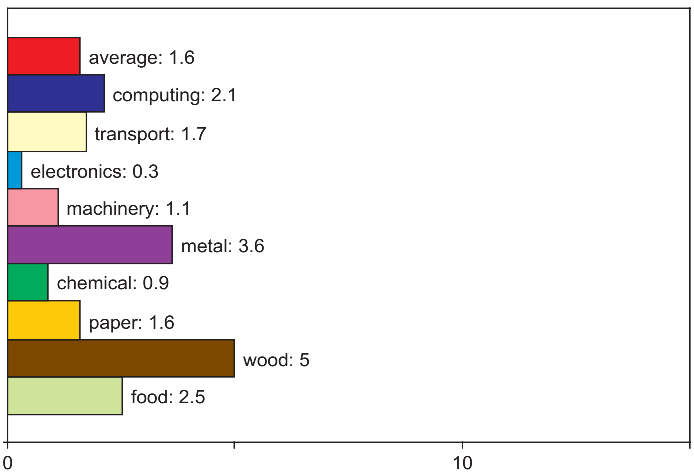


Figure 3.8. Finnish upgrade innovation efficiency. Source: Eurostat (2003)



Forest

The forest cluster has developed around its main products pulp, paper, paperboard and sawn wood. Even though these products may not be the hallmark of high technology, the Finnish industry has developed specialised competences in this field through continuous investment in state-of-the-art production facilities and leading engineering workshops. Furthermore, universities and research organisations are considered as important members of the industrial network. It is argued that because of expensive raw material the forest industry has been forced to invest in production methods, which are able to economize in the use of timber, thus increasing the value added (see also table 3.4). This could partly explain the relatively strong focus on upgrading innovation in the wood sector compared to other sectors in the Finnish economy (see figure 3.8). As for pulp and paper, Hernesniemi et al. (1996) acknowledge that this part of the forest cluster is faced with the greatest pressures. The noted low performance in product innovation (figure 3.7) could be related to a too high share of bulk production.

Base metal

Also the base metal industry is considered an important cluster for the Finnish economy (see also table 3.4). Its main products are steel and base metals (e.g. copper, zinc). The innovative edge in this sector should however not be sought in the manufacturing of highly sophisticated end-products but rather in the level of technological advancement which is used in the production methods. Typically, managers in the metal industry have a strong background in engineering. As a result, excellence has been achieved in improving the technology partly at the deficit of the development of marketing and strategic skills. This confirms our findings that relative to the national average, Finnish metal manufacturing performs better in upgrading innovations rather than product innovation (figures 3.7 and 3.8). However, to remain internationally competitive it is recommended that the focus moves away from bulk production to more 'niched' customer-specific applications (Hernesniemi et al., 1996). This admonition seems to be valid as we can see that competitiveness is declining (table 3.4).

Telecommunications

The fastest growing cluster in Finland is telecommunications which has rapidly become one of the cornerstones of the Finnish economy. This success is considered to be based on extensive R&D and sustained interaction between government, telecommunications operators and the equipment industry. Currently Finland is seen by many as a global leader in the development and production of telecommunication technology. In terms of products, mobile network systems, mobile phones and associated equipment are doing particularly well on international markets. Of course, Nokia should not remain unmentioned in this context being one of world's largest manufacturers of telecommunications with important linkages into its home country Finland. Somewhat as a cliché it could be suggested that the success of this industry in Finland is underpinned by the harsh geographical conditions. More useful lessons can however be learned from the active role played by public policy in the promotion of telecommunications technology through disproportionately large, and at the time risky, investments in technology development. The fruits from this early insight can now by picked as Finland has built up an impressive knowledge base in telecom knowledge. The level of education is world-class yet the industry is constantly faced with shortages in supply of skilled labour. Partly this should be seen in the light of the small size of the Finnish population. For the future, much is expected from the convergence between telecoms industry and media industry into information industry. Time will tell whether Finland will actually manage to follow up its successes in telecommunications.

Shipbuilding

With regard to the final competitive industry that the RCA index has identified, shipbuilding, Hernesniemi et al. (1996) are more sceptical. They claim that not only shipbuilding as such but the Finnish transportation cluster as a whole have been underperforming in comparison with other industries on the global market. Furthermore, they argue that this underperformance is contradictory given the importance of logistics in a peripheral country such as Finland yet close by to the emerging markets in Russia and the Baltic States. Concrete reasons why the authors argue that the industry is performing badly are however not really given. Our results suggest that at least a pocket of innovativeness and competitiveness can be found in shipbuilding given the increasing RCA index (table 3.4) and high rate of efficiency in innovation in the transport sector.

Energy

With regard to the semi-strong energy cluster, our results are too crude to cover this rather heterogeneous industry. It includes power generation, transmission and distribution equipment and electricity-fed machinery. The success of this cluster can be attributed to the success and size of two other important Finnish clusters: forest and metal. The combination of harsh geographical conditions and the importance of these two energy-intensive industries for Finland pushed the cluster to evolve from a fast adapter of state-of-the-art technology to an actual innovator itself.

Iceland

Employment numbers and gross production values for competitive Icelandic industries are missing.

Given Iceland's peculiar position at the northern periphery it deviates from the other Nordic countries. Figures 3.9 and 3.10 show that only the food sector and the metal sector are internationally competitive. Figures 3.11 and 3.12 (page 56) indicate that in terms of innovation pro-

Figure 3.9. RCA Iceland high tech and medium high tech. Source: OECD (2003)

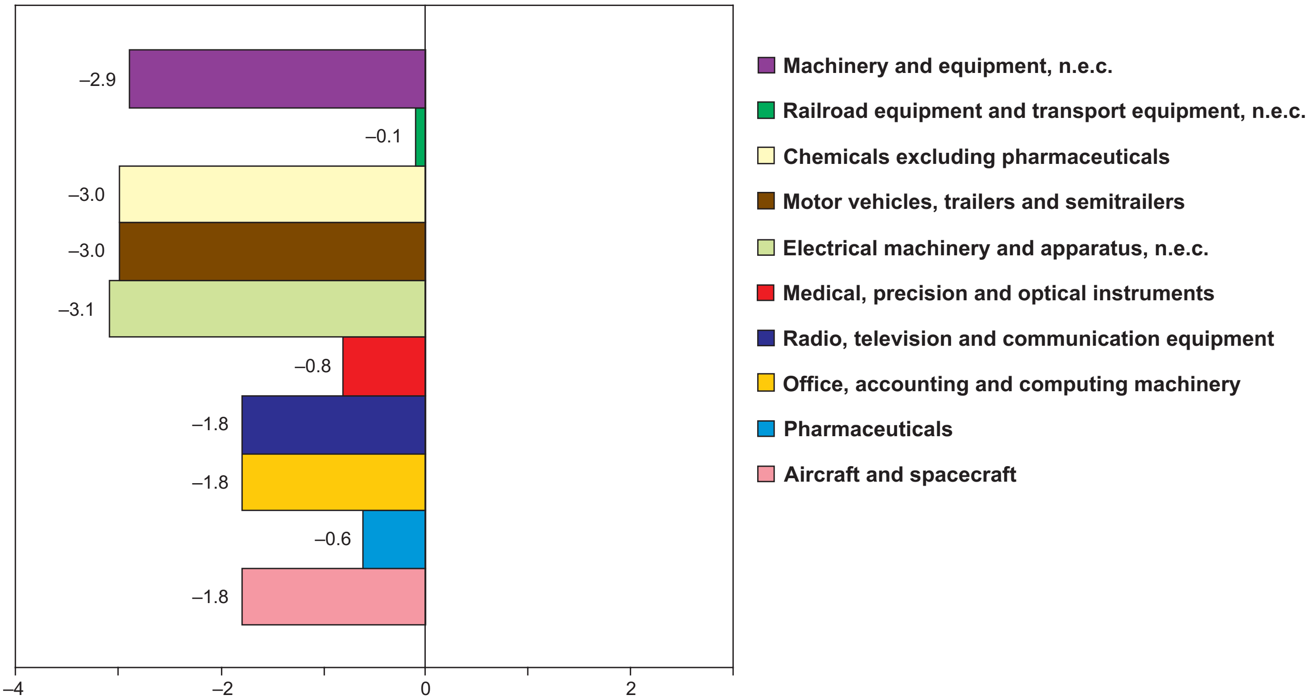
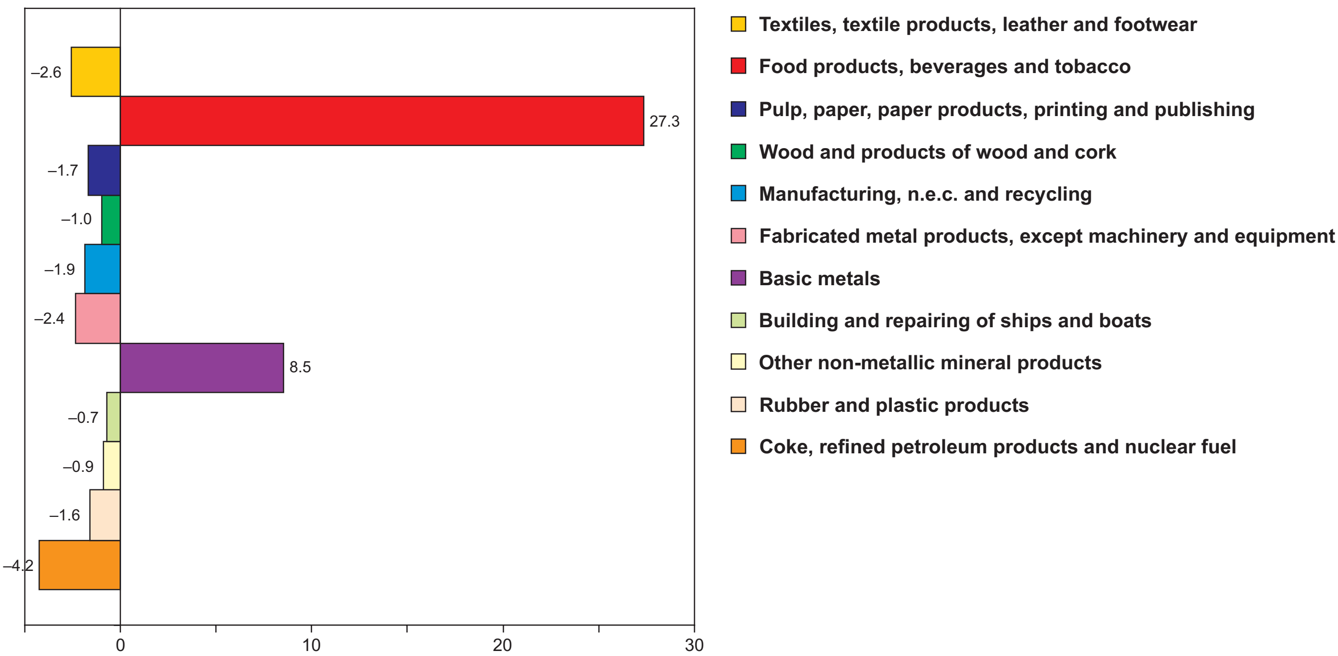


Figure 3.10. RCA Iceland medium low tech and low tech (only manufacturing). Source OECD (2003)



file, Iceland appears to be more conducive to upgrading product innovations rather than market innovations. This pattern is replicated for the large and important food sector, which is dominated by fisheries. A similar account can be given for the metal sector where nearly all innovation efforts seem to be directed towards upgrading. It is difficult to comment in a sensible way on the other sectors. The high results in transportation are surprising, as well as those in wood and chemicals.

Figure 3.11. Icelandic market innovation efficiency. Source: Eurostat (2003)

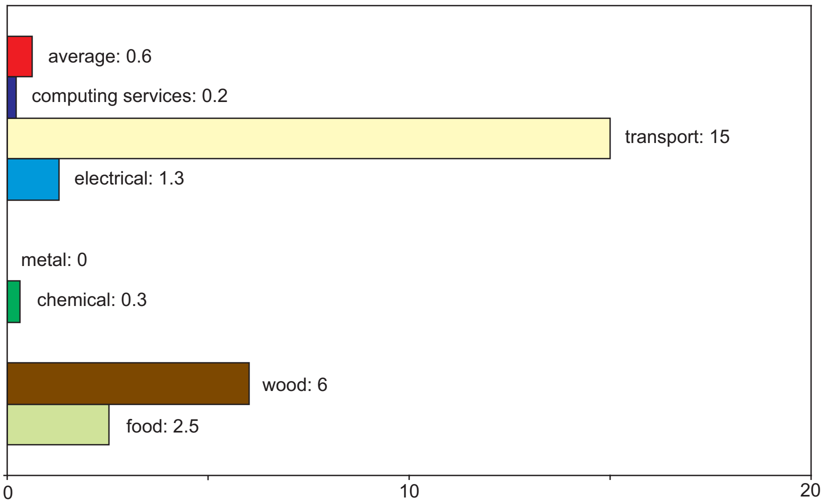
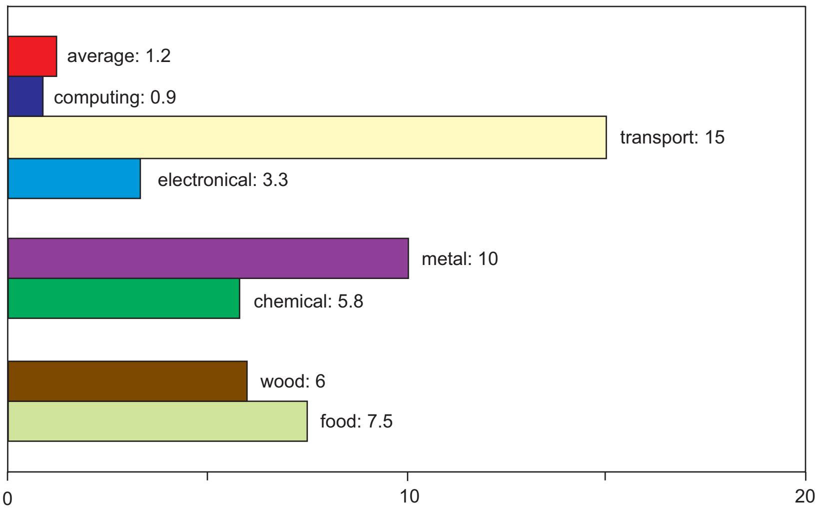


Figure 3.12. Icelandic upgrade innovation. Source: Eurostat (2003)



Norway

Figures 3.13 and 3.14 show that the Norwegian industry in general tends to be better at upgrading products than at introducing completely new products to market. Particularly efficient in upgrading products are the low-tech sectors metal, paper and food having scores above the national average. As we can see in table 3.5 (page 58) basic metals and the paper industry have been able to increase their competitiveness while it remained more or less stable for the food industry. On the other hand, relative employment in these three sectors declined. The relative gross production value decreased for pulp and paper as well as for food. This trend should however be seen against the light of an expanding oil production, the most important export product of the Norwegian economy. Also the transport sector performs better in upgrading products. An important and competitive sub-sector is shipbuilding even though it has to be noted that competitiveness, employment and gross production are decreasing. Surprising is the low efficiency for chemicals (including refined petroleum products) which performs well in the RCA index. Partly this could be explained by the high costs which are necessary for innovations.

Also the below average performance of the electrical sector confirms the finding that this Norwegian sector is not particularly competitive. Though performing slightly better in innovation efficiency, a similar story goes for the wood industry, which has witnesses a reduction in its RCA index from 0.2 to –0.4.

With regard to previous cluster analysis, Reve et al. (1992) provide a comprehensive analysis for Norway as part of the aforementioned Porter studies. The Norwegian contribution to the OECD cluster project takes a somewhat different direction in its analysis by mainly looking at sector-based input-output patterns to identify clusters complemented by additional statistical data to characterise

table 3.6 har ändrats till 3.5. det finnn ju ingen 3.5.

Figure 3.13. *RCA Norway high tech and medium high tech. Source: OECD (2003)*

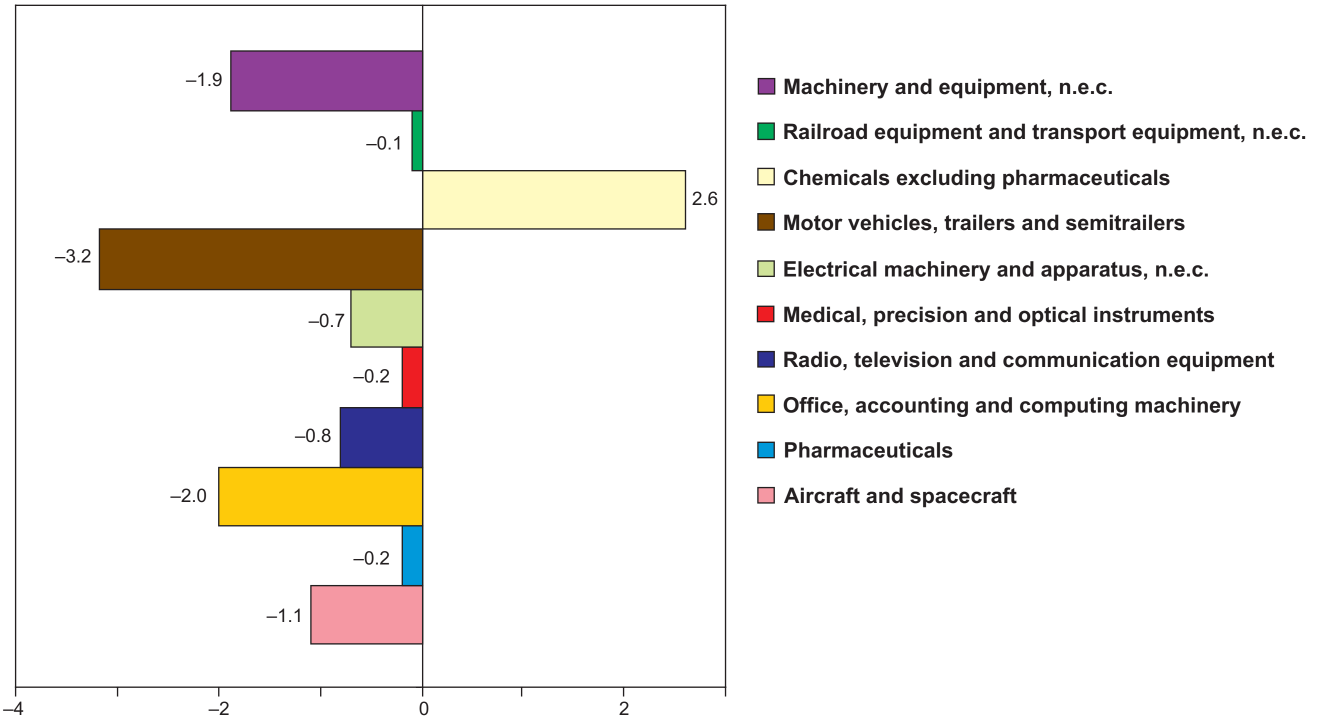
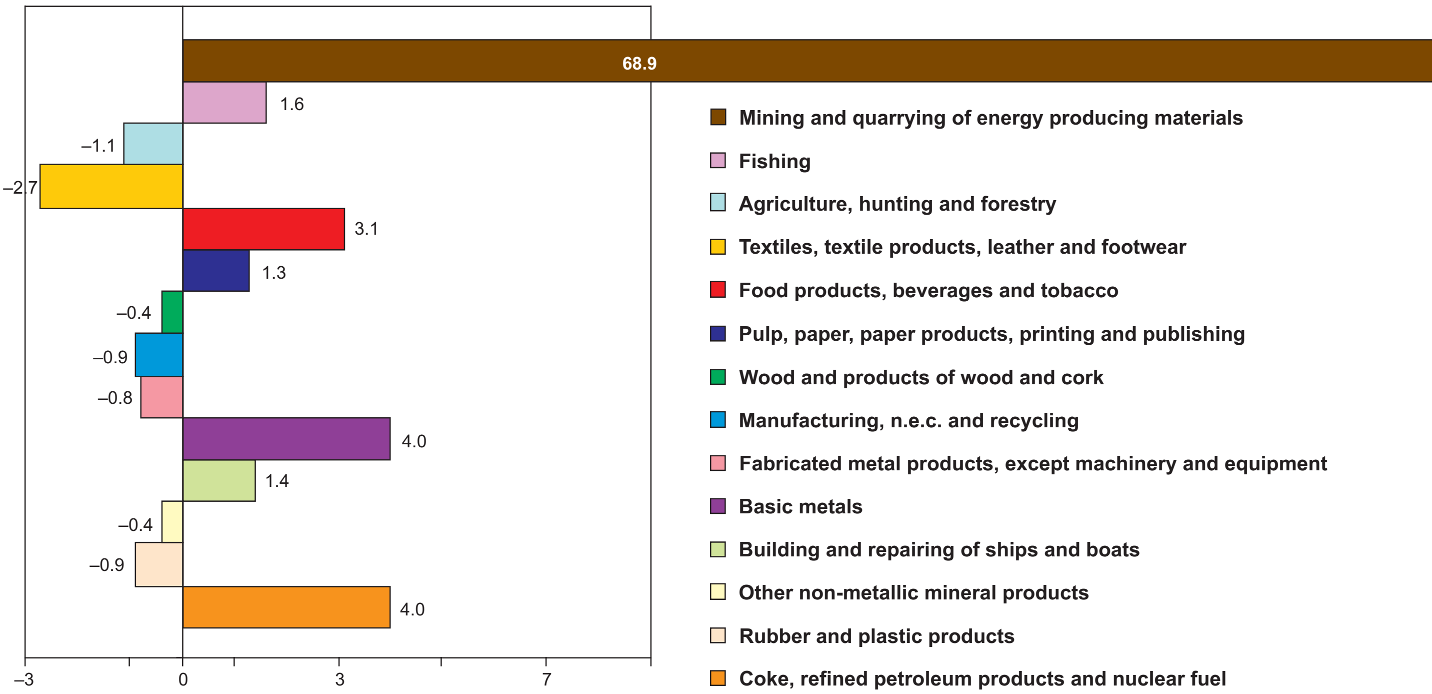


Figure 3.14. *RCA Norway medium low tech and low tech. Source: OECD (2003)*



gross features of innovation patterns (Hauknes, 1999). For the sake of comparability with the other countries, we choose to focus on the Porter study. Reve et al. (1992) identify eight competitive Norwegian clusters. Ordered hierarchically according to export strength these are: the oil cluster, the metal cluster, the maritime cluster, the forest cluster, the power generation cluster and the fishery cluster. The tourism cluster and the R&D cluster are considered as important potential clusters.

The oil cluster

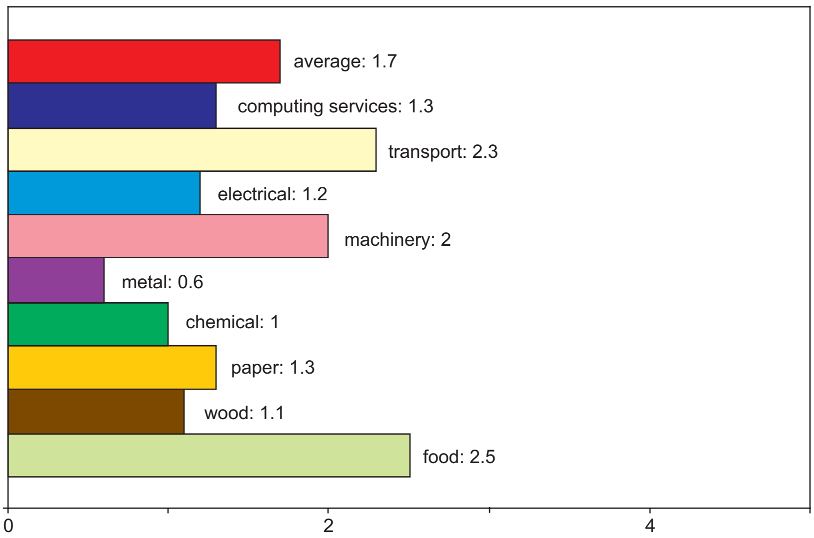
The oil industry is by far the most important sector in the Norwegian economy. The RCA index for 'mining and quarrying of energy producing materials' (see table 3.5) is

Table 3.5. Competitive Norwegian industries

	RCA index		Employment (hundreds)		As share of grand total (%)		Gross production value (DKK millions)		As share of grand total (%)	
	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001
Mining and quarrying of energy producing materials	41.8	68.9	205	261	1.4	1.2	118 584	357 979	8.8	14
Coke, refined petroleum products and nuclear fuel	3.5	4.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Basic metals	3.4	4.0	305	328	1.7	1.5	36 696	67 771	2.7	2.7
Food products, beverages and tobacco	3.0	3.1	494	535	2.7	2.5	79 156	114 914	5.9	4.5
Chemicals excluding pharmaceuticals	2.6	2.6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Fishing	1.9	1.6	79	79	0.4	0.4	10 592	22 157	0.8	0.9
Building and repairing of ships and boats	3.5	1.4	302	331	1.7	1.5	27 406	49 422	2.0	1.9
Pulp, paper, paper products, printing and publishing	0.9	1.3	461	464	2.5	2.2	38 593	57 179	2.9	2.2

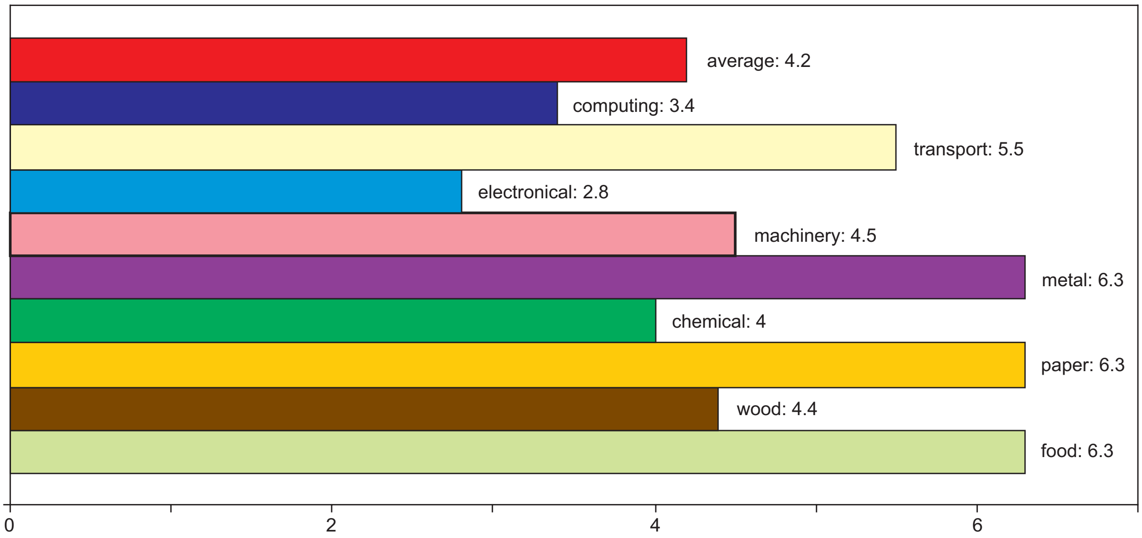
Source: OECD (2003) (2001)

Figure 3.15. *Norwegian market innovation efficiency. Source: Eurostat (2003)*



unsurpassed. The predominant export products are the typical commodities crude oil and natural gas which are exploited by a few large companies. Innovation mainly takes place by upgrading the technology and know-how to increase the efficiency in exploiting the oil-fields. Given its centrality a broad array of specialised suppliers of offshore products and services have established around the oil extracting industry, ranging from seismic research to helicopter transport and specialised food production. But also down the value chain, the petrochemical industry which produces refined petroleum products is an important and competitive sector in the Norwegian economy that managed to secure its share in the profit from the oil discovery (see table 3.5). Reve et al. (1992) argue that many petrochemical firms, spurred by their rapid growth, now prefer to invest close to their customers in other countries around the North Sea rather than close to their Norwegian suppliers. Another interesting and important link to the oil and gas industry is the shipping industry (with a RCA index of 1.4) which was faced with a severe crisis due to increased competition from Japan and South-Korea but managed to adapt successfully to the new off-shore situation. It is sug-

Figure 3.16. Norwegian upgrade innovation efficiency. Source: Eurostat (2003)



gested that a solid knowledge base in maritime engineering and technology underpinned this successful shift. This is not to say that the industry has entered calmer waters. Because it mainly consists of small firms, the industry has a relatively weak capital base and is quite vulnerable for foreign acquisitions. In table 3.5 we can indeed see that the competitiveness rate is decreasing. For the oil cluster the importance of public policy should certainly be emphasised as the Norwegian government purposefully invested in the rapid sophistication of oil linked industries and technologies. A critical weakness for the oil cluster is the dependence on the versatile global oil market dominated by OPEC.

The metal cluster

Before the discovery of oil in the North Sea, metal production was the most important export industry in Norway. The most important products have been aluminium and iron alloys. The rationale behind this specialisation was primary production based on imported raw materials using the cheap and abundant hydro-electrical energy in Norway. Nowadays the metal industry is dominated by a few large players involved in heavy competition with other international companies on a typical global commodity market. The level of sophistication of the production process and the scale of production often determine the success in such markets through cost competition. In the long-run opportunities for the Norwegian industry are in this respect fairly limited. Reve et al. (1992) maintain that in order to secure future competitiveness the emphasis should shift to increasing the value added of the metal product through further processing and product differentiation. Because of its long tradition, the metal sector has developed unique, specialised metallurgic competences. One of the success-stories is the specialisation of aluminium firms to supply car manufacturers and other demanding customers. This strategy requires the companies to establish themselves outside Norway. In table 3.5 we can see that the RCA index for Norwegian metal has increased from 3.4 to an impressive 4.0. Also in upgrading efficiency the sector scores well. This could hint to a successful future development path of the metal industry.

The maritime cluster

Similar to the metal cluster also the maritime cluster has solid roots in Norway's industrial history. Reve et al. (1992) argue that in the face of several severe crises due to tough global competition the shipbuilding and shipping demonstrated remarkable resilience. One of the main underlying reasons has been the ability to continuously adapt existing vessels. For this, the linkages with public research organisations have been of valuable support. Nowadays the industry has managed to differentiate in the production of specialised shipbuilding and shipping services. In fact, it is argued that the industry has adopted a strategy of flexible specialisation. Typically firms employ flat organisational structures and direct lines of communication. The aforementioned essential links with the oil extraction, petrochemical and offshore industry are complemented by important vessel supply connections with the fishery business.

The forest cluster

The forest cluster shows considerable historical similarities with the metal cluster, except that the industry is currently under greater pressure. The relative importance of the commodity producing wood industry for export markets has stagnated as we can also see in table 3.5. Notwithstanding this, several sub-industries in the forest cluster have remained to keep its competitive edge. In figures 3.15 and 3.16 we can see that the paper sector is being more innovative than the wood sector. Through differentiation and quality control paper manufacturing still has a considerable role to play though not with similar confidence as in Finland and Sweden. For this the industry lacks critical mass in connection with sophisticated suppliers and a relevant R&D environment. Therefore Reve et al. (1992) assert that stronger linkages with neighbouring companies in Finland and Sweden, especially in the field of machinery, are a necessary condition to guarantee future success.

The fishery cluster

Though similar in size as the forest cluster, Reve et al. (1992) consider the fishery cluster more important given its solid competences in addition to potential expansion opportunities. Also firmly rooted in industrial history the Norwegian fishery and fish producing sectors have mainly developed specialised competences in the actual process of catching fish and initial processing. Norway is considered to be world-leading in fishing boats, fishery tools and machinery. In contrast, the fish processing segment further down the value chain is relatively weakly developed as well as the distribution of the processed fish. This hampers necessary product differentiation.

The R&D cluster

Somewhat confusing Reve et al. (1992) have classified the ICT and pharmaceutical/biotech industries under R&D cluster. It is argued that in both case the industries are lacking critical mass in Norway. However, the situation seems to be slightly better for ICT than for biotechnology with a more developed R&D infrastructure. International competition should be sought in dedicated niche markets.

The power supply cluster

Reve et al. (1992) have identified two more clusters: power supply and industrial R&D. Unfortunately our data does not cover the first cluster. It is however argued that this traditionally support industry can be regarded as a competitive industry in its own right. Through deregulation of energy market opportunities have opened up for Norwegian hydro-power supply building on its long-lasting competences and the presence of all the segments of the value chain to exploit this sustainable energy source.

Sweden

The Swedish innovation pattern shows quite a homogeneous picture. Without hardly any exception, all industries perform better in upgrading products rather than introducing new products to market. Especially the high score in the natural resource based industries, paper, wood and food, is striking. These seem to perform better than transport, electrical equipment, machinery and chemicals. Another interesting outcome is that the wood sector is being more innovative than the paper sector even though the latter is traditionally considered more competitive. The score in market innovation efficiency is in fact surprisingly low. Partly this can be explained by the high costs that Swedish firms tend to invest into product innovating activities. Given the relative uniformity across sectors, a more useful comparison will follow in the cross-national sector analysis.

With regard to previous national cluster studies, the most exhaustive contribution is that of Sölvell et al. (1991). For Sweden, NUTEK participated in the OECD cluster project. Their report (NUTEK, 1998) refers to the Porter studies by Sölvell et al. (1991) as well as to studies of technological systems and regional clusters. The emphasis in this report is mainly on policy lessons and not so much on

Figure 3.17. *RCA Sweden high tech and medium high tech. Source: OECD (2003)*

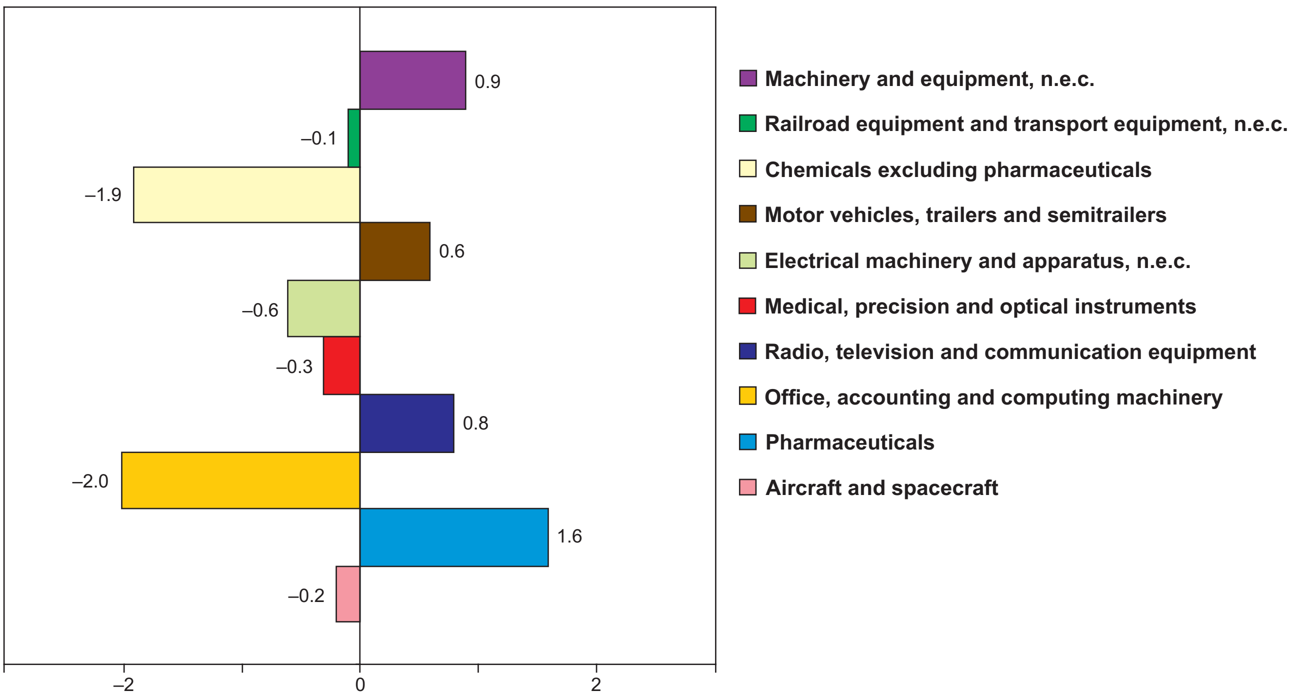


Figure 3.18. RCA Sweden medium low tech and low tech. Source: OECD (2003)

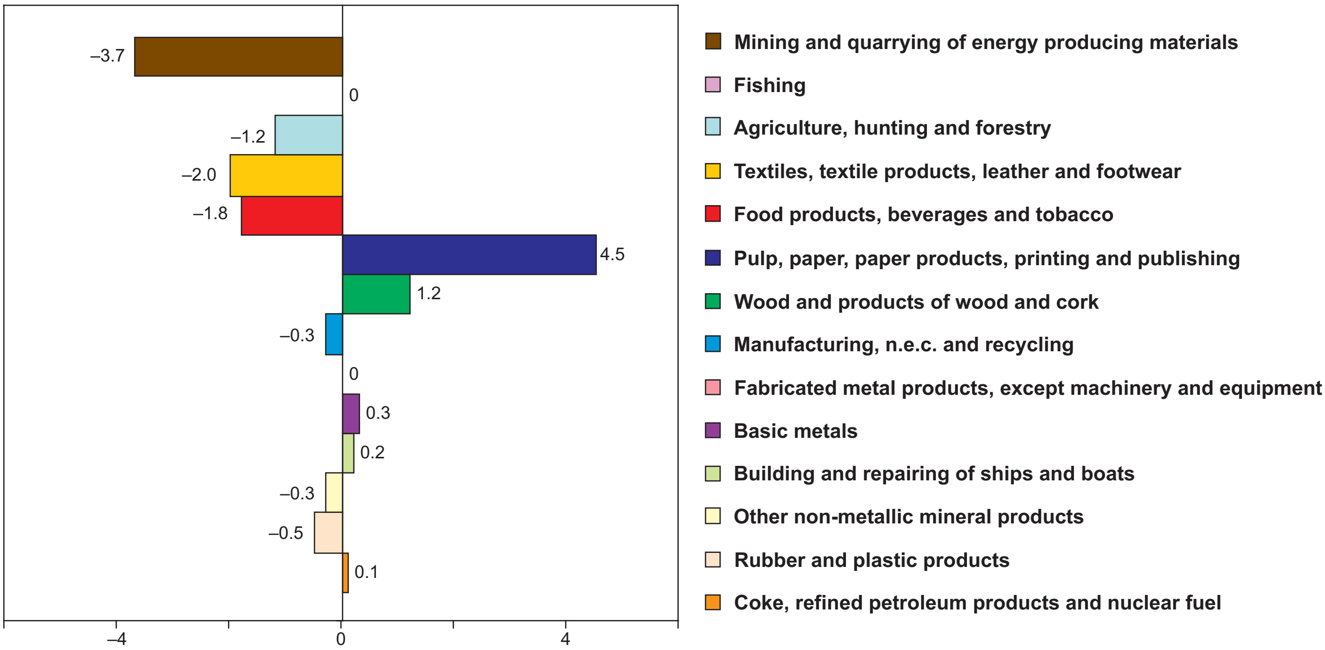


Table 3.6. Competitive Swedish industries

	RCA index		Employment (hundreds)*		As share of grand total (%)		Gross production value (DKK millions)		As share of grand total (%)	
	1992	2001	1992	1998	1992	1998	1992	1998	1992	1998
Pulp, paper, paper products, printing and publishing	5.9	4.5	1 099	940	2.6	2.3	116 576	154 422	4.6	4.4
Pharmaceuticals	1.0	1.6	n.a.	n.a.	n.a.	n.a.	17 461	38 871	0.7	1.1
Wood and products of wood and cork	1.8	1.2	404	370	0.9	0.9	39 874	55 451	1.6	1.6
Machinery and equipment, n.e.c.	1.0	0.9	1 007	986	2.3	2.4	78 217	129 507	3.1	3.7
Radio, television and communication equipment	0.4	0.8	n.a.	404	n.a.	1.0	27 616	123 031	1.1	3.5
Motor vehicles, trailers and semi-trailers	2.2	0.6	687	743	1.6	1.8	73 050	153 994	2.9	4.4
Basic metals	0.9	0.3	1 049	1 113	2.4	2.7	87 974	149 916	3.4	4.3
Building and repairing of ships and boats	0	0.2	n.a.	n.a.	n.a.	n.a.	2 955	4 932	0.1	0.1
Coke, refined petroleum products and nuclear fuel	–0.4	0.1	27	29	0.1	0.1	20 717	26 036	0.8	0.7

*NB. number engaged
Source: OECD (2003) (2001)

Figure 3.19. Swedish market innovation efficiency. Source: Eurostat (2003)

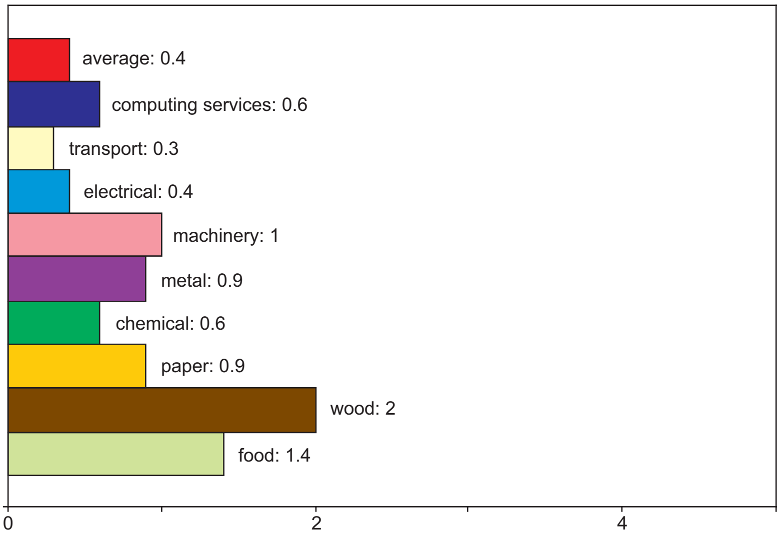
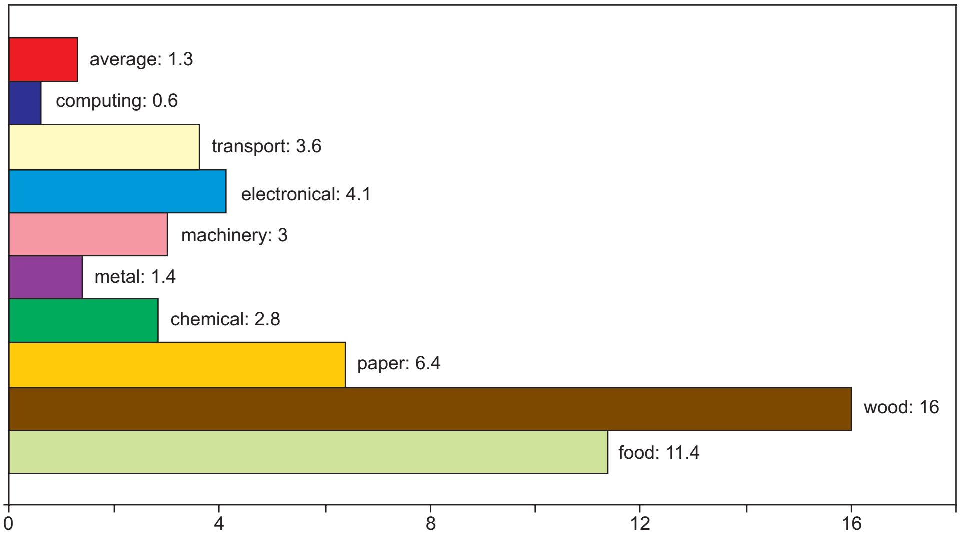


Figure 3.20. Swedish upgrade innovation efficiency. Source: Eurostat (2003)



substantial empirical analysis. With regard to the regional clusters and technological systems the extent of empirical material is limited to a few examples. Therefore we chose to focus on the original Porter studies. In total, four dominant clusters are identified: materials/metals, forest products, transportation equipment, multiple business. In addition, power generation, transmission and distribution and telecommunications are seen as strong clusters. The analyses in Sölvell et al. (1991) put a lot of emphasis on the historical trajectory of the clusters to explain the emergence of specialised competences often developed in the interaction between users and producers of technologies.

The materials/metals cluster

Besides steel, aluminium and copper are important Swedish metals. Especially in iron ore mining and iron and steel manufacturing Sweden has a long tradition and specialised competences. Increased global competition is however putting pressure on this commodity producing industry. An important effect of the mechanisation of the iron and steel industry has been the development of specialised machinery and equipment industry manufacturing rock-drills, electrical industrial furnaces and rolling mills. Typical for a natural resource based, commodity producing industry, its competitive advantage slowly but gradually eroded away under pressure of globalisation processes. The surviving manufacturers developed international positions in certain specialty steel niches. Because of the historical importance of the metal industry, specialised research and education facilities have been established around various materials technologies.

The forest products cluster

Also building on a long industrial history, the forest products cluster constitutes a second important national cluster in Sweden. The origin of the industry can be traced to the abundance of raw materials. Initially, primary wood production was very important but this gradually evolved into paper and pulp production. Swedish paper manufacturers are considered to have developed particularly strong positions in newsprint, kraft paper and paperboard. Parallel to the rise of the paper and pulp, the machinery and equipment manufacturing industry grew in importance.

The multiple business cluster

This national cluster covers a variety of machinery and specialty inputs which are used in a wide range of mechanical engineering industries. Especially in precision-based instruments, bearings, fans, pneumatic and hydraulic systems, Sweden has developed particularly strong positions.

The transportation equipment cluster

Because of the importance of the metal industry and the forest-based industry, Sweden needed a good transport infrastructure. Close linkages can be found between the shipyard industry and the steel industry, where technologies for large steel constructions have been jointly developed. In the 1920s Sweden was a leading shipbuilding nation based on a tradition in building propeller-driven steel ships. Also a broad range of supplying industries in machinery and equipment developed. In the 1970s Sweden reached its heydays in shipbuilding famous for its skilled workers, the use of computers for production planning and construction and the use of pre-fabricated design. However, the oil crisis and increased competition from low labor-cost countries brought the Swedish industry in a severe crisis shutting down many of its shipyards and shipping companies. In other parts of the transportation equipment cluster Swedish firms managed to create a more sustainable competitiveness based on continuous innovation. The typical case is that of the automotive industry with its multinational companies Volvo and Saab. Swedish car and truck manufacturing earned itself a reputation of being highly safe and reliable. An important supporting industry is the machine tool industry by which it has been possible to continuously upgrade the production process.

Power generation, supply and distribution cluster

Due to the presence of energy-intensive industries such as steel and pulp, Sweden developed a strong position in the production of (hydro-) electricity forming the base for an increasingly advanced industry in electro-technical equipment and systems. Important products include steam turbines and turbines for hydro-electric power generation, relays, transformers, switchgear and cable.

Telecommunication cluster

Throughout history, Ericsson has been the driving force in developing telecommunication products and systems in Sweden, starting with the manufacturing of telephone equipment in 1876. From then on the company diversified into a wide range of telecommunication and related products including switching stations, telephone networks (cable), private exchanges, railway communication and signal systems, military communication electronics and systems, radar, broadcasting equipment, TV and radios, mobile radio, mobile data and mobile telephone systems, measuring instruments and a broad range of components. Especially mobile phones have become the company's hallmark. Over time, a wide array of electronics manufacturers in Sweden has linked to Ericsson's activities. In recent years, the company has endured quite some turmoil after the burst of the ICT bubble, causing massive lay-offs and closures of supplying firms.

Food cluster

Even though the food cluster does not have a positive RCA index, it still makes an interesting case because of the strong Swedish specialisation in food-processing equipment. Sölvell et al. (1991) argue that consumer products have been given very little attention by Swedish food firms. Instead attention was directed to the actual manufacturing process building on the Swedish tradition of engineering know-how. Main products are separators, industrial refrigeration, freezing equipment and packaging machinery.

Health care cluster

Known for its universal health care and high standards, Swedish firms have developed internationally significant positions in pharmaceuticals and medical instruments and equipment. The development of firms in the Swedish health care cluster is strongly linked to advanced research facilities at leading universities and to hospitals with a strong research tradition. Sölvell et al. (1991) possibly underestimate the potential of the industry which can be explained by the time of writing.

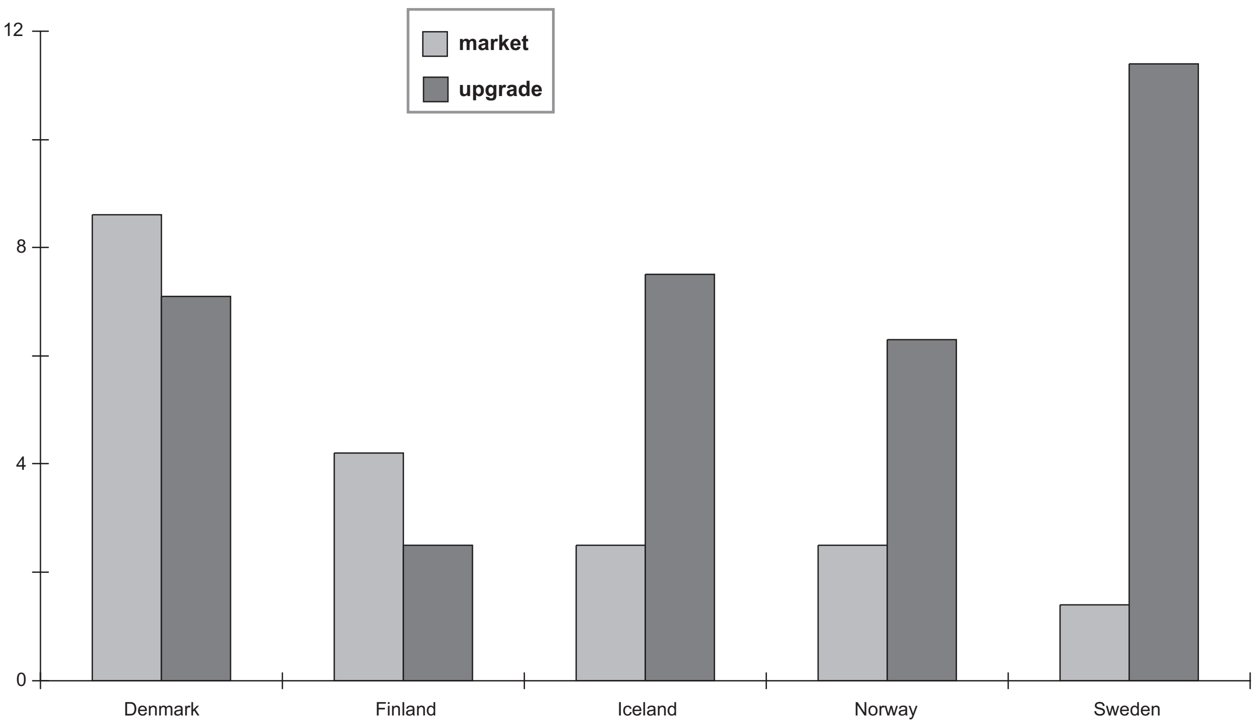
4. Comparing countries within sectors

Food products, beverages and tobacco

From the national cluster studies it became clear that Denmark is the most competitive of the Nordic countries in food production with a long tradition of competence development in its agro-industrial complex. More specifically the country appears to do very well internationally in the dairy sector, slaughterhouses and the fish sector. Furthermore, a sub-industry has developed around producing agricultural machines and equipment. Also Norway and Iceland have developed a competitive advantage around food production but this is nearly completely based on fish production. If we now look at the innovation efficiency in the food sector in figure 4.1, we can see that Denmark has the best overall score doing best of all Nordic countries in product innovations, which are new to the market.

In contrast, Iceland and Norway are more inclined to gradual upgrading innovations. This can be seen as a confirmation of the argument made in the Norwegian cluster studies that the fishery industry is mainly investing in technology far up the value chain (i.e. close to the actual catching process). Swedish food does not seem to be a very competitive sector of the national economy. Characteristic for the Swedish tradition of engineering know-how, firms have specialised in food-processing equipment at the deficit of consumer products. This is well illustrated in figure 4.1 where upgrade efficiency by far outclasses market innovation efficiency.

Figure 4.1. *Innovation efficiency in the food sector. Source: Eurostat (2003)*



Wood and wood products

Another important sector in the Nordic countries is the wood sector. Here Finland scores best on the competitiveness indicator followed by Sweden.

But when we look at the CIS data we can see that both countries are surpassed by Denmark. This result is highly surprising as the NACE sector definition excludes the furniture industry which is the only sector related to wood in which Denmark has developed special competence. Partly this pattern can be explained by the low costs against which the Danish firms have been innovating. When we instead

Figure 4.2. Innovation efficiency in the wood sector. Source: Eurostat (2003)

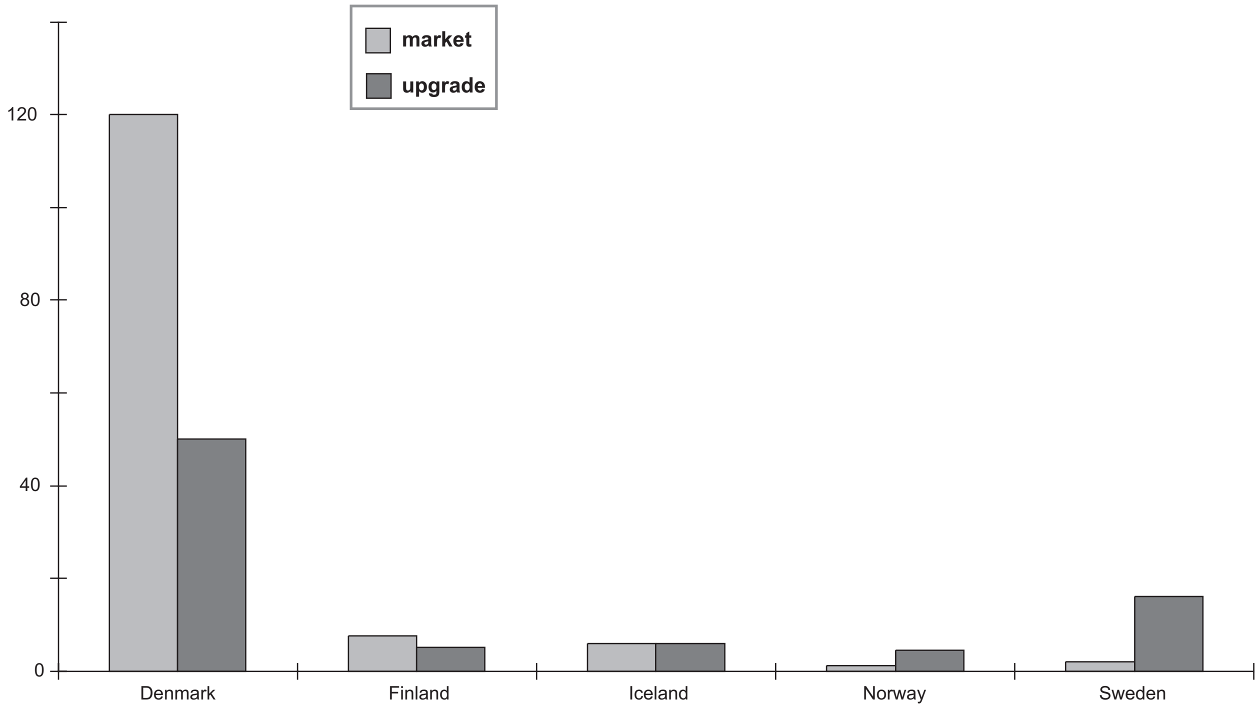
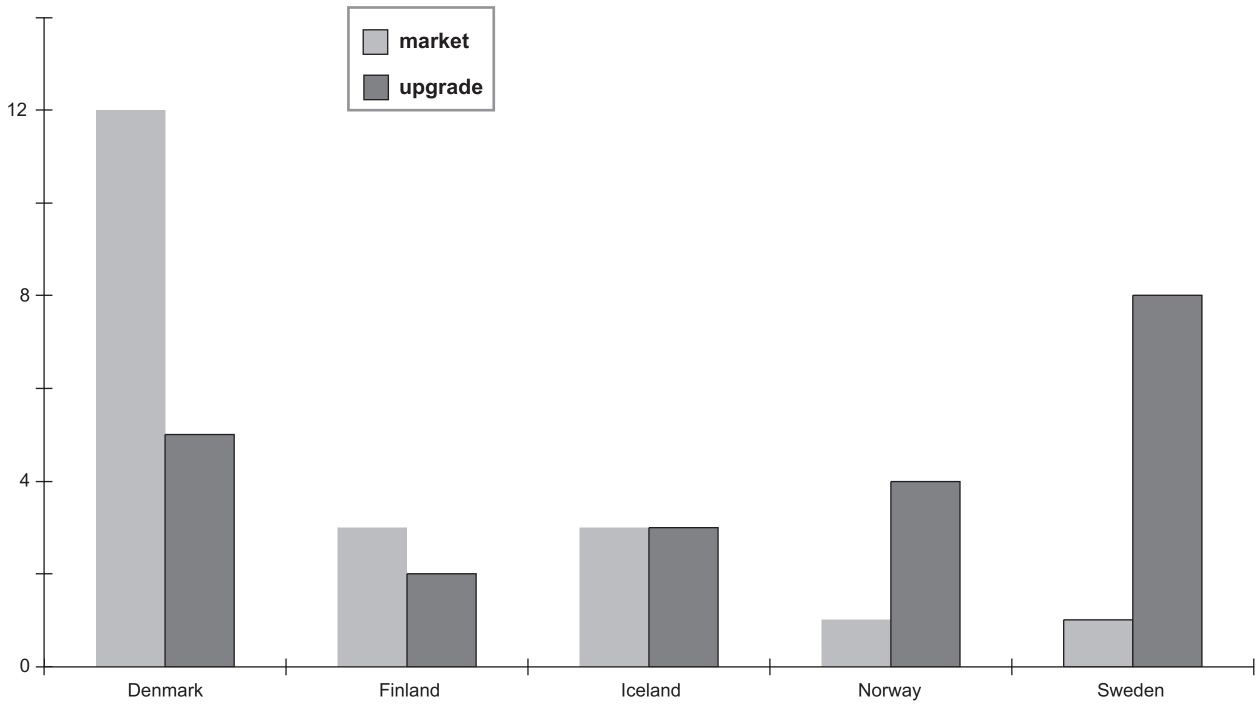


Figure 4.3. Turnover generated by innovation in the wood sector. Source: Eurostat (2003)



look at the turnover, the results become more in line with our expectations. Finland scores best in the introduction of new and improved products to market even though this score should be seen in the light of an industry that is quite mature and is faced with the difficult task to switch from commodity production to more customer-oriented, niche products. This maturity of the industry is even better illustrated in the Swedish case where most innovating efforts are directed to upgrading existing product lines. Finally, figure 4.3 shows that the Norwegian wood sector, which was in the past an important national industry, is losing ground. Here it could be suggested that the industry does not manage to move into niched product differentiation but remains stuck in economically unsustainable commodity markets.

Pulp, paper and paper products, publishing and printing

In pulp, paper, paper products, printing and publishing the highest competitiveness scores belong to Finland (8.9), Sweden (4.5) and Norway (1.3). For Sweden as well as Finland this sector is in fact by far the most competitive using the RCA-index as a measure. This can be explained by the historical origins of the forest related industry in these countries following from the abundance of raw materials and the availability of cheap energy. Over time, all three countries have become main producers of paper and pulp even though the picture is currently changing. Similar to the aforementioned wood industry, Finnish, Norwegian and Swedish paper is facing great pressures within the commodity markets due to a generally high cost level. For all three countries a transition towards product differentiation and increased competition based on quality is considered as the only way to survive on global markets. If we now look at the innovation patterns in figure 4.4 we are however faced with some surprising outcomes. Similar to the wood industry, Denmark rules over all the other Nordic countries when it comes to innovation efficiency. Even though Denmark has a considerable publishing industry, these outcomes are highly unexpected.

If we bracket Denmark and look at the turnover generated by innovations, the results coincide more with our line of expectations (see figure 4.5 on next page). The country with the highest competitiveness in paper and pulp, Finland, scores highest in market innovativeness compared to Norway and Sweden. On the other hand, Hernesniemi et al. (1999) have pointed out that Finnish paper is the weakest segment in its national forestry cluster. As for the other two countries, it becomes clear that Norway is less innovative because it arguably lacks critical mass compared to Sweden (Reve et al., 1992). Furthermore, the clear tendency for upgrade product innovations is characteristic for this mature industry. In Sweden, a specialised equipment and machinery industry has evolved out of the importance of the paper and pulp industry.

Figure 4.4. *Innovation efficiency in the paper sector (data for Iceland is missing). Source: Eurostat (2003)*

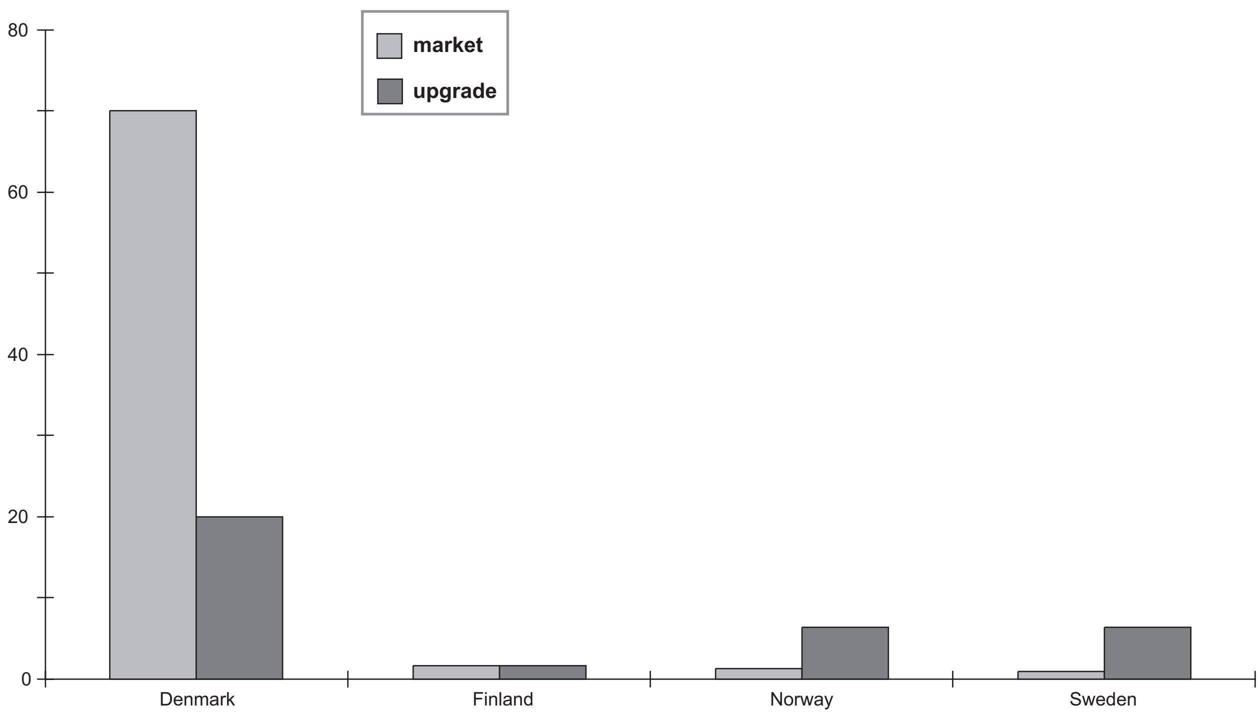
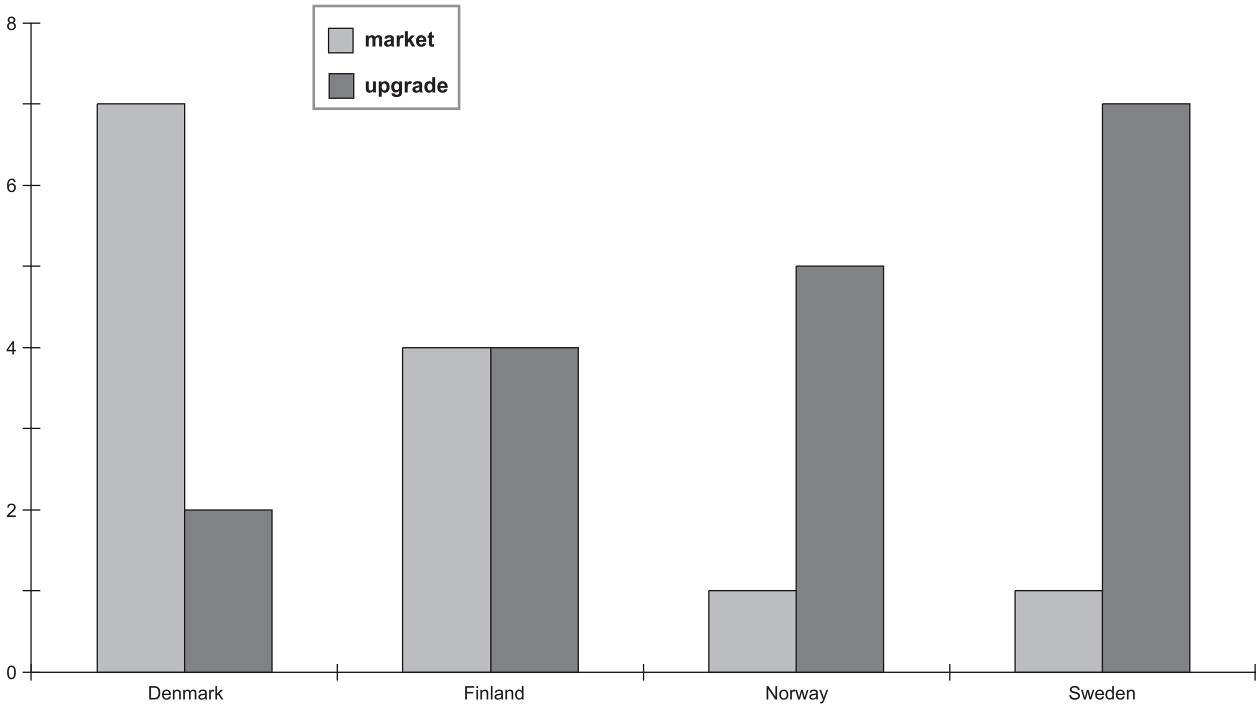


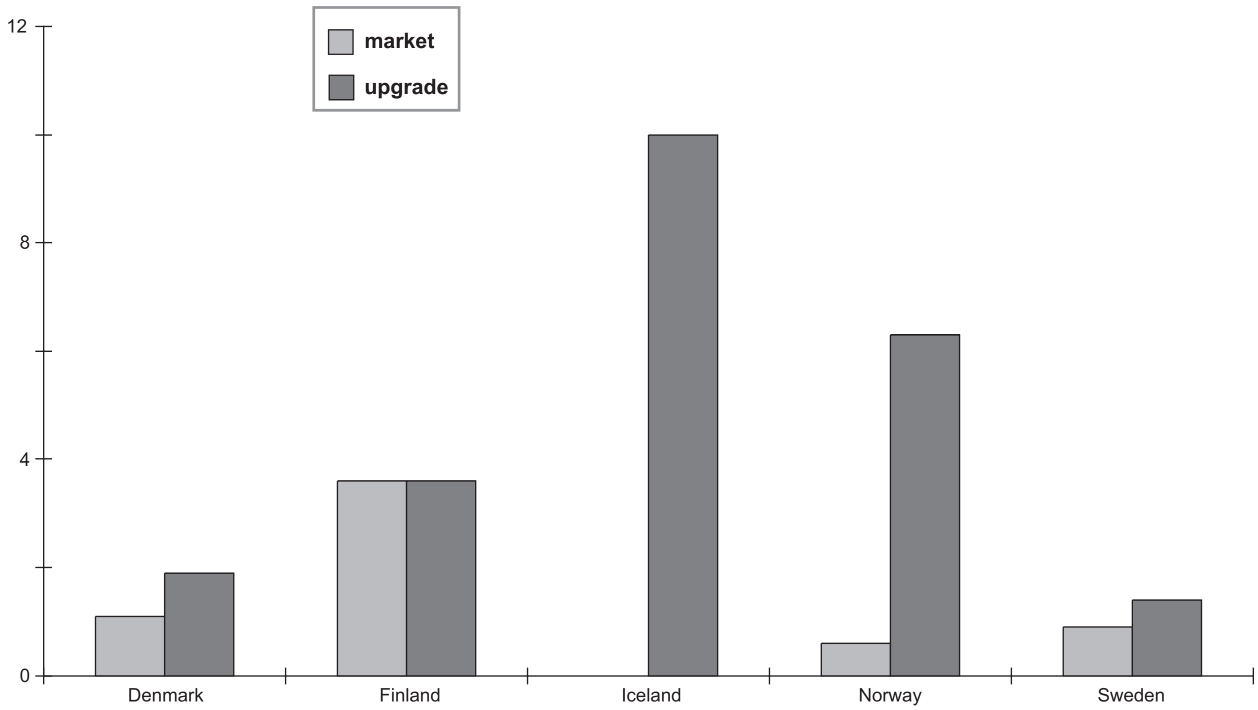
Figure 4.5. Turnover generated by innovation in the paper sector (data for Iceland is missing). Source: Eurostat (2003)



Basic metals and fabricated metal products

This natural resource-based industry is also central for several Nordic economies. In Norway, the industry scores second best in competitiveness following the all-important oil industry (RCA is 4.0), while for Sweden and Finland the sector still holds competitive advantage but this is gradually declining. Iceland scores best of all Nordic countries with a RCA index of 8.5. This outcome in terms of competitiveness fits very nicely with the CIS based results

Figure 4.6. Innovation efficiency in the metal sector. Source: Eurostat (2003)



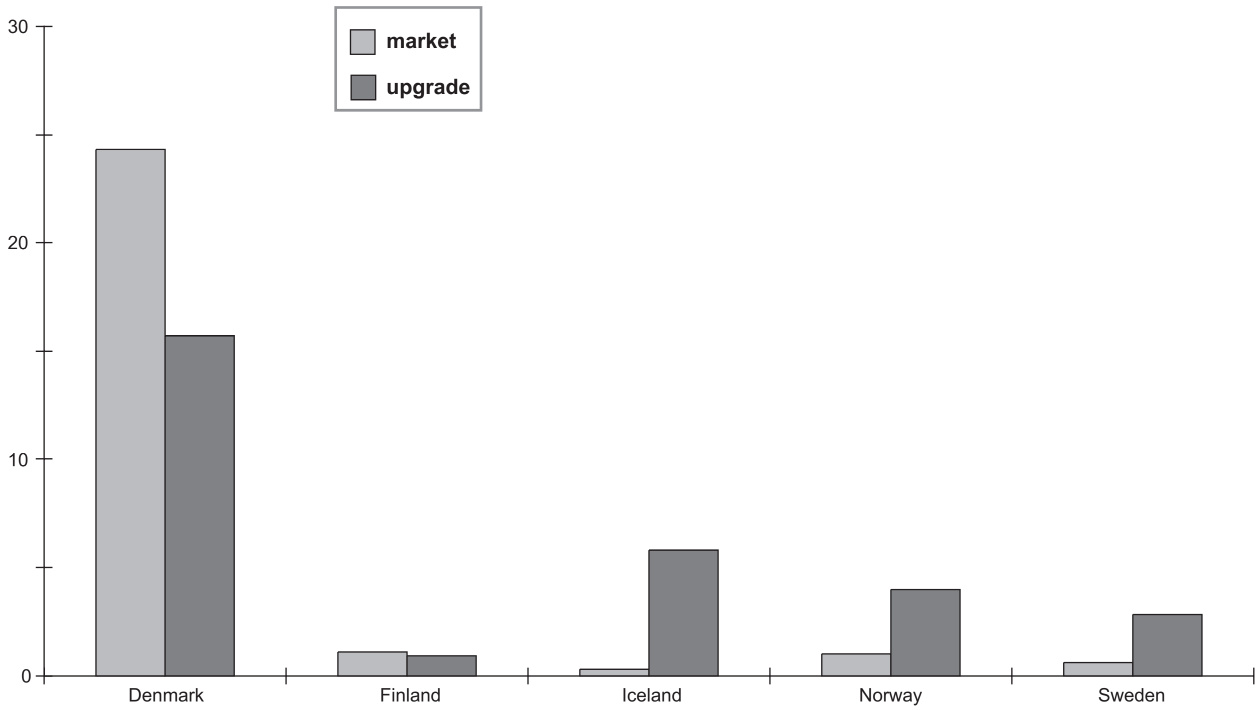
in figure 4.6. Metal manufacturing is the only sector in which Iceland clearly tops the Nordic league also in terms of innovativeness. Second best is Norway with a distinct advantage in upgrade innovations over new and changed products to market. Before the discovery of oil, metal production (as a commodity) was indeed the most important export industry in Norway through a combination of imported raw materials and very cheap hydro-electrical energy. Again, the sector is threatened by international competition in the commodity markets and the industry is moving towards increased product differentiation (e.g. specialised aluminium supply to car manufacturers). The Finnish metal producers seem to combine both upgrading processes and new product development. The Swedish and Danish metal manufacturers seem to be lagging behind despite moves in the direction of product differentiation with comparatively low innovativeness rates.

Chemicals and chemical products (including pharmaceuticals)

Within this sector an important distinction should be made between the more traditional chemical industry and pharmaceuticals. With regard to the former, Norway is ahead of the other Nordic countries in terms of competitiveness. This has to do with the all-important oil cluster, which provides the petrochemical industry with abundant raw material and capital. With regard to pharmaceuticals, Denmark and Sweden are having a high RCA index (2.4 and 1.6). This sub-sector is definitely on the rise with its links to what is often considered the new generic technology, biotechnology. The industry has witnessed a substantial growth on both Denmark and Sweden over the past ten years (see tables 3.2 and 3.6), with a striking geographical concentration around universities and research centres (e.g. Medicon Valley in the Öresund region). It is somewhat unfortunate that we do not have differentiated data on the innovation efficiency for this sub-sector. Nonetheless we can see in figure 4.7 that Denmark dominates the other countries on the aggregated level covering both traditional chemicals and pharmaceuticals. This strength is very pronounced in the field of new or improved products to market. It is likely that this result to a large extent can be ascribed to the pharmaceutical industry.

In this context, the comparatively poor performance of Sweden needs to be highlighted. The costs needed to produce product innovations are significantly higher in Sweden than in Denmark, which could be explained by the typical dominance of small firms in Denmark. Moreover, this hints to an illustrative example of the Swedish paradox: high investments in R&D, little market return. In

Figure 4.7. *Innovation efficiency in the chemicals sector. Source: Eurostat (2003)*



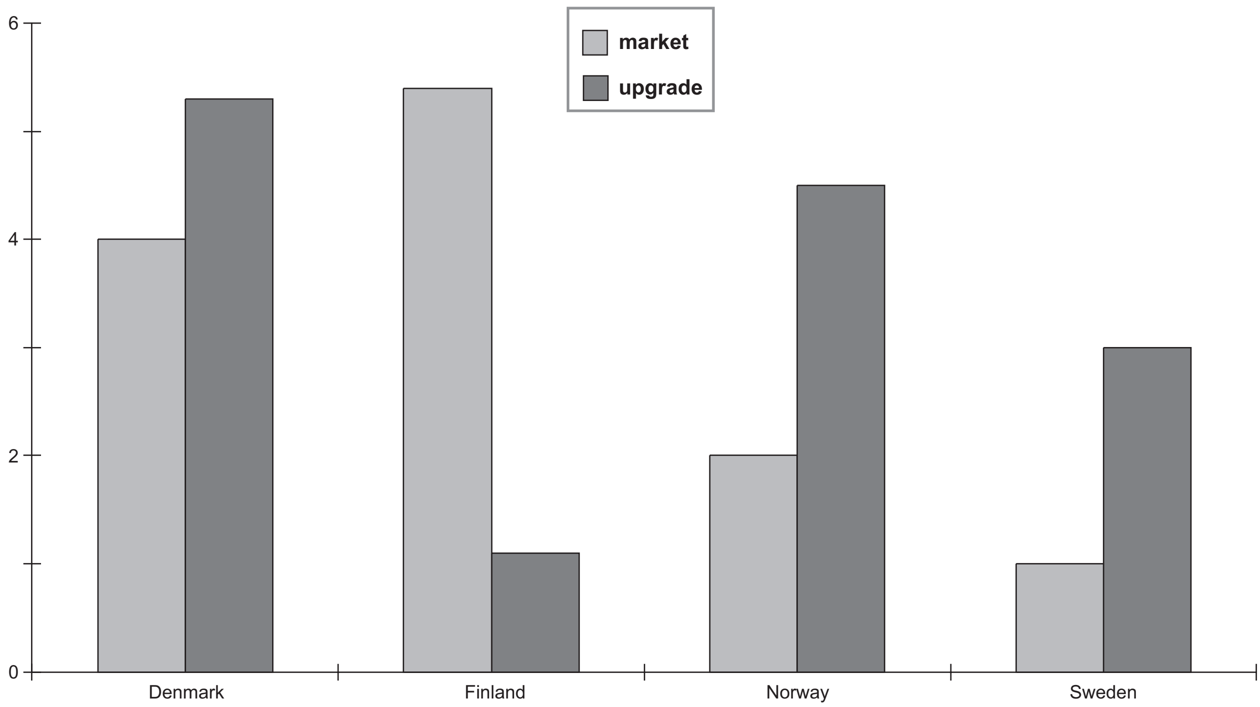
terms of innovativeness in the chemical sector, the Norwegian companies are even doing better than the Swedes. Typical for the bulk-production of the petrochemical industry, product innovations are characteristically done in the area of upgrading. Also worth mentioning is the good performance in upgrading innovations in Iceland.

Machinery and equipment n.e.c.

In this sector Denmark and Sweden call the shots, with a RCA index of 1.4 and 0.9 respectively. In the case of Denmark this specialisation has mainly grown out of the agro-industrial complex while Swedish supporting machinery manufacturers have closely collaborated with a range of sectors, most importantly the large natural resource industries wood, paper and metals.

If we look, however, at the innovation rates, we can notice that the Nordic countries are quite similar in terms of total innovativeness. Important differences occur with regard to the innovation strategies that are used. Typically, Sweden performs best in the sphere of upgrading but is set back by the high costs, which are involved to arrive at innovations. Norway demonstrates a somewhat similar pattern but seems to be more efficient at it. Untypical for Denmark its machinery and equipment sector is relatively better at producing upgrade innovation even though entirely new product development is not lagging behind very far. As for Finland, the machinery sector does, quite surprisingly, best of all Nordic countries in developing new products to market. This partly fits with the tendency in the Finnish industry at large to become increasingly entrepreneurial especially in the high value-added segments.

Figure 4.8. *Innovation efficiency in the machinery sector (data for Iceland is not available). Source: Eurostat (2003)*



Transport equipment

Similar to the chemical sector, we are faced with another slightly miscellaneous sector as important differences exist between various modes of transportation equipment in the Nordic countries. Given their tradition in natural resource exploitation, ship transportation has been important for the Nordic in order to serve export markets. This dependence was further fuelled by linkages with the fishery sector. In terms of the RCA index, Finland, Norway and Sweden have a positive score despite that this industry has undergone quite some severe crises over the years. In

Figure 4.9. *Innovation efficiency in the transport sector (data for Denmark is not available). Source: Eurostat (2003)*

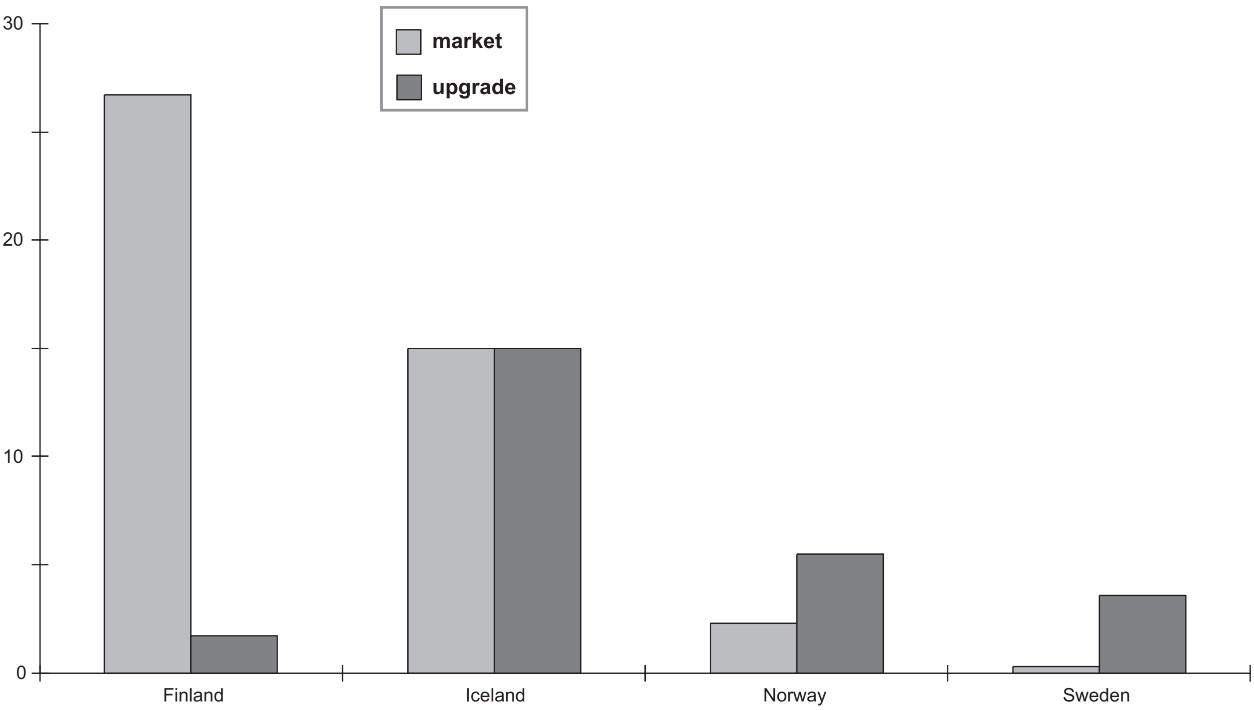
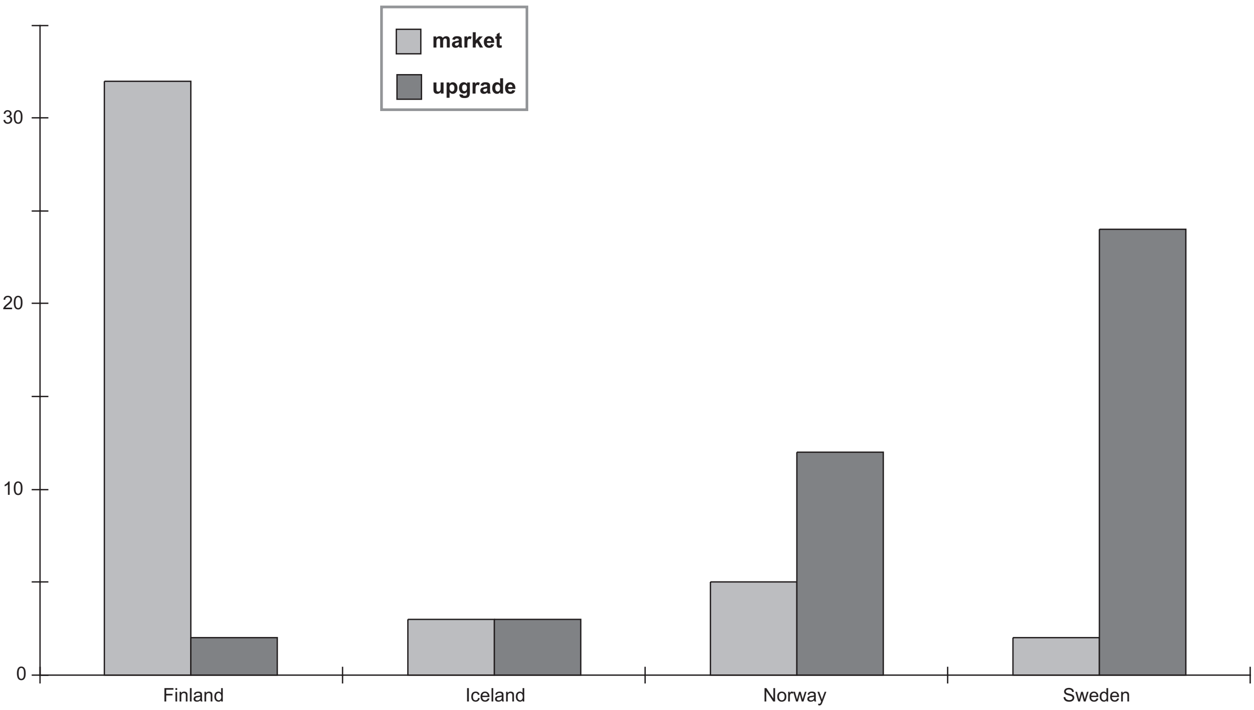


Figure 4.10. *Turnover generated by innovation in the transport sector (data Denmark is not available). Source: Eurostat (2003)*



transportation equipment Sweden has another competitive industry: motor vehicles, trailers and semi-trailers. This can of course be linked to the large Swedish car manufacturers Volvo and Saab. But when we look at the innovativeness rates in figure 4.9, some surprising findings can be reported.

Here it is suggested that Finland actually is most innovative when it comes to new and improved products to market, followed by Iceland which is strong in both market and upgrade innovations. This is not in line with the findings in the Porter studies which claim that in fact Norwegian shipbuilding has managed to become highly competitive through niche specialisation and product differentiation (Reve et al., 1992) while the Finnish researchers contend that the shipbuilding cluster in Finland is underperforming (Hernesniemi et al. 1996). Even though Swedish shipbuilding has been severely affected by the global crises, the low score in innovation efficiency is striking in the light of the car manufacturing industry. By looking at the turnover generated by innovation a probably more accurate picture for Swedish transportation manufacturing is provided (see figure 4.10).

Electrical and optical equipment

At the high end of the technological spectre several Nordic countries have also developed a solid competitive basis. In the area of telecommunications Sweden and particularly Finland have witnessed a sharp increase in competitiveness in the last decade due to the success of Ericsson and Nokia. Denmark seems to be more specialised in medical applications and electronics in general. The innovation efficiency is again extremely high for Denmark, as we can see in figure 4.11. This suggests that the Danish manufacturers managed to keep the innovation cost level particularly low compared to the other Nordic countries.

If we on the other hand look at the turnover generated by product innovations (figure 4.12), a clear link between competitiveness and innovativeness becomes visible. Especially the difference in innovation strategies between Finland and Sweden is highly illustrative for the general national tendencies to innovate in upgrading existing product lines or in new product development.

Figure 4.11. *Innovation efficiency in the electrical sector. Source: Eurostat (2003)*

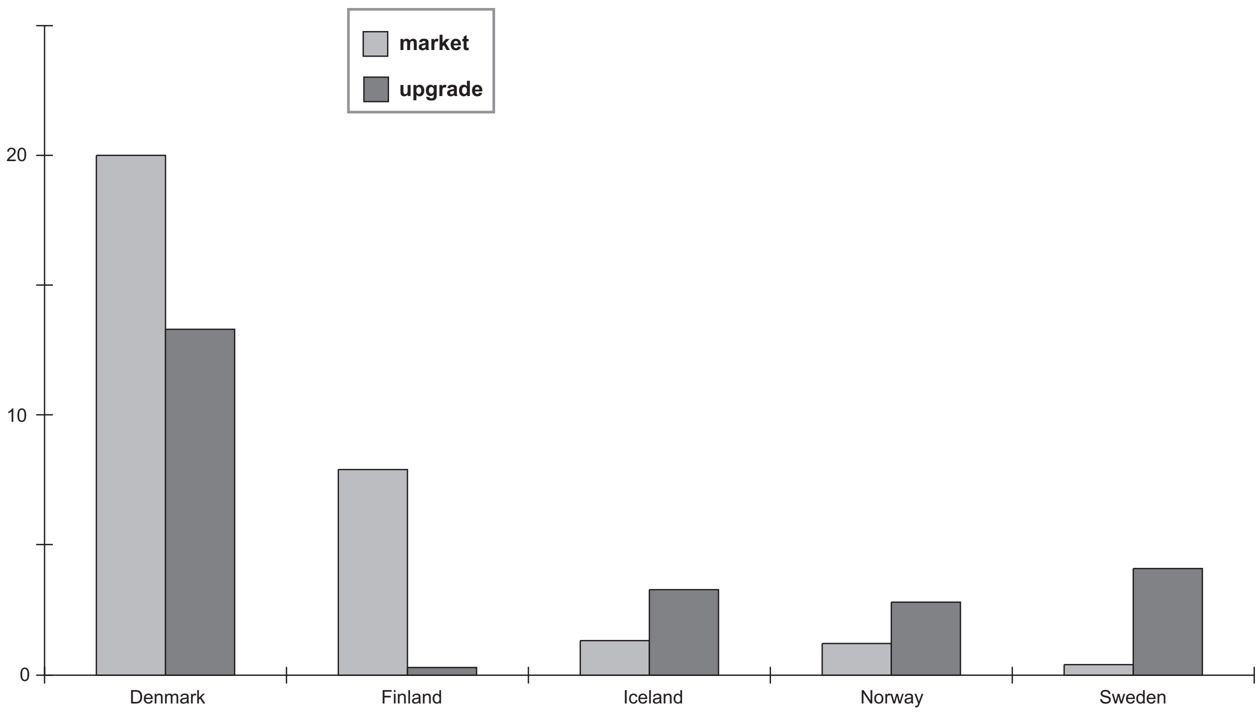
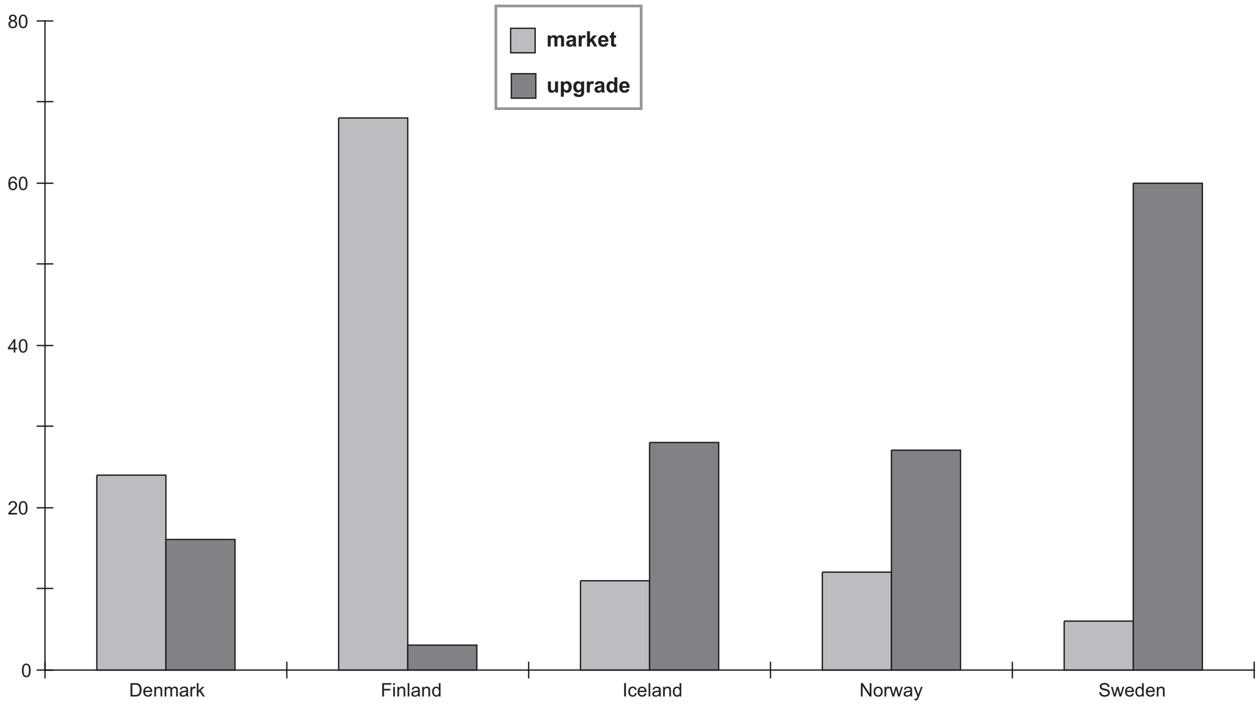


Figure 4.12. Turnover generated by innovation in the electrical sector. Source: Eurostat (2003)



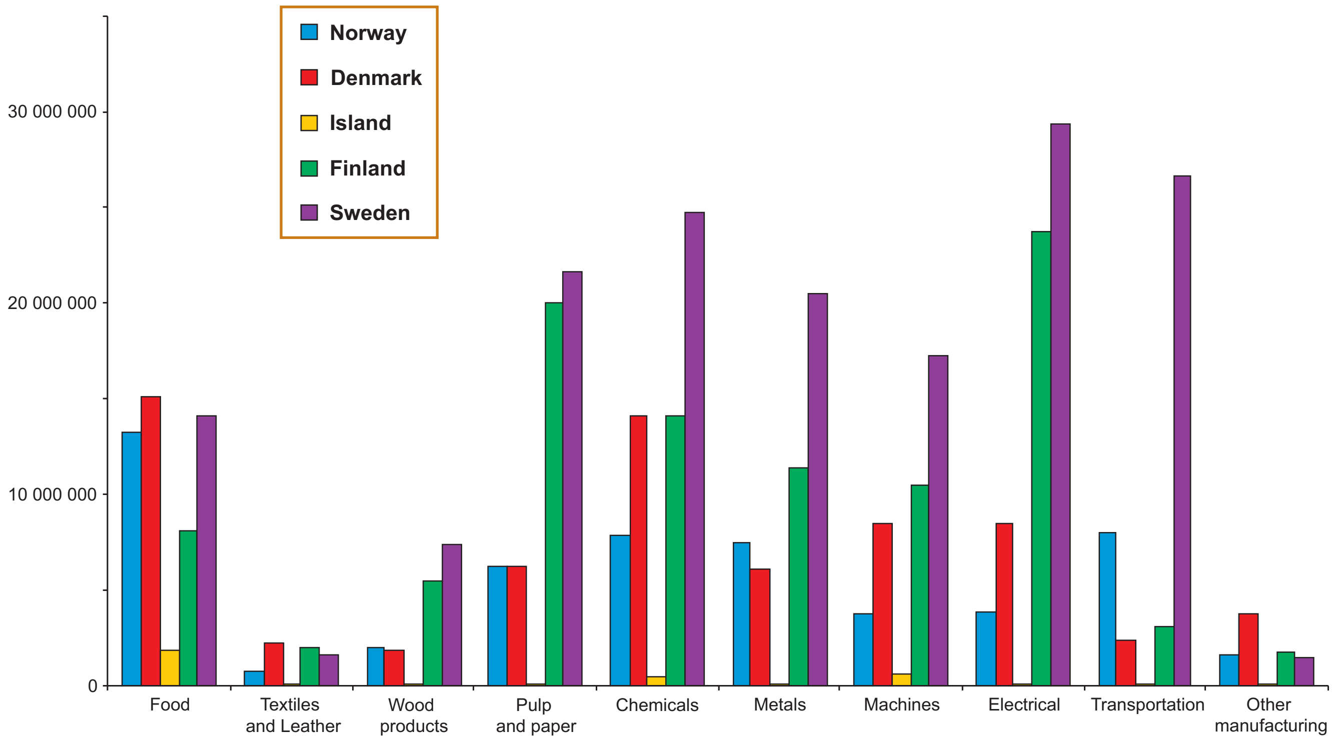
5. Nordic regions: Industrial structure

This regional analysis is based on regionalised Gross Domestic Product[1] (GDP) figures distributed by regions[2] and sectors within manufacturing[3].

The gross regional product (GRD) for manufacturing sectors within each region can give a description of the industrial structure in each region. Which regions are strong in the unlike manufacturing sectors?

If we look at the Nordic countries and GDP distributed by manufacturing sectors in year 2000, we see that Sweden had the highest GDP in 7 out of 10 sectors we have looked at. Finland had the second largest GDP in 6 of the 10 sectors. Denmark had not surprisingly the highest GDP of all the Nordic countries in the food sector. This was also the largest sector for Norway measured in GDP for manufacturing sectors. Iceland has also their largest GDP by manufacturing in the food sector. Iceland has a

Figure 5.1. *Gross Domestic Product in manufacturing (Nace 14–37) for Nordic Countries in 1 000 Euro, year 2000*



[1]For a region, the GDP is 'the market value of all the goods and services produced by labour and property located in' the region, usually a country. It equals GNP minus the net inflow of labour and property incomes from abroad. A gross regional product is the same figure, but for a smaller regions than countries. For our sake this is for the most regions on Nuts 2 level.) See next footnote.)

[2]We use Nuts 2 level regions for Norway, Finland and Sweden. Denmark do not have any Nuts 2 level, but they have their own classification: 'Hovedstadsregionen' (København og Fredrikshavn kommune, Københavns Amt, Frederiksborg Amt and Roskilde Amt); 'Øst for Storebælt' (Vestsjællands Amt, Storstrøms Amt and Bornholm Amt); 'Fyn' (Fyn Amt); 'Sydjylland' (Vejle Amt, Ribe Amt, and Søderjylland Amt); 'Vestjylland' (Ringkjøbing Amt and Viborg Amt); 'Østjylland' (Århus Amt) and 'Nordjylland' (Nordjyllands Amt). Iceland is treated as one region. In addition we look at lower levels where we have figures on metropolitan areas or where we have case studies.

[3]To make the analysis as comparable as possible we have used figures for manufacturing (2 digits Nace 15–37). Some of these Nace codes are also aggregated into new categories. 'Food' (Nace 15–16) Manufacture of food products, beverages and tobacco; 'Textiles and Leather' (Nace 17–19) Manufacture of textiles, leather and leather products; 'Wood products' (Nace 20) Manufacture of wood and wood products, 'Pulp and Paper' (Nace 21–22) Manufacture of pulp, paper, and paper products; publishing and printing; 'Chemicals' (Nace 23–26) Manufacture of coke, refined petroleum products and nuclear fuel, chemicals, chemical products and man-made fibers, rubber and plastic products and other non-metallic mineral products; 'Metals' (Nace 27–28) Manufacture of basic metals and fabricated metal products; 'Machines' (Nace 29) Manufacture of machinery and equipment n.e.c. 'Electrical' (Nace 30–33) Manufacture of electrical and optical equipment; 'Transportation' (Nace 34–35) Manufacture of transport equipment and 'Other Manufacturing' (Nace36) Manufacture n.e.c.

relatively modest GDP in the other manufacturing sectors.

The figures above can be read as follows: The blue columns are the specific regions GRP in a specific manufacturing sector in percent of the countries total GDP in this specific manufacturing sector. The red columns are total GDP in a specific manufacturing sector in percent of total GDP in Norway as a whole.

In this way we can see if the sectors in the different regions are higher than the national level and which manufacturing sectors that are dominating the region.

Norway

The regions of Norway is categorised according to the NUTS 2 classification (see appendix), which for Norway is 6 regions. In addition to these regions we are describing 3 more regions on a lower level (NUTS 3). There are three regions in which case studies have been done: 'Oslo and Akershus' Knowledge intensive business services, 'Vestfold' Electronics and 'Rogaland' food. 'Oslo and Akershus' is also the capital area of Norway.

In figure 5.2 there is an overview of sector specific manufacturing in percent of total manufacturing in Norway, measured by GDP. The largest manufacturing sectors in Norway are 'Food', then 'Transportation', 'Chemicals' and 'Metals'.

This region consists of the capital of Norway, Oslo and to surrounding counties, Akershus and Østfold. Østfold is the county in Norway that is closest to the European Union. As we can see from figure 5.3, 'Oslo, Akershus and Østfold' have the highest GRP in 'Pulp and paper' but are over the national level in several other sectors, especially in sectors like 'Electrical', 'Textiles'. The large GRP in 'Pulp and paper' is related to a large printing and publishing branch.

Figure 5.4 is the same as the previous figure, but now Østfold is not included and this region can be described as the metropolitan area of Norway. We see that this region has over 35 percent of total GDP in 'Pulp and Paper' manufactured in Norway in this sector and over 25 percent of total GDP in 'Electrical' i.e. manufacturing of electrical and optical manufacturing. As a metropolitan area one should expect this region to have a higher GDP in percent of total GDP in the sectors totally in Norway. One explanation of this is that most of the manufacturing and production of products have moved out from this region to the surrounding areas.

Aust- and Vest Agder, Telemark, Vestfold and Buskerud constitute a region that is located west and south for Oslo. As we can see from Figure 5.5 (page 78) this region's GRP is higher and much higher than the specific sectors in per-

Figure 5.2. *Sector specific GDP, manufacturing in percent of total GDP in manufacturing in Norway, in 2000*

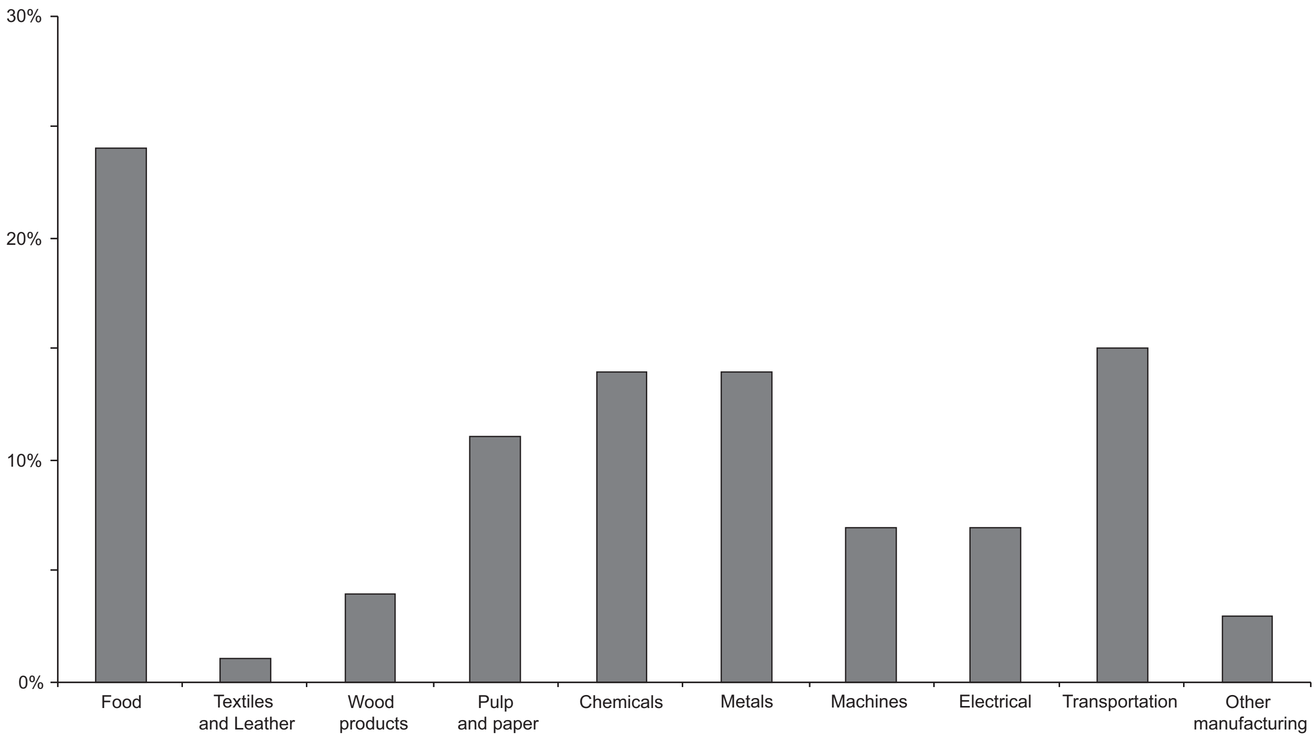


Figure 5.3. Oslo, Akershus and Østfold GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000

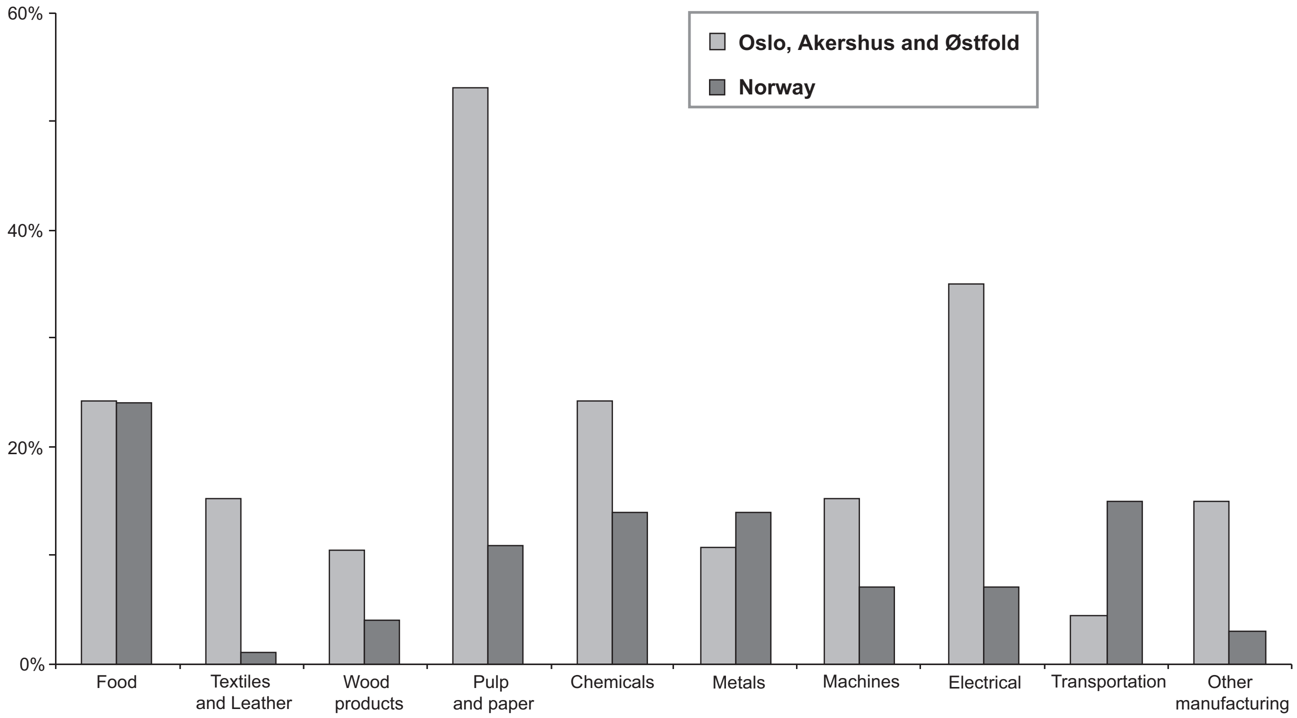


Figure 5.4. Oslo and Akershus GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000

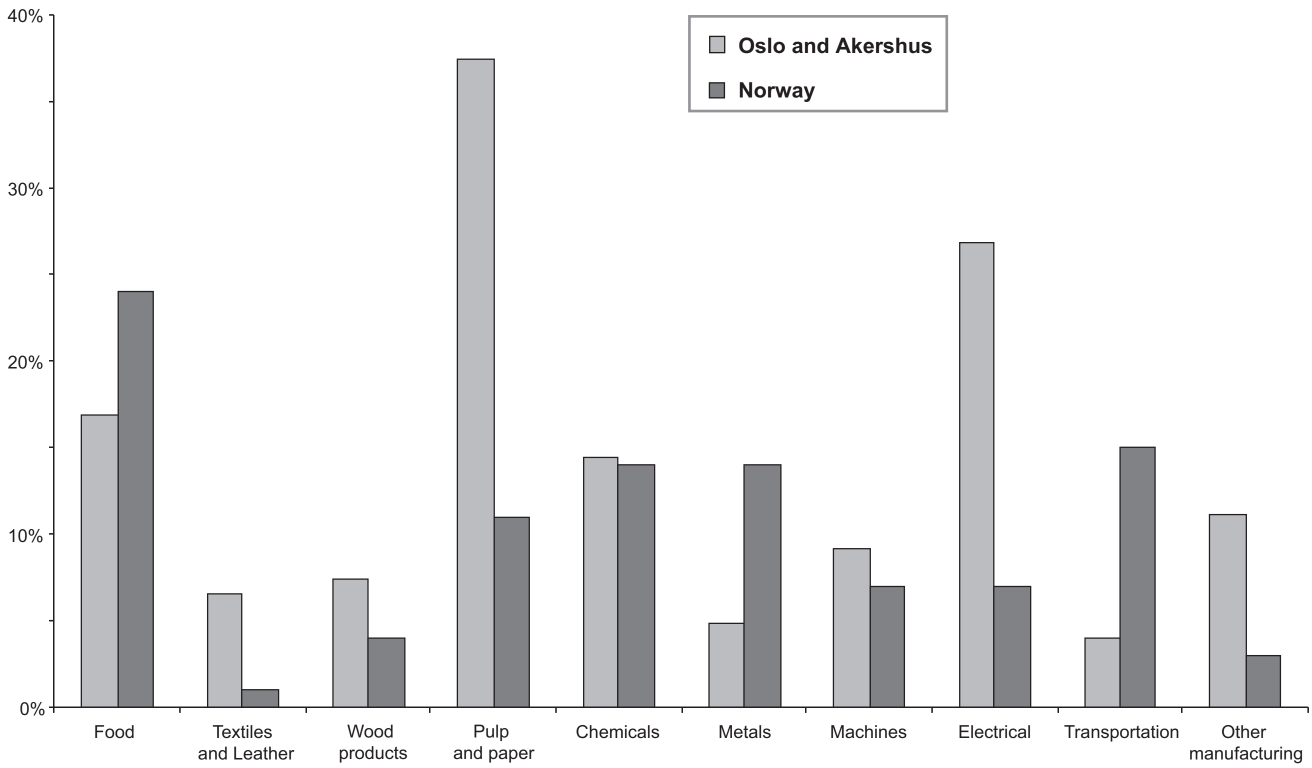


Figure 5.5. Aust- and Vest-Agder, Telemark, Vestfold and Buskerud GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000

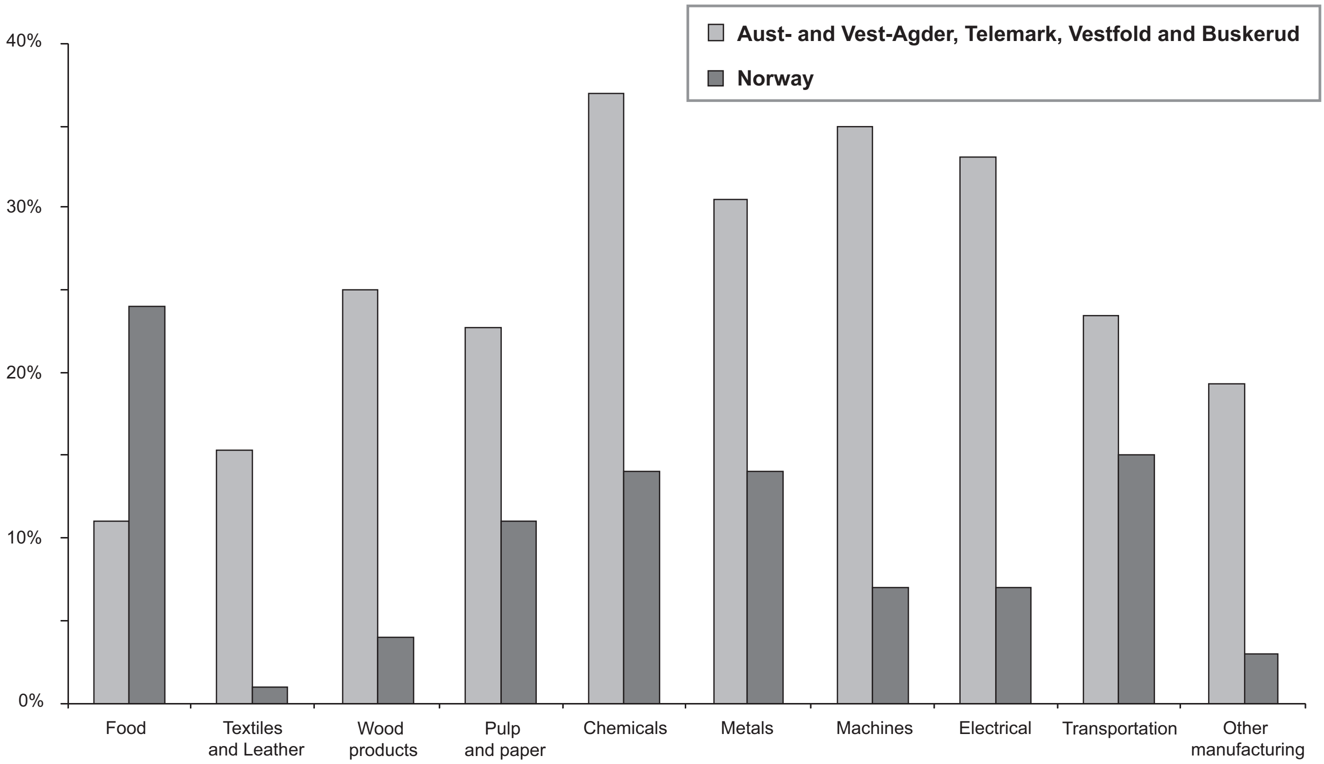


Figure 5.6. Vestfold GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000

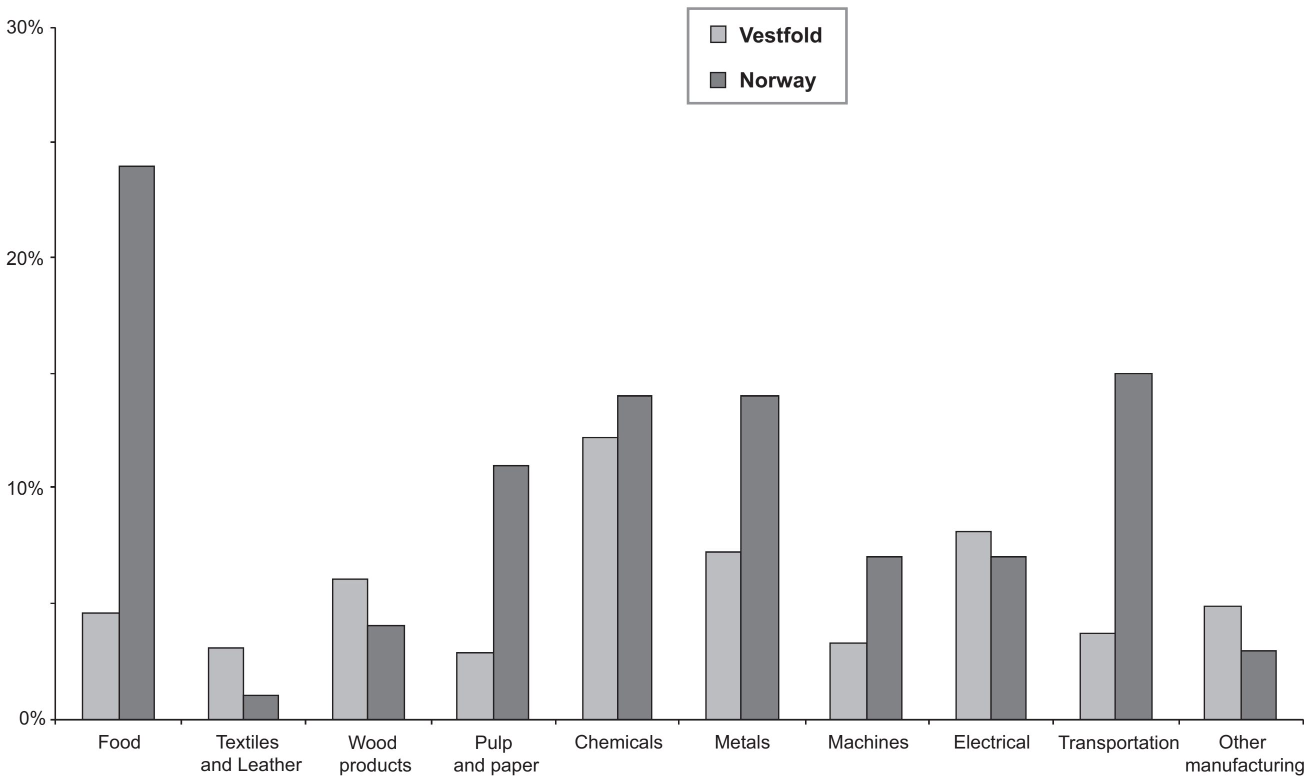
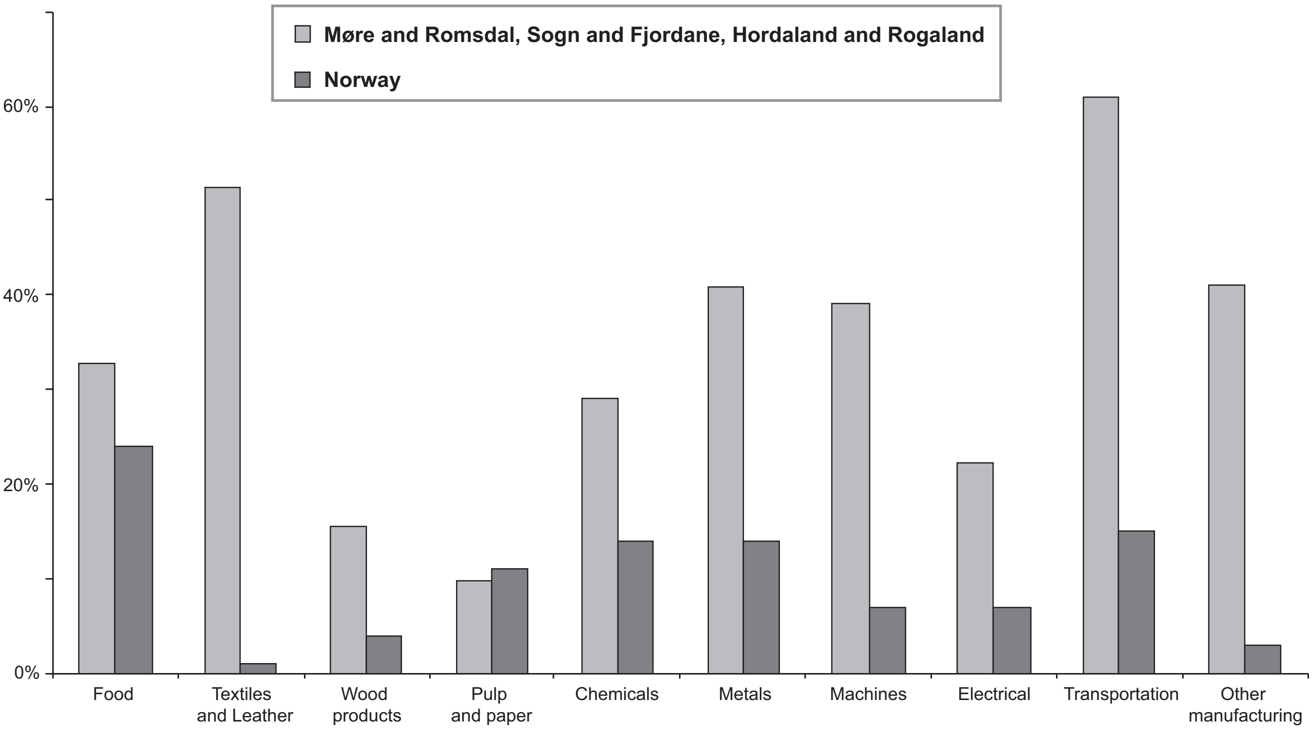


Figure 5.7. Møre and Romsdal, Sogn and Fjordane, Hordaland and Rogaland GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000



cent of Norway's total GDP in manufacturing in the different sectors. This is especially noticeable in 'Machines' and 'Electrical'. One explanation to this can be the electrical cluster located in Horten, Vestfold. 'Wood products' and 'Chemicals' have respectively 25 and 37 percent of the total GDP in these specific sectors in Norway.

The only manufacturing sector where the GRD is lower than Norway is 'Food'.

If we particularly look at Vestfold, we can see that 'Electrical' sector amounts to about 8 percent of total GDP in this sector in Norway, a sector that stands for about 7 percent of total GDP in manufacturing in Norway. 'Textiles and Leather', 'Wood products' and 'Other manufacturing' are also higher than the share of the sectors at a national level.

Møre and Romsdal, Sogn and Fjordane, Hordaland and Rogaland are parts of a region located at the west coast of Norway. Manufacture of transport equipment is the largest sector in the region measured in GDP. Over 60 percent of the manufacturing of these products is being done in this region. Over 50 percent of textiles and leather is also produced in this region although this sector only stands for 1 percent of GDP in manufacturing in Norway. Manufacture sectors in this region like 'Metals' and 'Machines' also stands for about 40 percent of total manufacturing in these sectors in Norway. These sectors amount to 14 and 7 percent of total manufacturing GDP in the country. This region has a high degree of manufacturing also in all the biggest sectors in percent of national GDP in manufacturing in Norway.

If we look at Rogaland separated from the rest of the region referred to above, we see from figure 5.8 (next page) that Rogaland almost manufactures 25 percent of transportation equipment in Norway and this sector amount for 15 percent of total GDP within manufacturing. Rogaland also manufactures nearly 15 percent of 'Metals' in Norway, which is one of the largest sectors within manufacturing in Norway. It sizes up to 14 percent of total manufacturing, measured by GDP in Norway. Manufacture of 'Transport' and 'Metals, and 'Machines' equipment is closely connected to the oil industry in the region.

Figure 5.9 (next page) shows a region, which consists of three counties in Norway; Sør-Trøndelag, Hedmark and Oppland. Most part of this region can be referred to as inland. The dominating manufacture sector here is 'Wood products', which stands for 39 percent of total manufacture of wood and wood products in Norway. This sector as a whole contributes with only 4 percent to the national GDP in manufacturing.

Troms, Nordland and Nord-Trøndelag constitute a region of the northern Norway. Except for 'Textiles and Leather' and 'Wood products' this region manufactures less than the total sectors do in percent of total national manufacture. The dominant manufacture sector is 'Food'. The region manufactures nearly 15 percent of total manufacture of food, a sector that stands for 24 percent of total GDP within manufacturing in Norway. This is related to the fish industry.

Finmark is the northernmost region in Norway. As figure 5.11 (page 81) illustrates most of the manufacture in-

Figure 5.8. *Rogaland GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000*

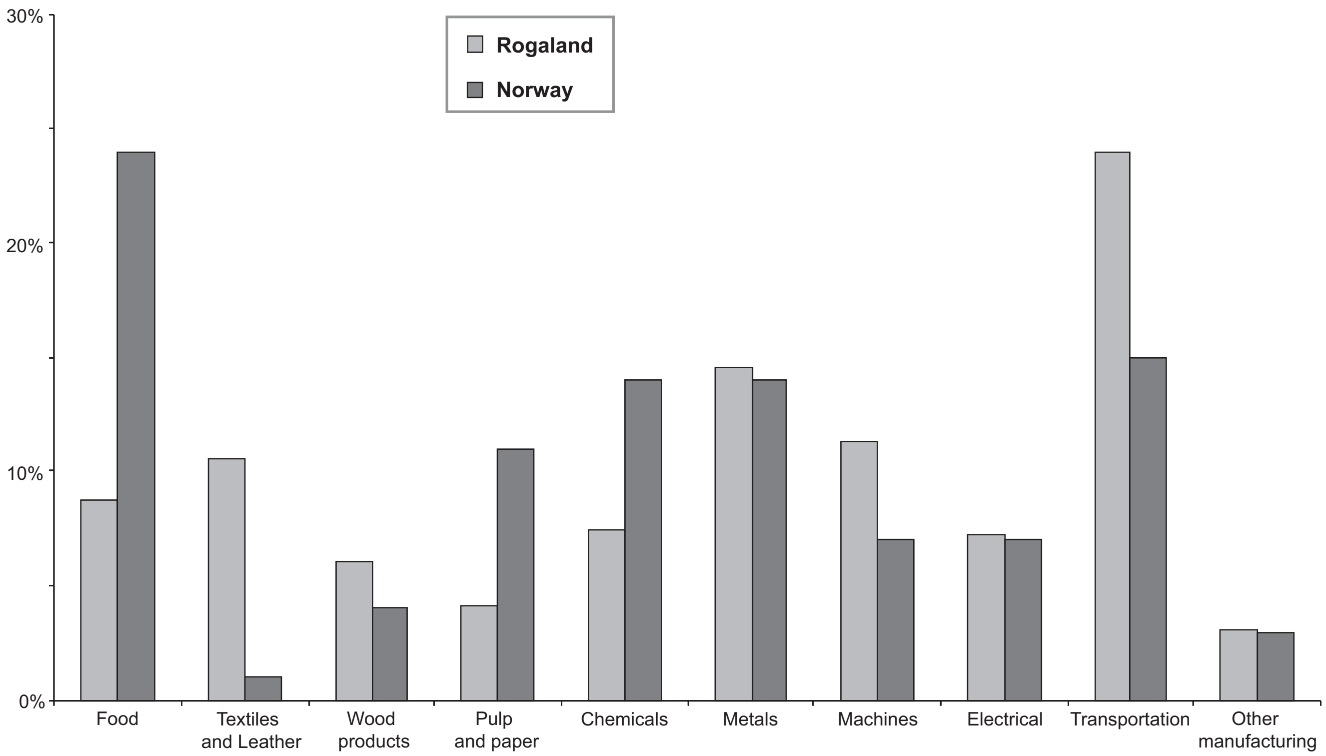


Figure 5.9. *Sør-Trøndelag, Hedmark and Oppland GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000*

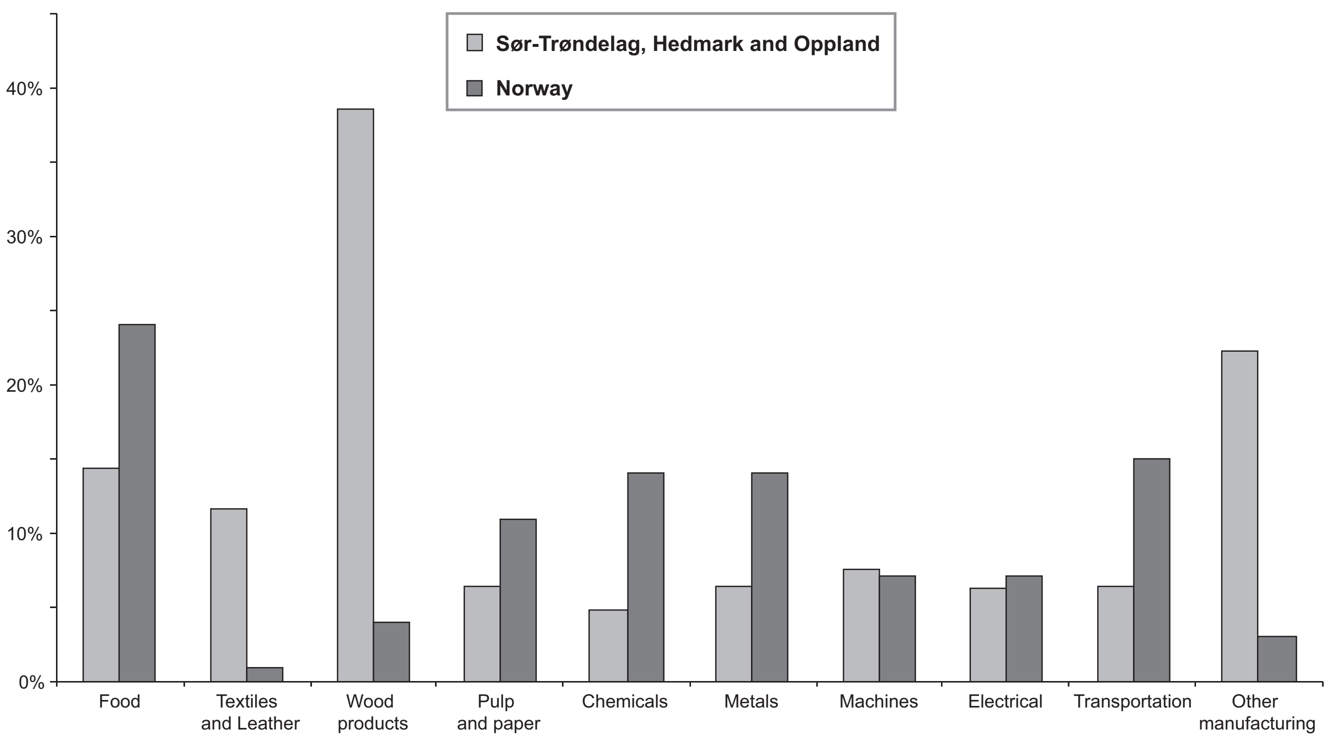


Figure 5.10. Troms, Nordland and Nord-Trøndelag GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000

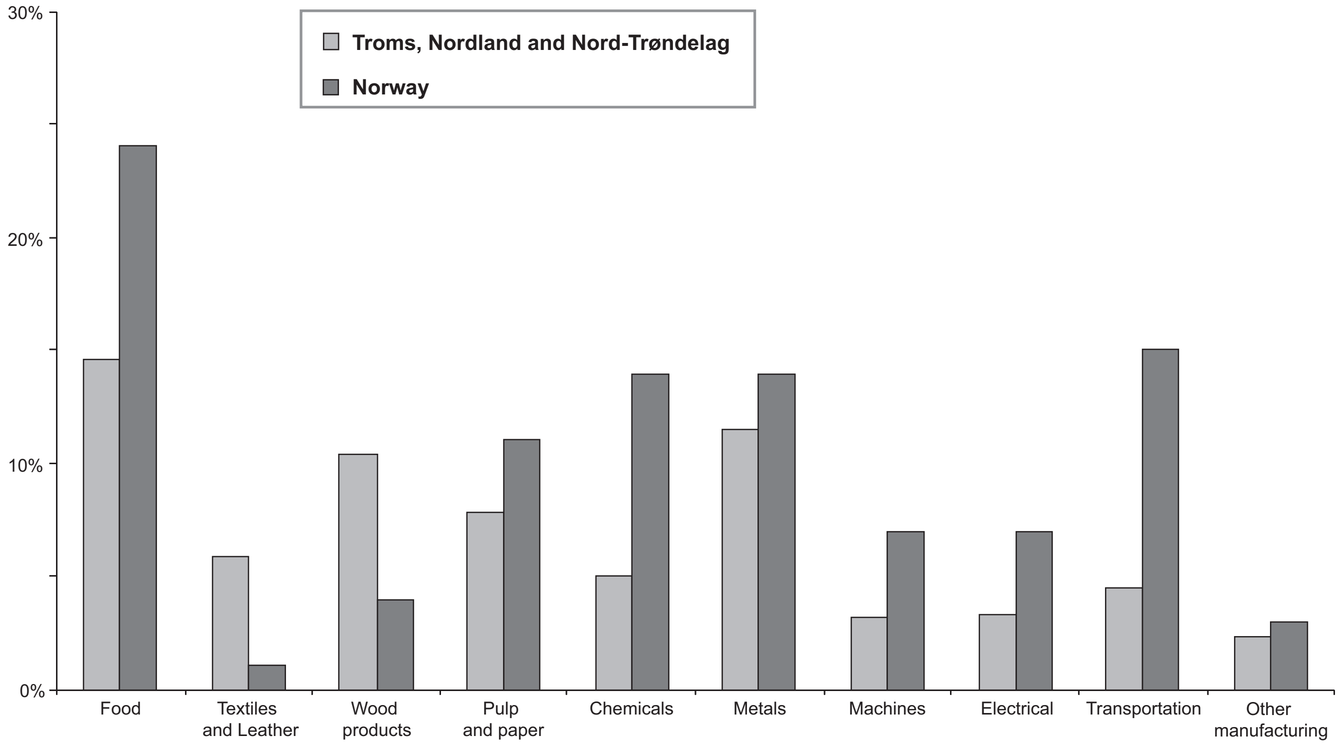


Figure 5.11. Finmark GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000.Gross Regional Product for Finmark and Norway, Manufacturing (Nace 14–37), in 1 000 Euro

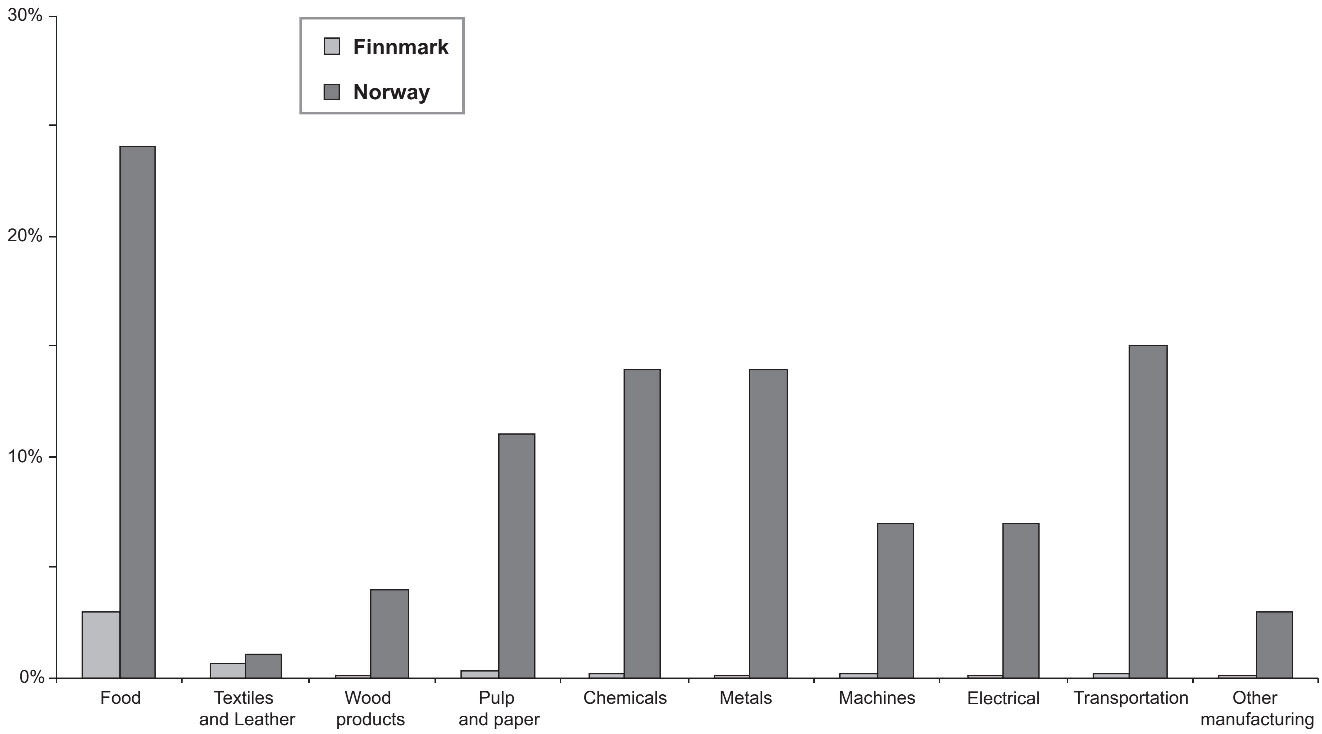
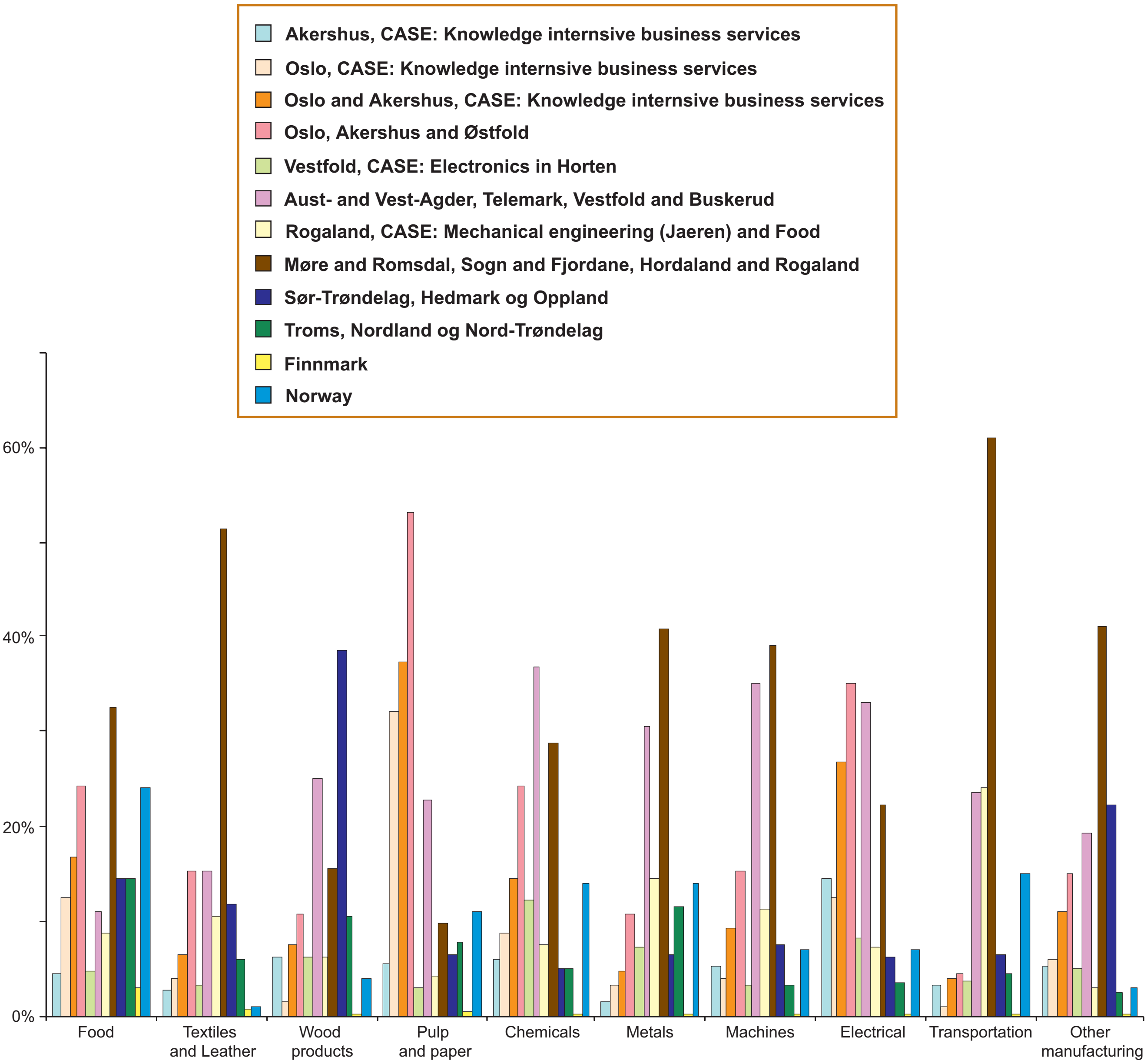


Figure 5.12. All NUTS 2 regions GRP in Norway by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Norway, in 2000 and case regions (nuts 3), Manufacturing (Nace 14–37), in 1 000 Euro



dustry for this region is in the food sector and is basically related to the fishing industry.

Figure 5.12 shows all the regions and manufacturing sectors together in one figure. We see that 'Møre and Romsdal, Sogn and Fjordane, Hordaland and Rogaland' together with 'Aust- and Vest Agder, Telemark, Vestfold and Buskerud' are the two regions that have most sectors with a high gross regional product in share with total GDP in this sector in Norway. 'Møre and Romsdal, Sogn and Fjordane, Hordaland and Rogaland' also have the highest shares in the manufacture sectors that stand for the highest amount of sector specific GDP and total GDP in manufacturing in Norway as a whole.

Denmark

The division of the Danish regions are based on the fact that 'amterne' or the counties are united into larger geographical units[4]: The metropolitan area or 'Hovedstadsregionen' include Københavns and Frederiksberg municipalities and Københavns, Roskilde and Frederiksborg County. East of Storebelt or 'Øst for Storebelt' includes Vestsjællands, Storstrøms and Bornholms County. 'Fyn' includes Fyns County, 'Sydjylland' includes Sønderjyllands, Ribe and Vejle County.' Østjylland' includes Århus County. 'Vestjylland' includes Ringkøbing and Viborg County and at least 'Nordjylland' includes Nordjyllands County.

Figure 5.13 is a histogram of sector specific manufacturing in percent of total manufacturing in Denmark, measured by GDP. The largest manufacturing sectors in Denmark are 'Food' with 22 percent and 'Chemicals' with 20 percent of total manufacturing. 'Machines' and 'Electrical' stands each for 12 percent of total manufacturing.

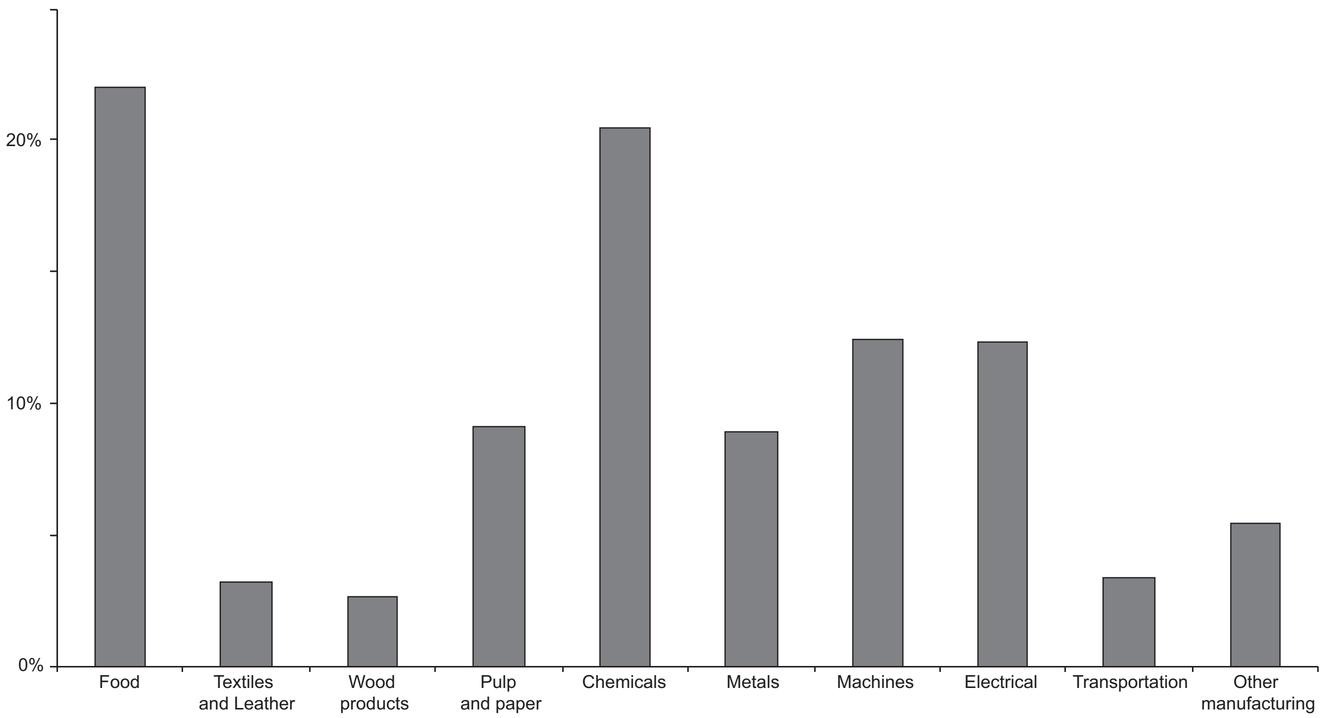
The metropolitan area of Denmark has a high GRP in all the largest manufacturing sectors in the country. Especially in sectors like 'Chemicals' and 'electrical'. For 'Chemicals' the region manufactures nearly 50 percent of total manufacture in chemicals and nearly 37 percent in the electrical sector. In 'Pulp and Paper' sector this region manufactures approximately 45 percent of total manufacturing. 'Food' is also a sector in which this region has a large GRP in share of total manufacturing in this specific sector in the country. The food manufacture sector has the highest GDP among the manufacture sectors.

'Øst for Storebelt' is located south of metropolitan area in Denmark. The industry sector in this region is dominated by 'Food' and 'Chemicals'. The manufacture in these sectors is both close to be 10 percent of total manufacture at a national level. Overall the sectors in this region manufacture at a lower rate than the specific sectors share of total GDP in the country as a whole.

Figure 5.16 (page 85) shows the industrial structure of Fyn, a region located at the eastern side of Jylland. This region has almost 30 percent of total manufacture of transport equipment, but this is a rather small sector at a national level with a share of 3 percent and total manufacturing in Denmark. The largest sector if we take in consideration the size of the sector at a national level is 'Food'.

Sydjylland is a region south in Denmark and border on to Germany. 'Transportation' and 'Machines' make respectively 27 and 30 percent of total manufacturing in this sector at a national level. If we also take the size of the sector at a national level in consideration 'Food' is the largest manufacture sector.

Figure 5.13. *Sector specific GDP, manufacturing in percent of total GDP in manufacturing in Denmark, in 2000*



[4] The Danish Centre for Studies in Research and Research Policy (http://www.cfa.au.dk/)

Figure 5.14. Metropolitan area 'Hovedstadsregionen' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Denmark, in 2000

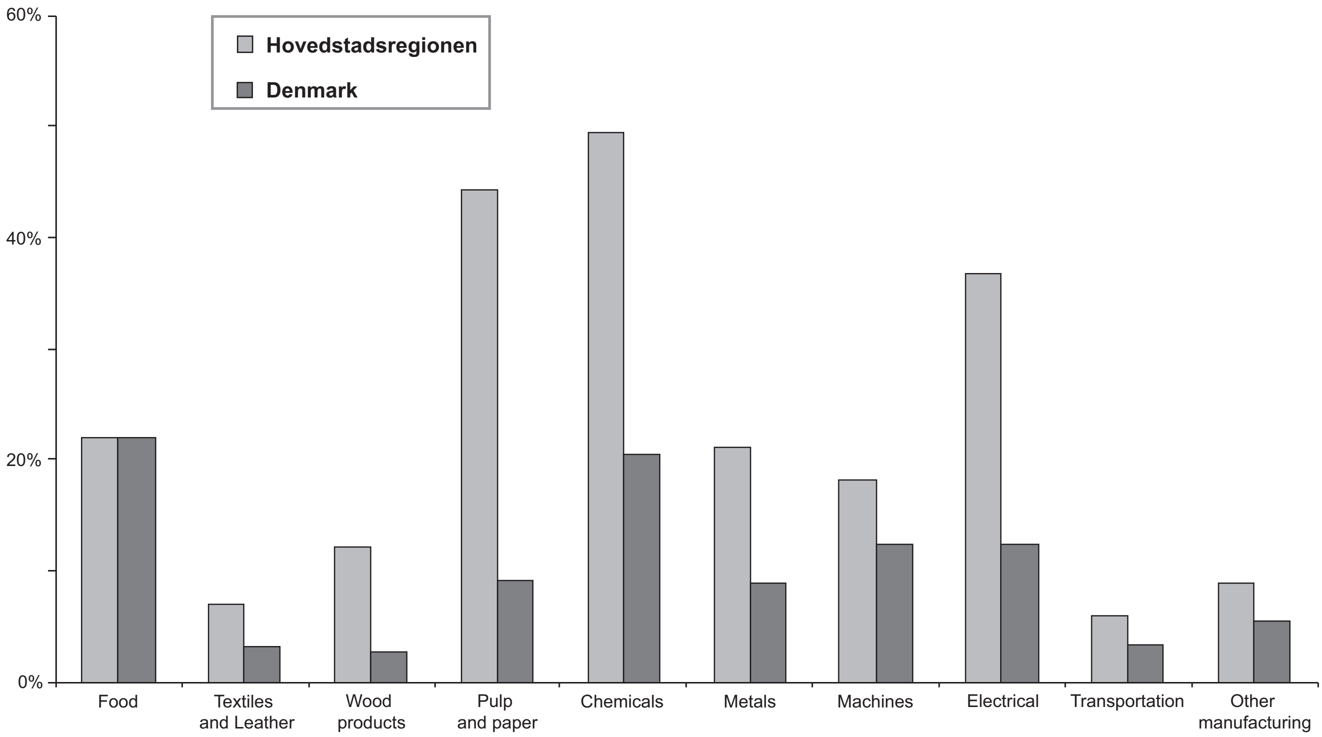


Figure 5.15. 'Øst for Storebelt' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Denmark, in 2000

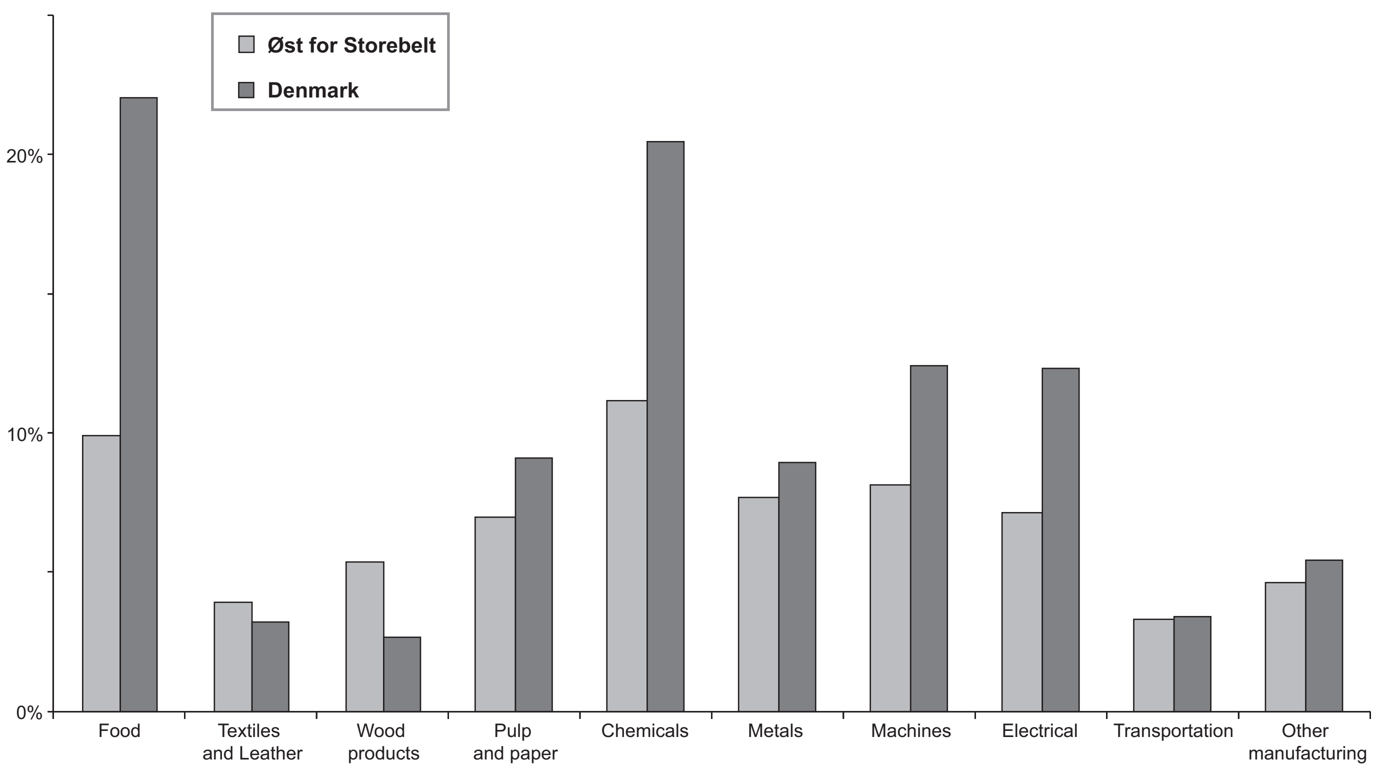


Figure 5.16. *Fyn GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Denmark, in 2000*

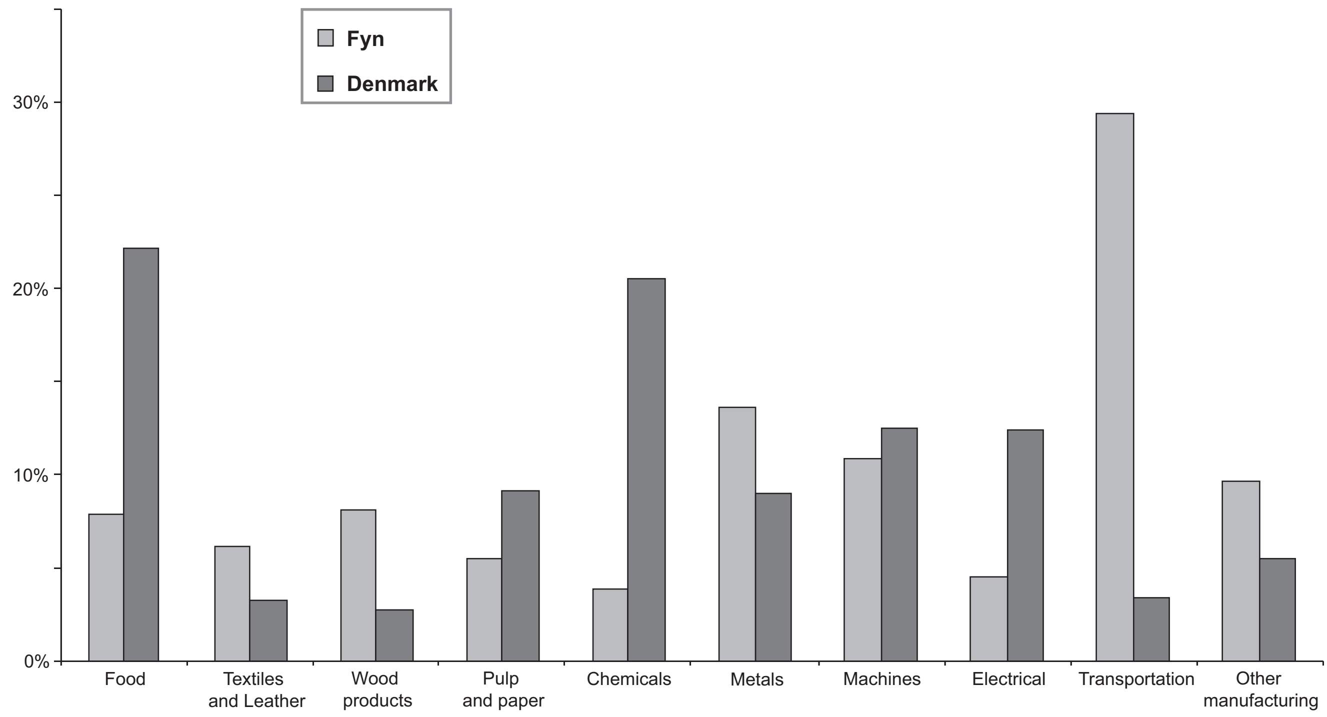


Figure 5.17. *'Sydjylland' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Denmark, in 2000*

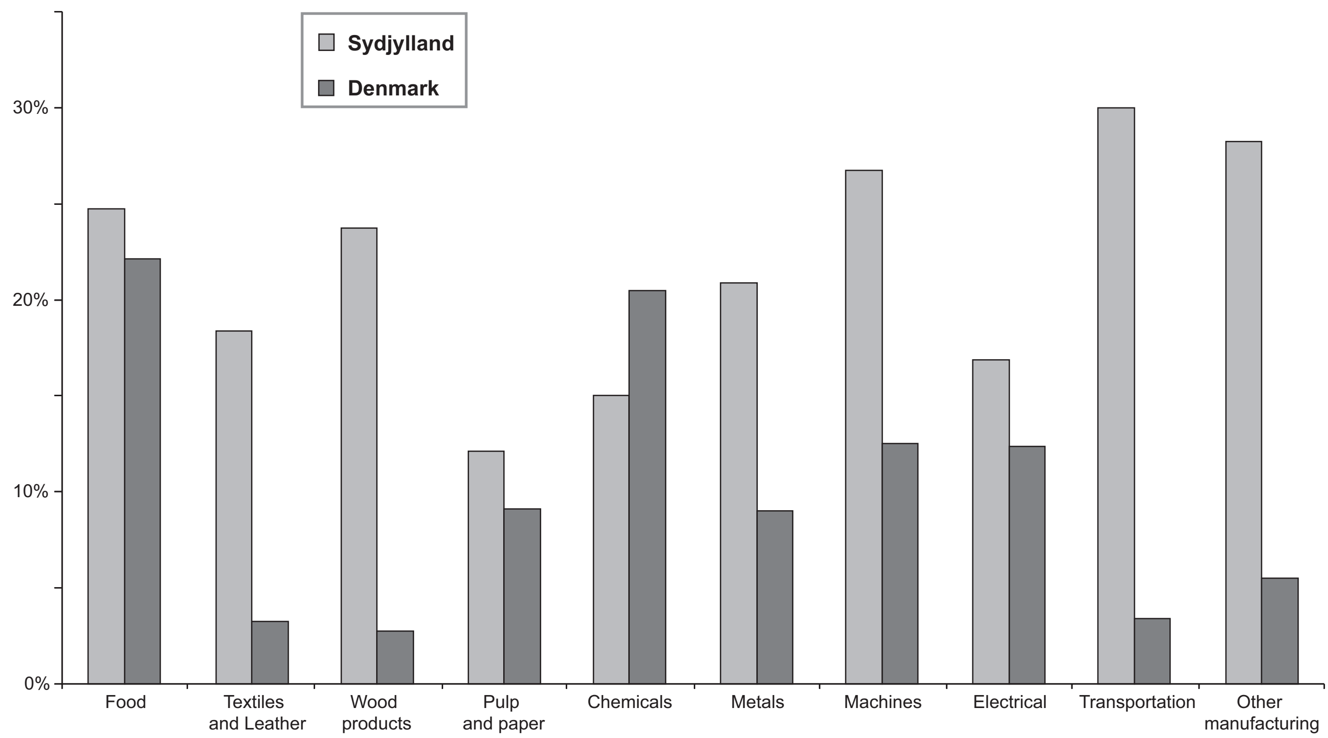


Figure 5.18. *'Vestjylland' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Denmark, in 2000*

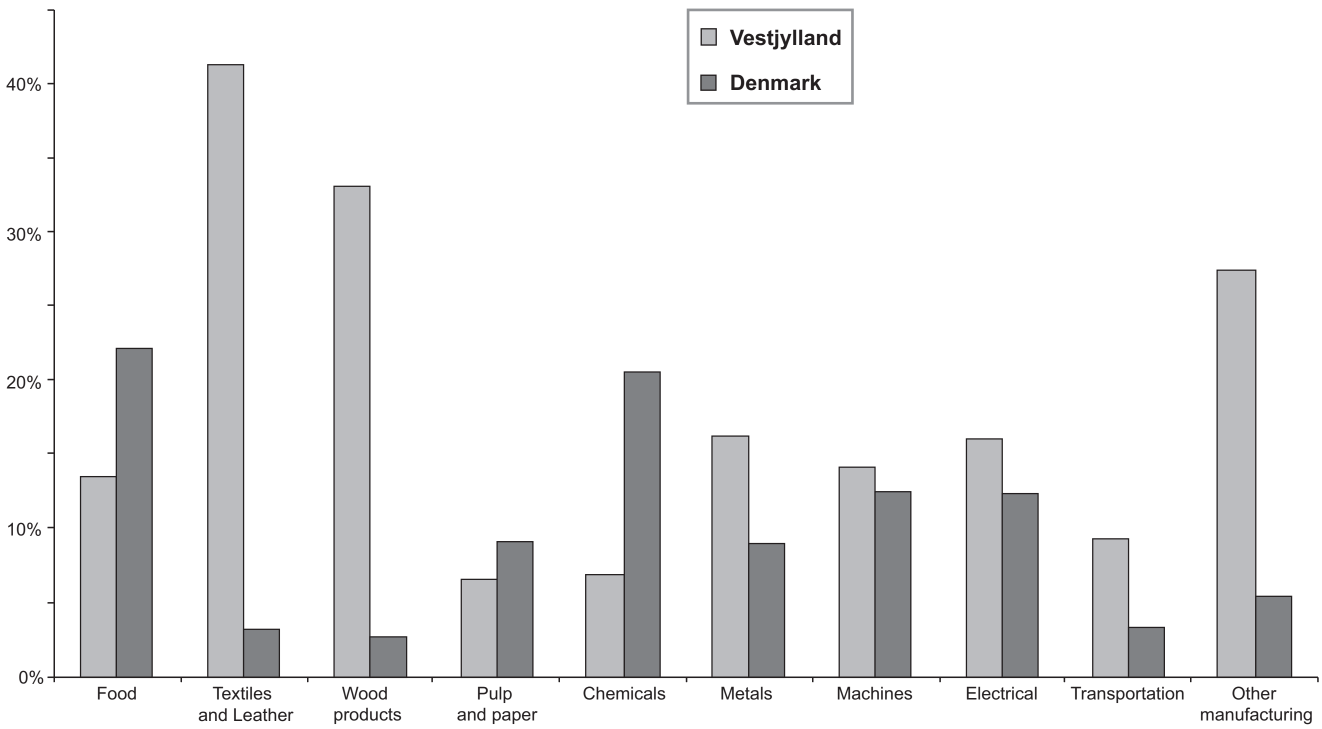


Figure 5.19. *'Østjylland' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Denmark, in 2000*

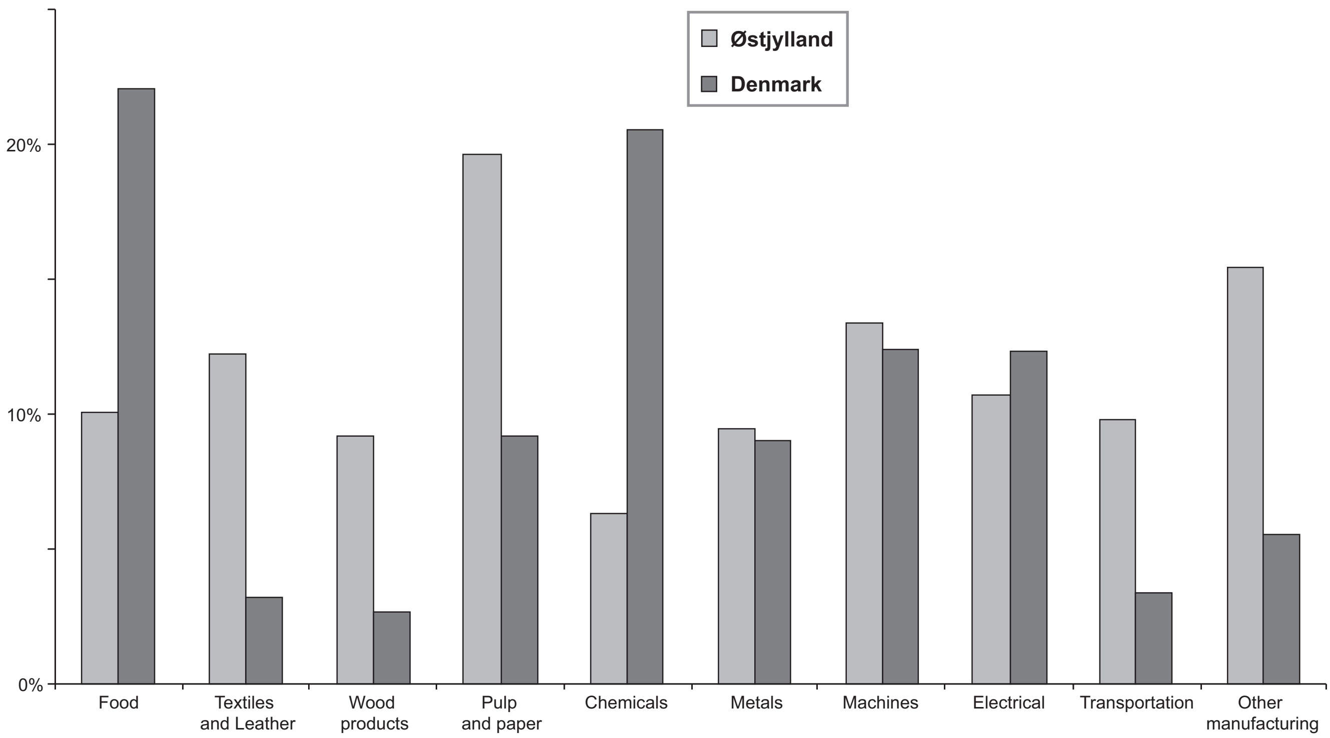
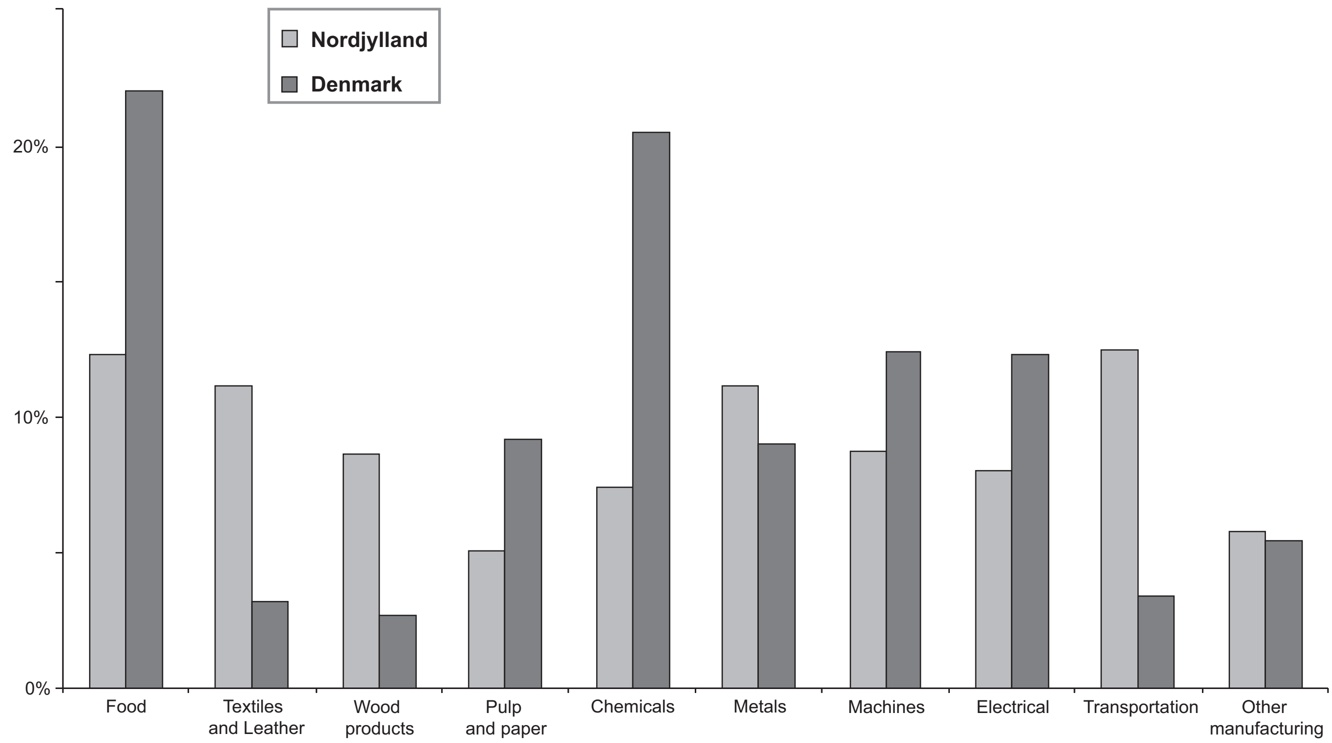


Figure 5.20. 'Nordjylland' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Denmark, in 2000



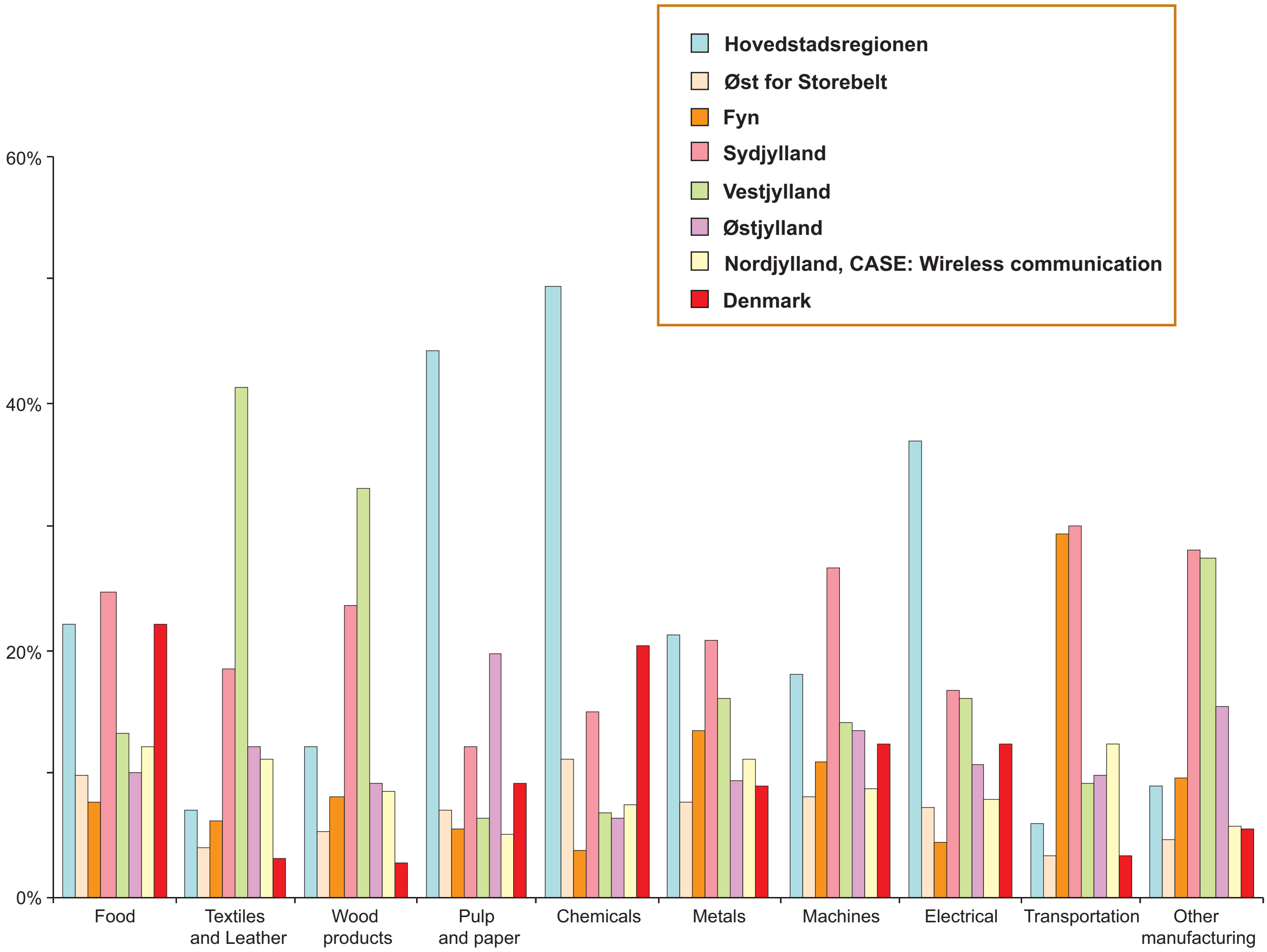
'Vestjylland' include Ringkøbing and Viborg County and are geographically located at the west side of Denmark. If we look at specific sectors in this region, which have the largest GRP in percent of national specific sectors we see that this region manufacture over 40 percent of total textiles and leather products and 33 percent of total wood manufacturing in the country. The region has also a relatively large GDP in share of total sector specific manufacturing in i.e. 'Electrical', 'Machines' and 'Metals'.

Figure 5.19 gives a description of the industry structure in 'Østjylland' measured in GRD in percent of total GDP in manufacturing in Denmark. The pattern we can see in this region is that the region for instance manufactures nearly 20 percent of 'Pulp and paper' in Denmark. The machine sector in this region has also a large share of GDP at a national level. In addition it manufactures over 10 percent of the food products in Denmark.

Nordjylland is the northernmost region in Denmark. The region manufactures both 12 percent of food products and transportation equipment in these specific sectors in Denmark. If we take the size of the sector at a national level in consideration 'Food' is the largest manufacture sector with 'Chemicals' at second place.

If we look at all the regions at the same time, we can see that the 'Hovedstadsregionen' mostly has the largest GRD in most manufacture sectors in percent of total GDP in the specific manufacturing sector in the country. 'Vestjylland' and 'Sydjylland' also dominate some manufacture sectors.

Figure 5.21. All NUTS 2 regions GRP in Denmark by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Denmark, in 2000 and case regions (nuts 3), Manufacturing (Nace 14–37), in 1 000 Euro

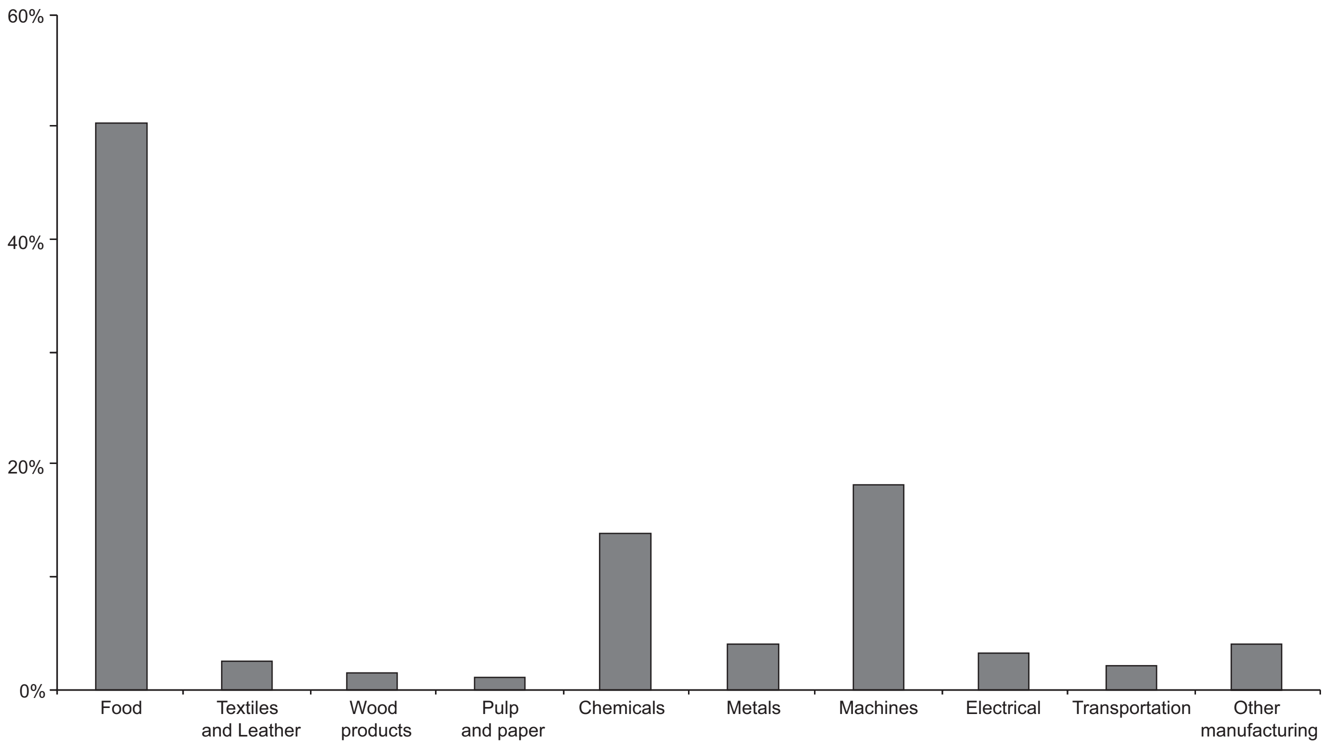


Iceland

In this analysis Iceland is treated as one region. This is due to the fact that most of the statistics in Iceland are on national level.

Figure 5.22 shows GDP that comes from manufacturing sectors (Nace 14–37), in percent of the total manufacturing sector. Over 50 percent of total manufacturing in Iceland comes from the food sector and this is related to the fishing industry. Manufacture of 'Machines' and 'Chemicals' sums up to respectively 18 and 14 percent of total manufacturing in Iceland. The rest of the sectors stand for 4 percent or less of the total manufacturing.

Figure 5.22. *Gross Domestic product for Iceland by Manufacturing (Nace 14–37), in percent*



Finland

For Finland we use the NUTS 2 level on the regions. The NUTS 2 level divides Finland into five regions. In addition we have extracted Uusimaa as a separated region since it often is seen as the metropolitan area in Finland. 'Keski-Suomi' is also separated since one of our case studies is from this specific area.

From figure 5.23 we can see that the largest manufacturing sector in Finland is 'Electrical', with nearly 24 percent of total manufacturing in Finland. 'Pulp and paper' stands for approximately 20 percent of total manufacturing, while 'Chemicals', 'Metals' and 'Machines' respectively amount for 14, 11 and 10 percent.

'Etelä-Suomi' is a region located in the south of Finland and it includes the metropolitan area around Helsinki, the capitol city. We see that this region has a very high GRP in each specific sector in percent and of the total GDP in this sector in the country, also in the largest sectors measured in sector specific manufacture GDP in total manufacture GDP of the country. For instance the region manufactures nearly 66 percent of electrical equipment, which is a sector that amounts to about 24 percent of the total manufacturing in Finland.

If we look at Uusimaa (figure 5.25) a smaller region than 'Etelä-Suomi', the picture is not so dominating, but still this region amounts for nearly 36 percent of total manufacturing in the 'Electrical' sector and has a high percentage GRP of the national sector specific GDP.

'Länsi-Suomi' is located in the west of Finland and is a part of inland Finland. Over 60 percent of Finland's textiles and leather products are manufactured in this region, but this sector only contributes with 2 percent of total manufacturing in Finland. If we take the size of the sector at a national level in consideration 'Pulp and paper' is the largest manufacture sector with 'Machines' at second place.

'Keski-Suomi' is located in the centre of Finland. We can see, when the regions are getting smaller, their manufacturing industry sector GRD, is not so large in percent of total manufacturing in specific sectors. One of the largest manufacturing sectors in this region is 'Pulp and paper', which stands for almost 10 percent of Finland's total GDP in this specific sector. Since 'Pulp and paper' is one of the dominating manufacturing sectors at national level, this sector has the largest GRP measured in absolute figures.

'Pohjois-Suomi' is the region located northernmost in Finland. This region manufactures nearly 28 percent of total manufactured 'Metals' in Finland, but the 'Electrical' sector is the largest, measured in absolute figures. This is due to the fact that over 16 percent of electrical equipment is manufactured in this region, which is the largest manufacture sector in Finland. 'Wood products' and 'Pulp and paper' are also manufactured in a relatively large scale in this region with respectively 12 and 11 percent of total sector specific GDP.

Åland is the smallest region at NUTS 2 level in Finland

Figure 5.23. *Sector specific GDP, manufacturing in percent of total GDP in manufacturing in Finland, in 2000*

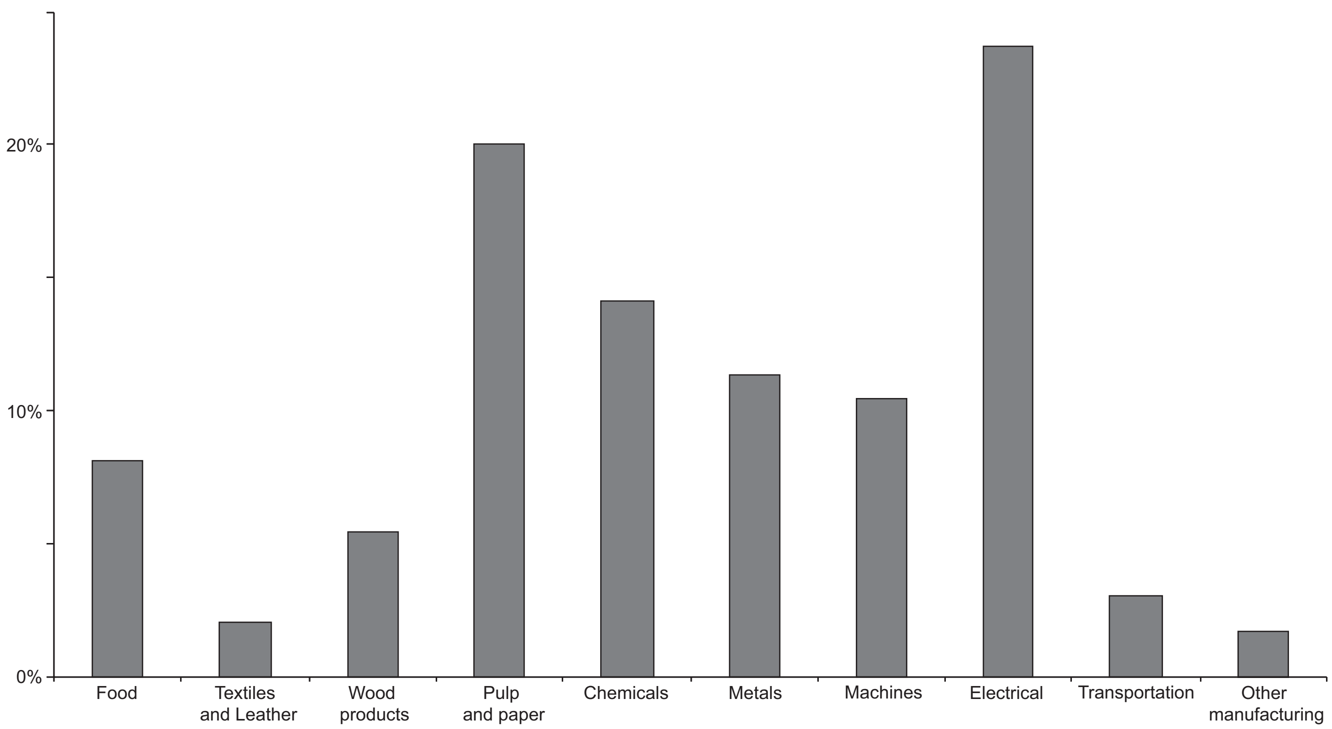


Figure 5.24. 'Etelä-Suomi' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Finland, in 2000

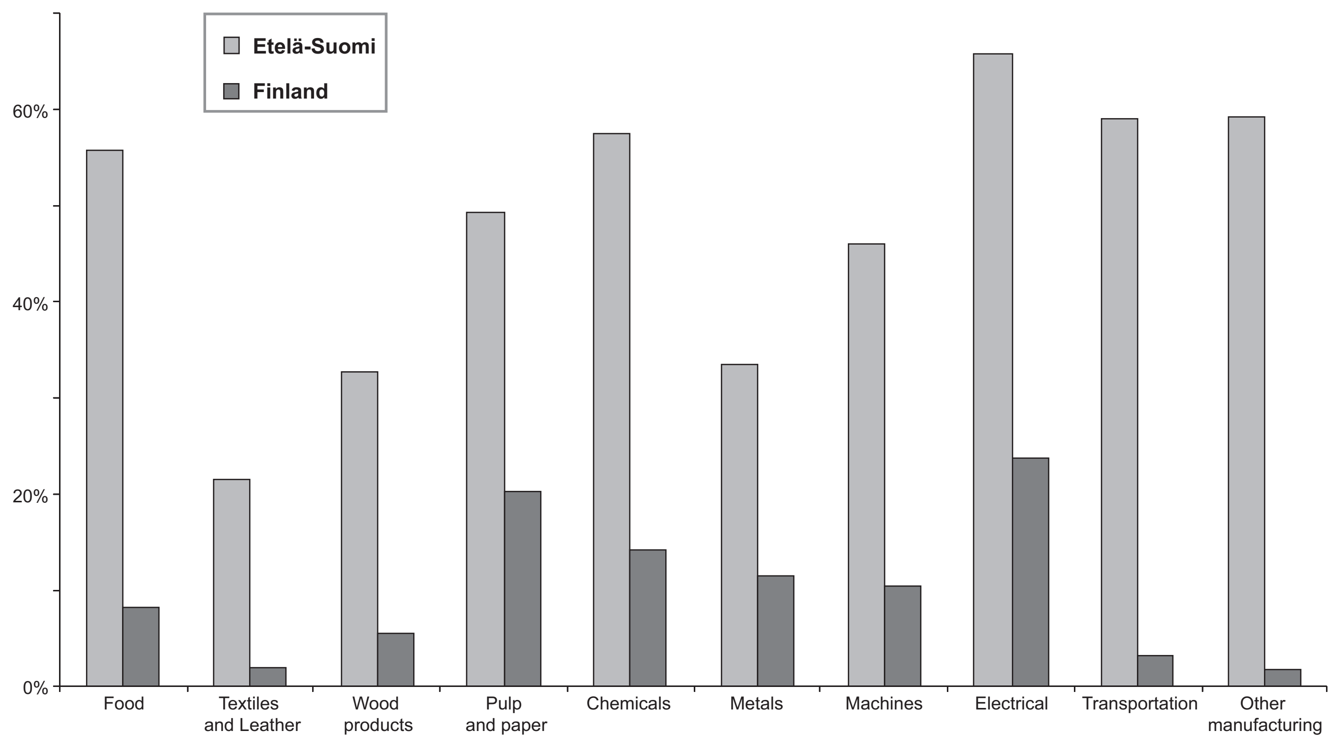


Figure 5.25. Uusimaa GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Finland, in 2000

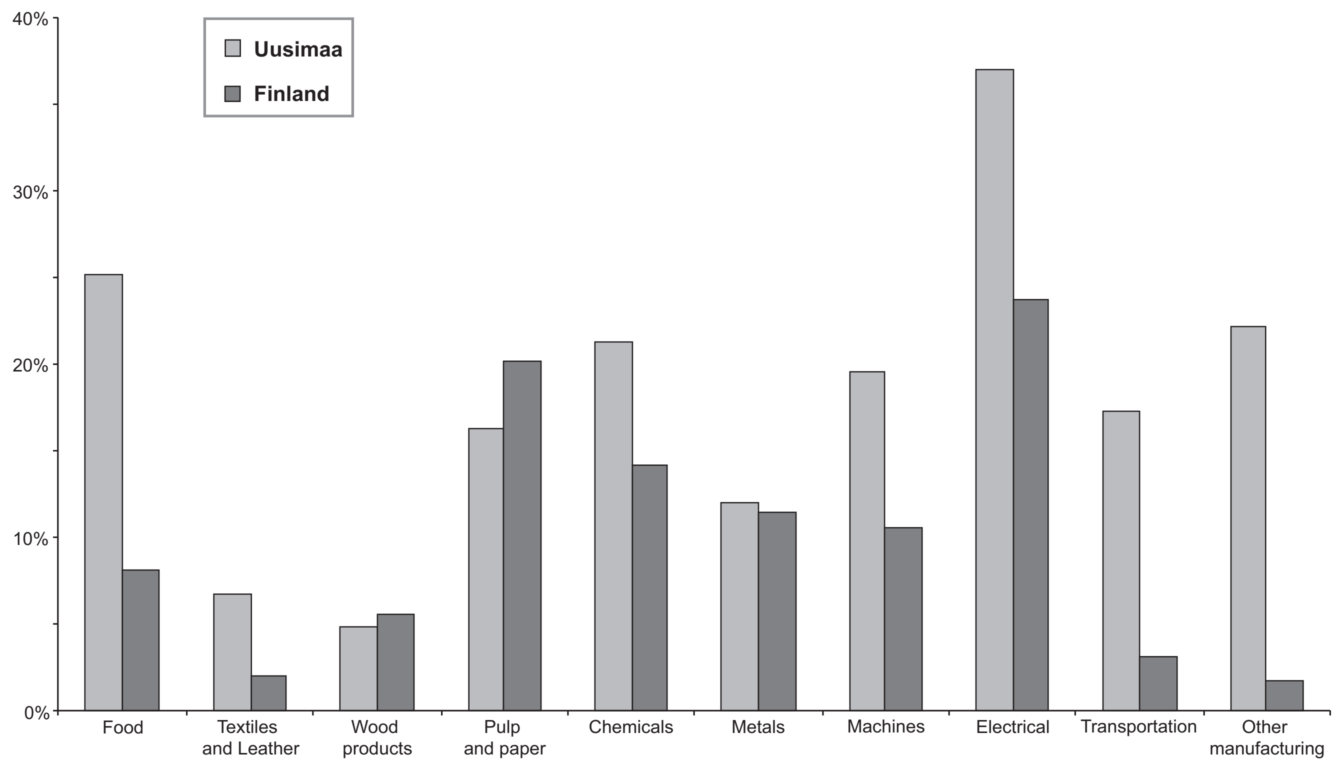


Figure 5.26. 'Länsi-Suomi' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Finland, in 2000

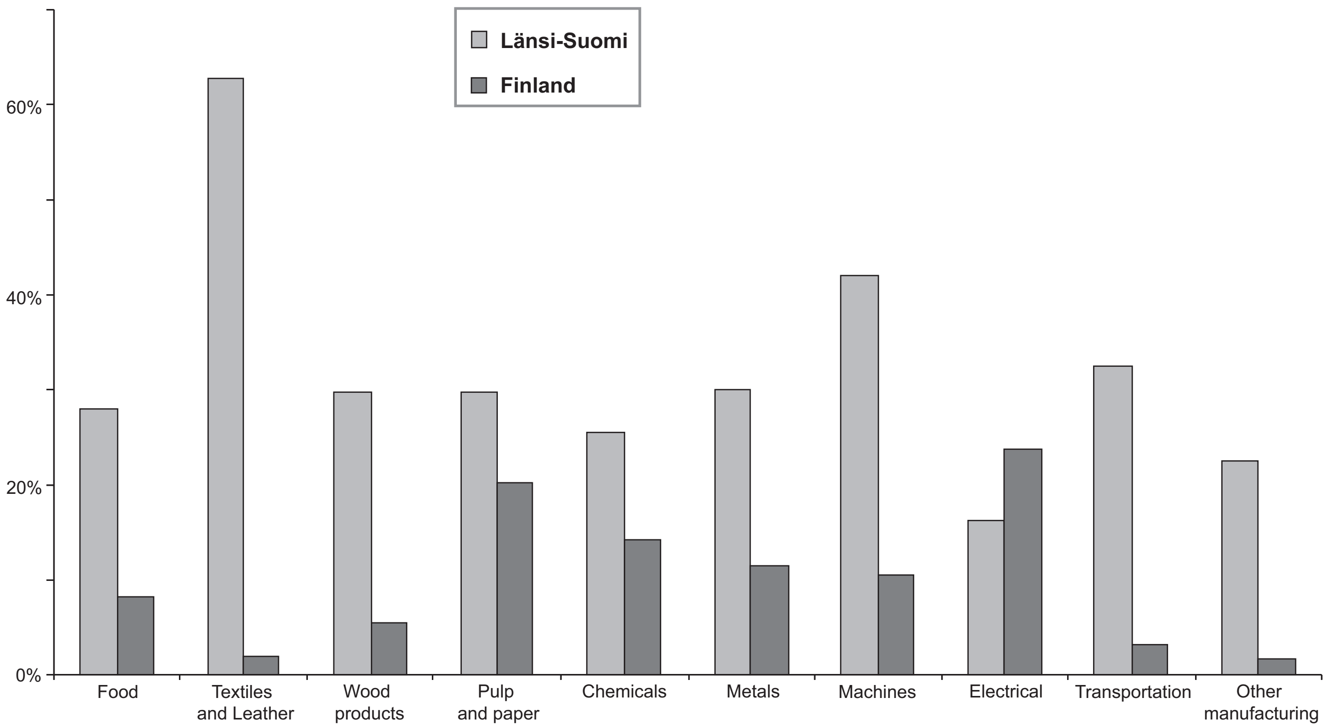


Figure 5.27. 'Keski-Suomi' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Finland, in 2000

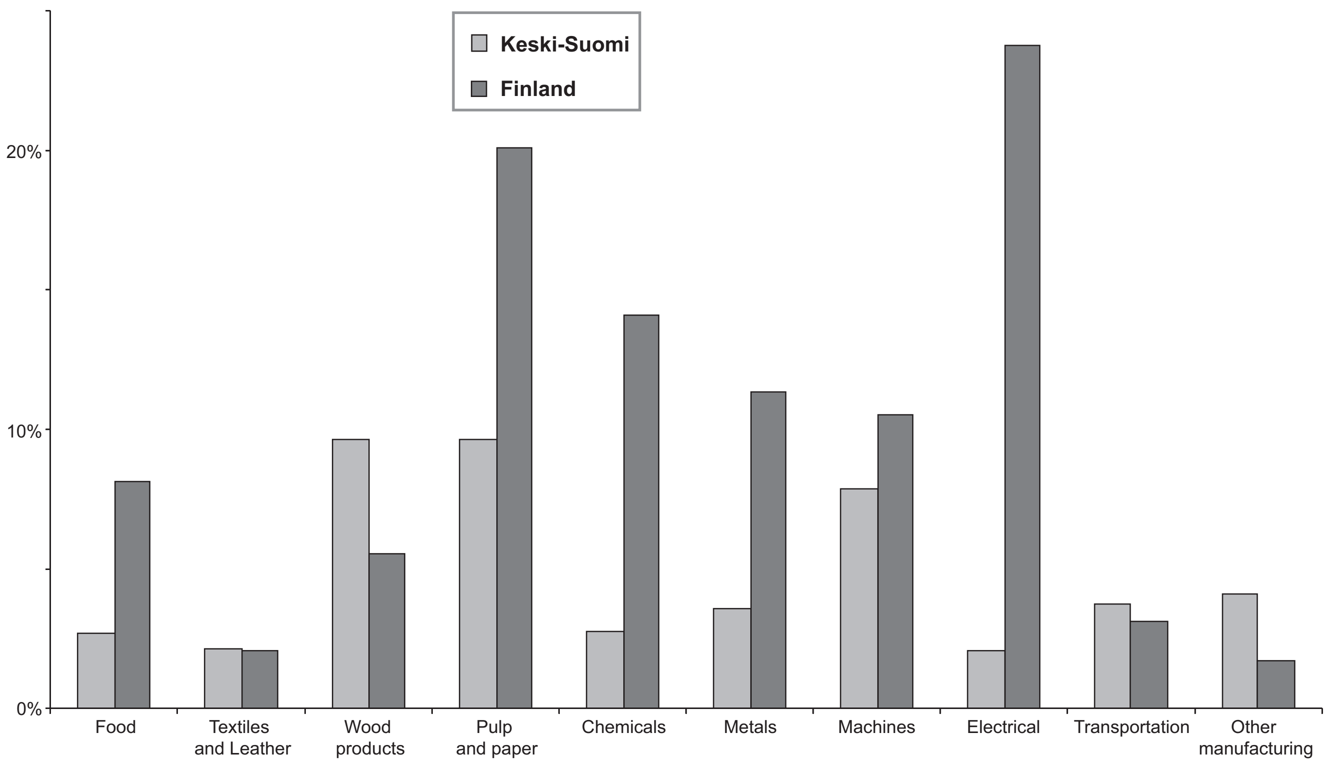


Figure 5.28. 'Pohjois-Suomi' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Finland, in 2000

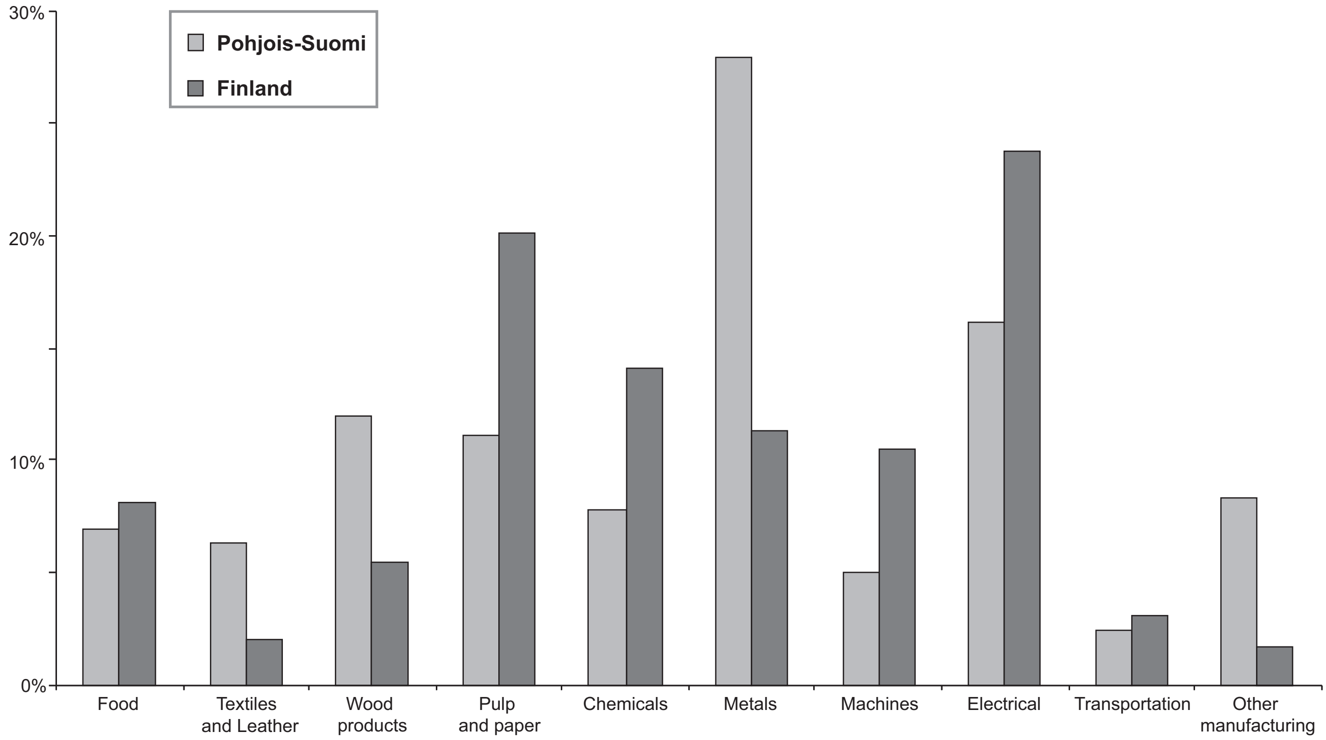


Figure 5.29. Åland GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Finland, in 2000

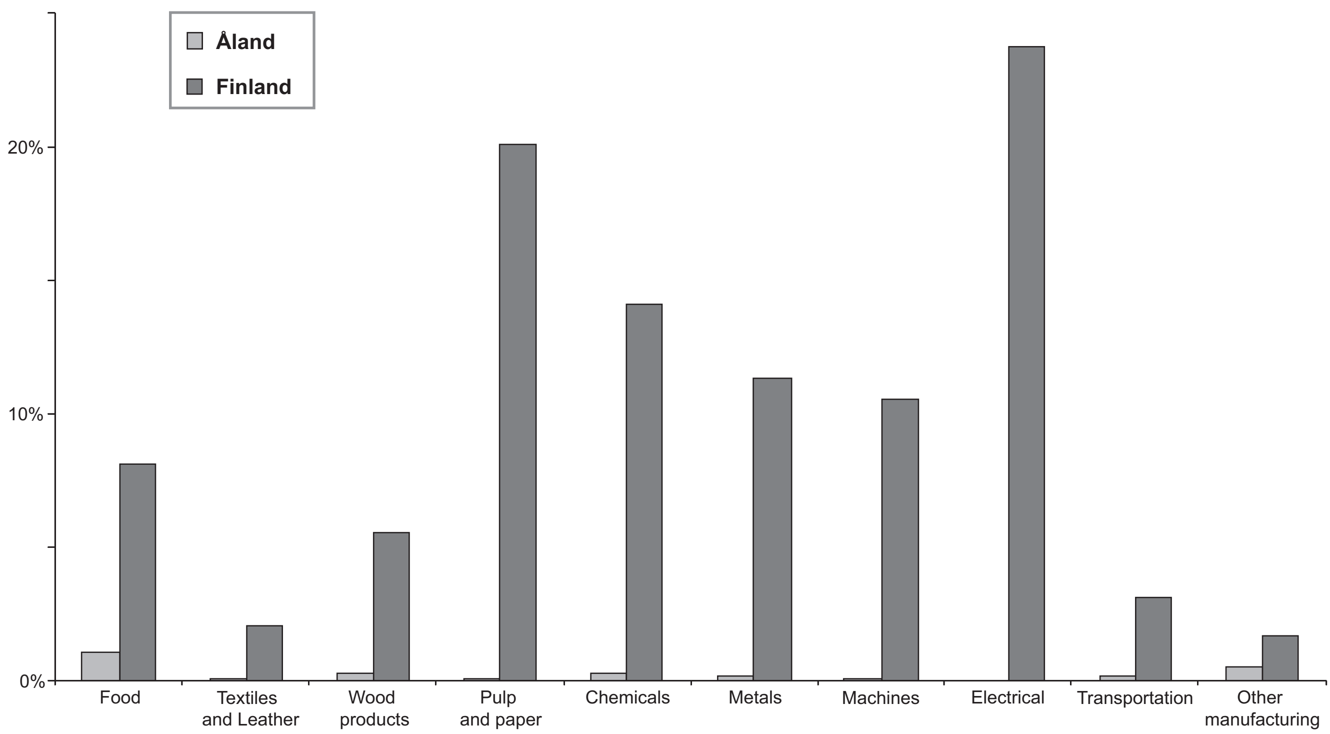
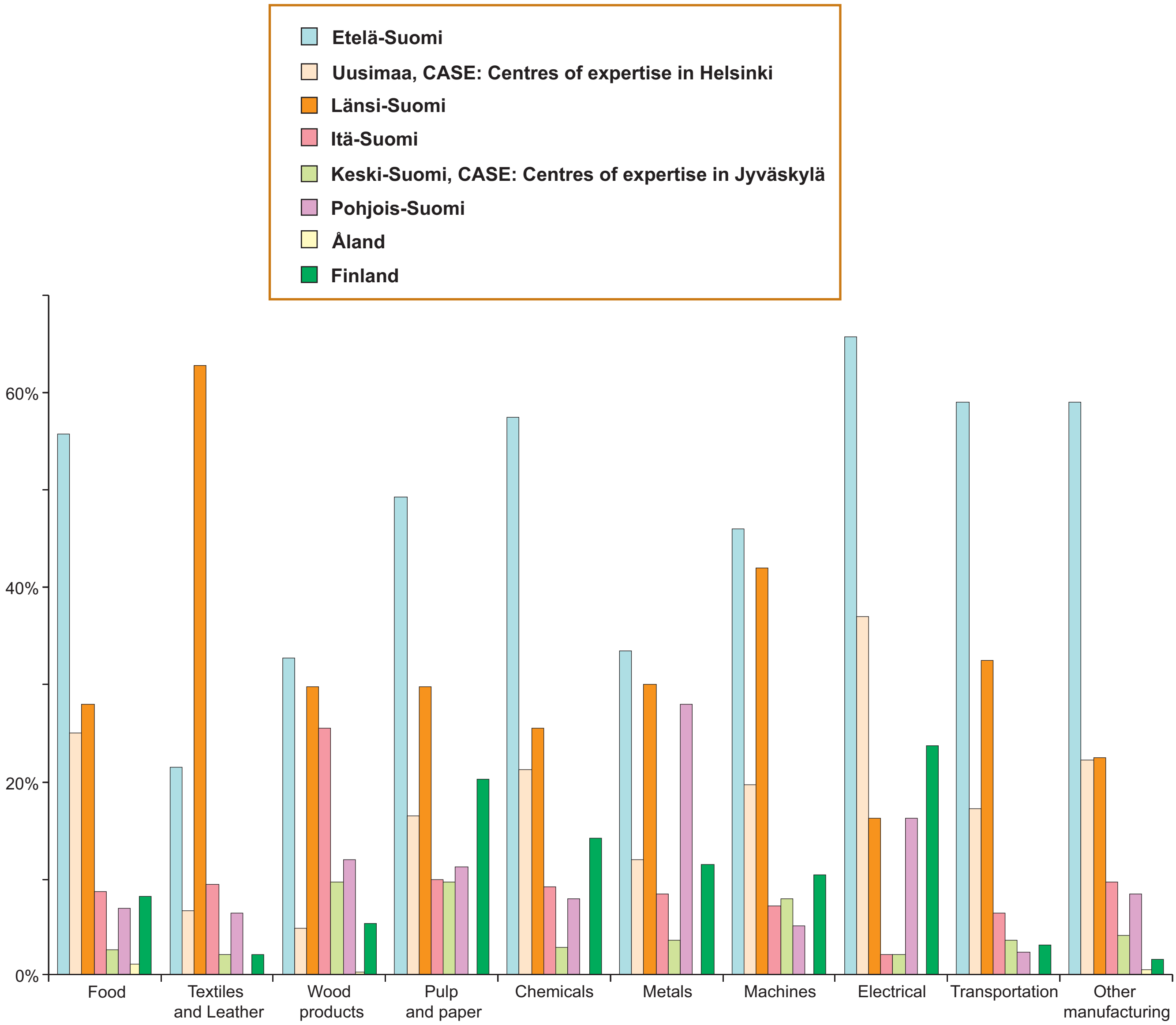


Figure 5.30. All NUTS 2 regions GRP in Finland by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Finland, in 2000 and case regions (nuts 3), Manufacturing (Nace 14–37), in 1 000 Euro



and has only 1 percent of the total manufacturing of the 'Food' sector. When we are looking at regional specific share of the different manufacturing sectors, the other sectors are close to zero.

All the regions we have looked at in Finland are put together in figure 5.30. There is a rather clear pattern that we can see from this figure. The region with largest GRD in most the manufacturing sectors in percent of total manufacturing in specific sectors, is with few exceptions the region 'Etelä-Suomi. 'Länsi-Suomi is the second largest manufacturing region in most of the manufacturing specific sectors.

Sweden

For Sweden we also use the NUTS 2 level to categorise the regions. This classification divides Sweden into eight different regions.

If we look at figure 5.31 we can see that Sweden's largest manufacturing sector is 'electrical', the same sector as in Finland, but it's not as large in percent of total manufacturing as in Finland. In Sweden this sector amounts to nearly 18 percent and in Finland to 24 percent of total manufacturing. The Swedish manufacturing industry is distributed over several large industries besides 'Electrical'. 'Transportation', 'Chemicals', 'Pulp and paper' and 'Metals' respectively amount to around 16, 15, 13 and 12 percent of total manufacturing in these sectors.

Stockholm is the capital city of Sweden and from figure 5.32 (next page) we can see that the dominating manufacturing sector in this area is 'Electrical'. This region manufactures alone over 34 percent in this sector in Sweden. This is the largest manufacturing sector in Sweden and is one of the largest contributors to the total GDP coming from manufacturing in Sweden. This region has also large GRP in 'Chemicals', 'Pulp and paper' and 'Food' in prevent of total GDP in these specific manufacture sectors.

'Östra Mellansverige' can be looked upon as an inland region. This region manufactures nearly 26 percent of 'Metals', 23 percent of 'Machines' and 20 percent of 'Electrical' in Sweden. They produce also around 17 percent of 'Textiles and leather', 15 percent of 'Chemicals' and 'Transportation'.

Småland contributes with nearly 30 percent of total manufacturing of 'Food' in Sweden, which is the greatest of all regions. They have also a relatively large share of 'Chemicals' GRP, with 19 percent of total manufacturing in this specific sector in Sweden.

'Sydsverige' is the southernmost region in Sweden and border on to Denmark. The manufacturing industry in this region is dominated by the 'Metals' sector, which manufactures 24 percent in Sweden. Around 16 and 15 percent of 'Pulp and paper' and 'Wood products' comes from this region.

Figure 5.36 (page 98) gives an overview over the industry sector in 'Västsverige'. This region also includes Gothenburg, another large city in Sweden. This region manufactures 9 percent of 'Pulp and Paper' and over 6 percent of 'Wood products' in Sweden. The rest of the sectors manufacture 4 percent or lower of total manufacturing in the specific sectors.

'Norra Mellansverige' has over 12 percent of total manufacturing of 'Wood products'. 'Pulp and paper' stands for nearly 6 percent of national manufacturing in this sector. Since this sector constitutes such a large sector at national level, it generates the largest GRP measured in absolute figures in this region.

In figure 5.38 (page 99) the industry structure for 'Mel-

Figure 5.31. *Sector specific GDP, manufacturing in percent of total GDP in manufacturing in Sweden, in 2000*

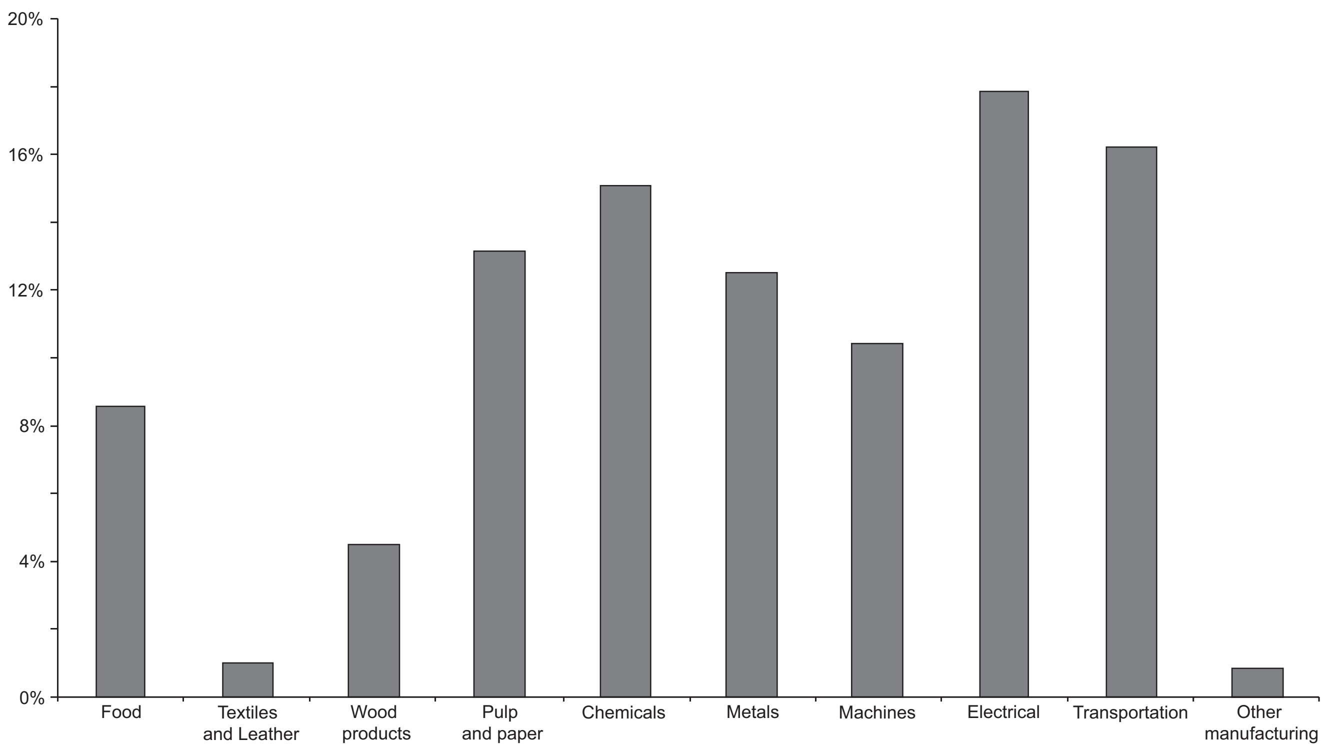


Figure 5.32. *Stockholm GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000*

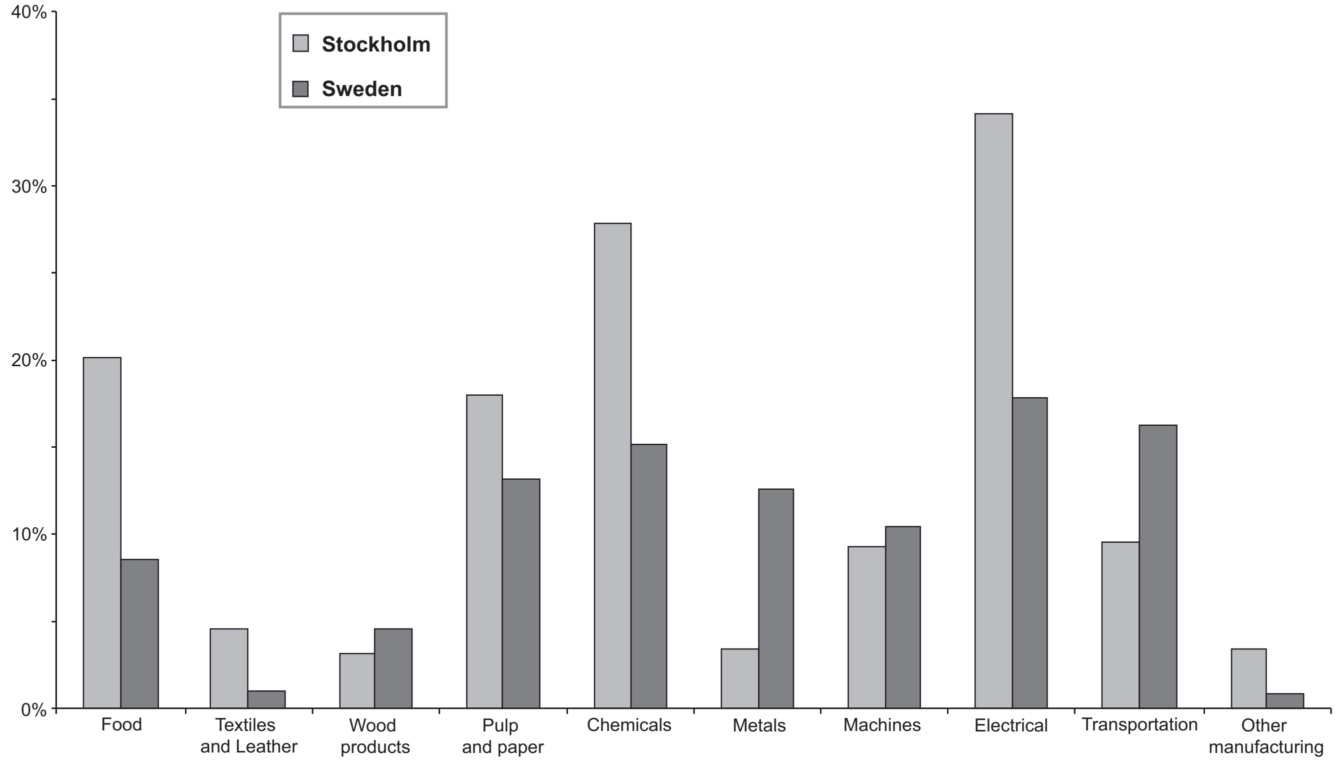


Figure 5.33. *'Östra Mellansverige' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000*

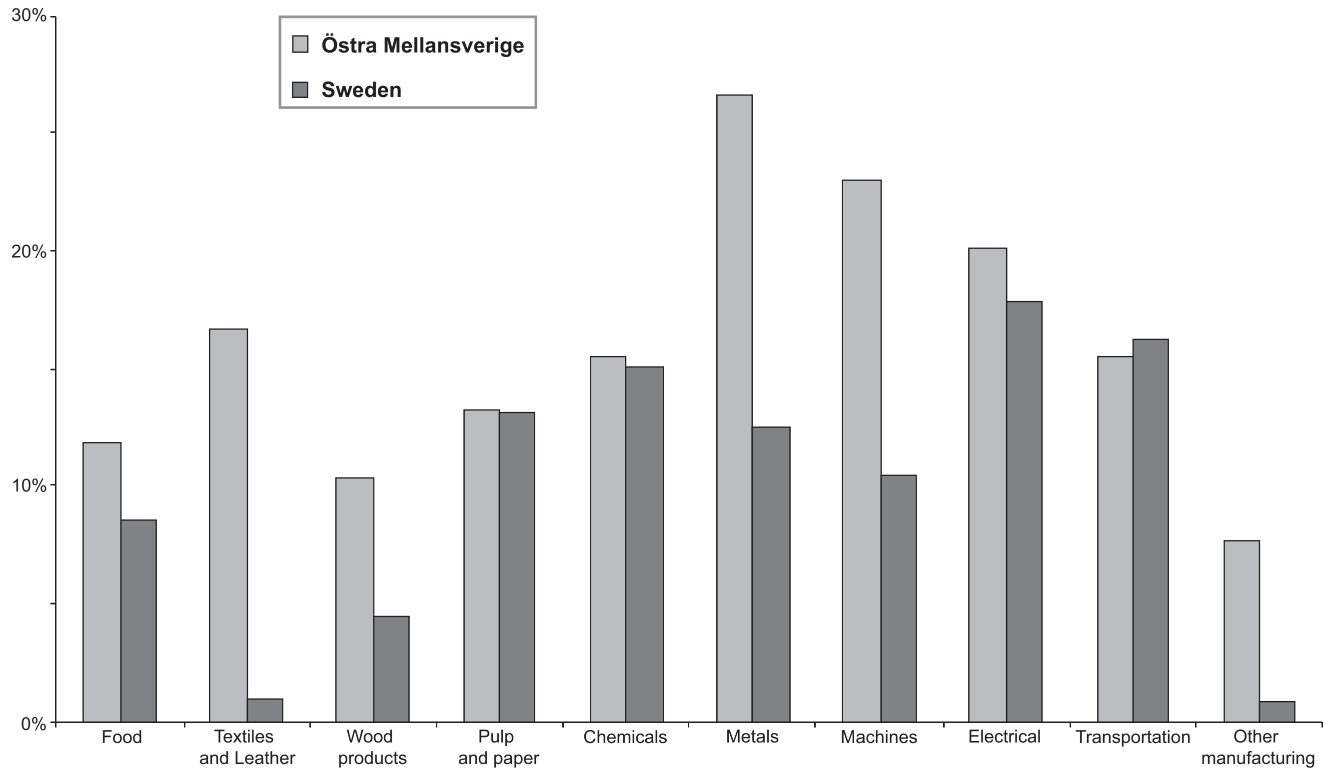


Figure 5.34. *'Småland med öarna' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000*

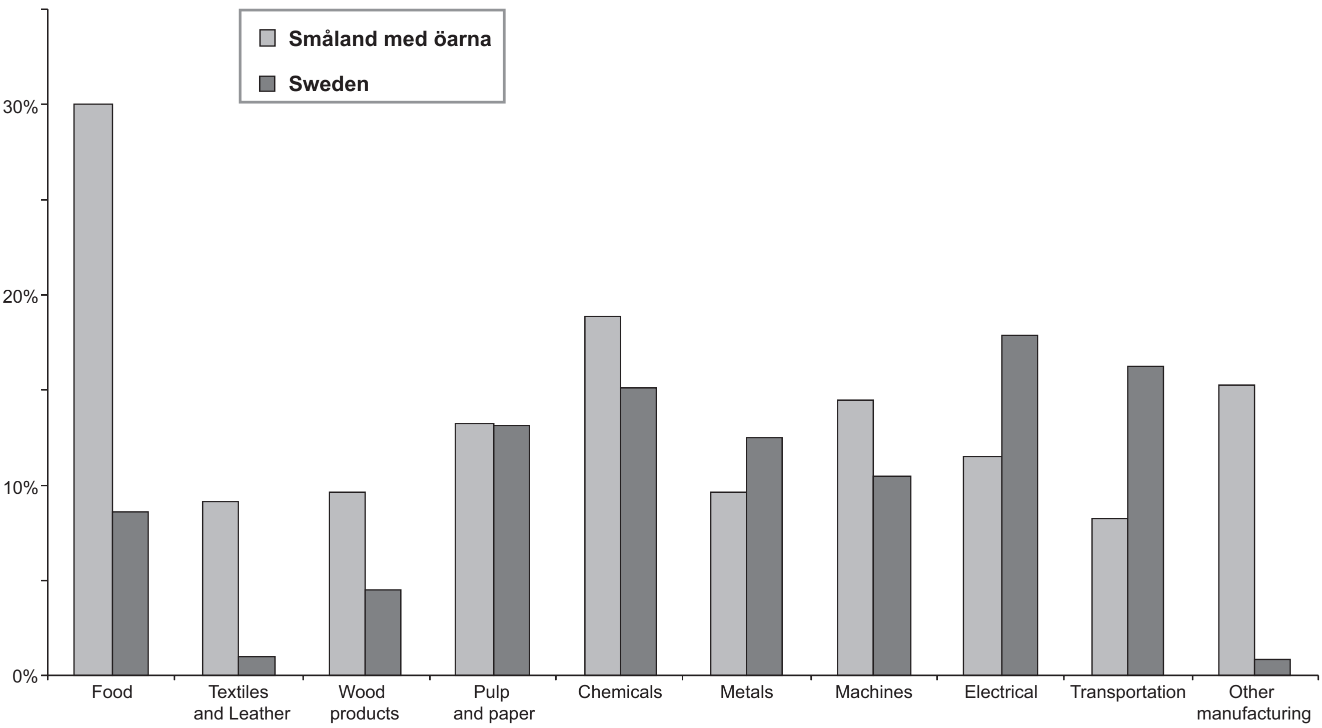


Figure 5.35. *'Sydsverige' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000*

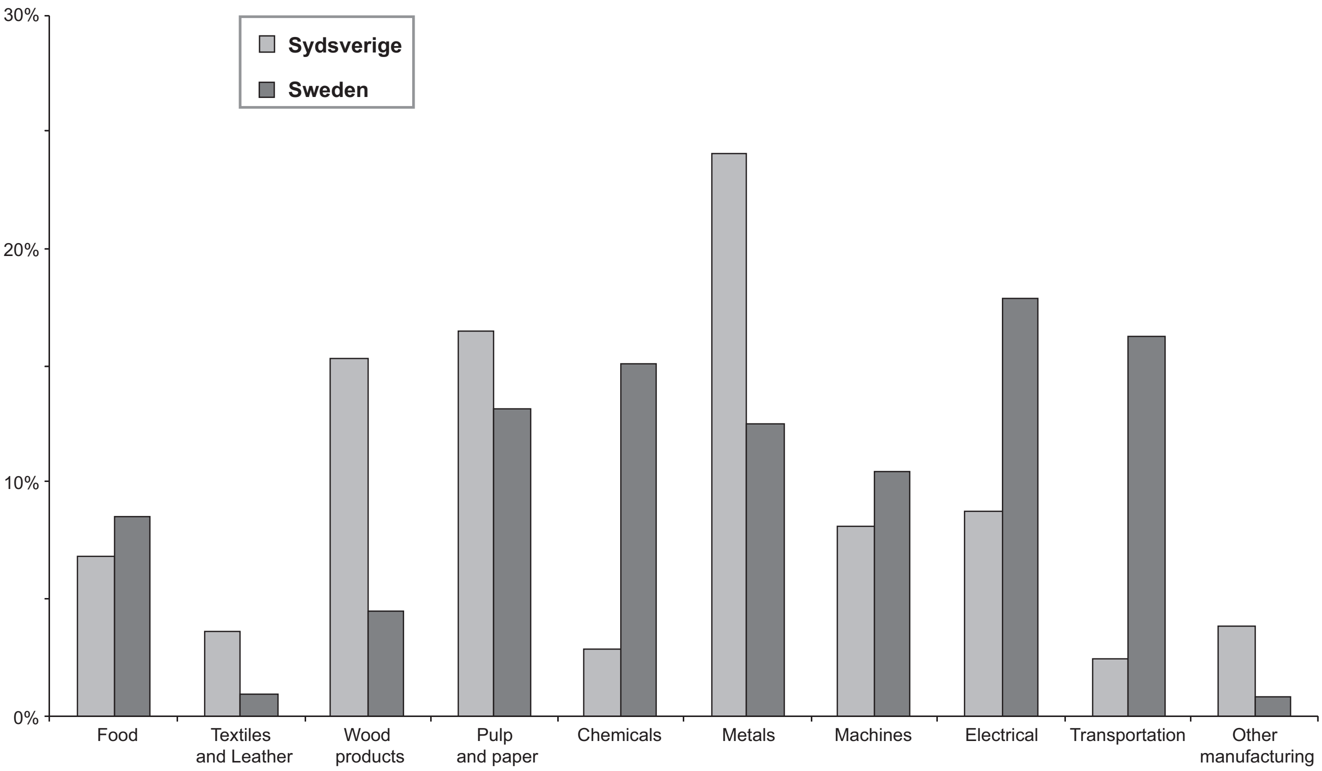


Figure 5.36. *'Västsverige' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000*

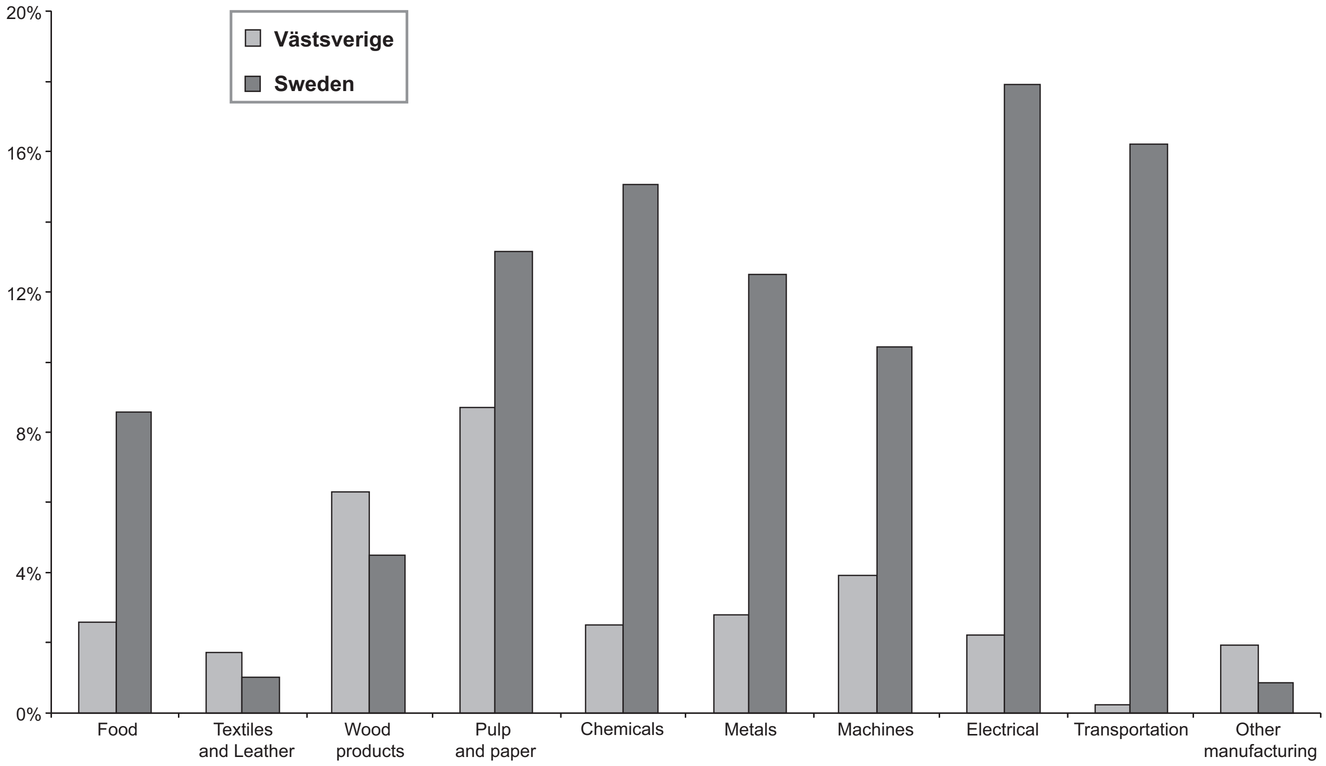


Figure 5.37. *'Norra Mellansverige' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000*

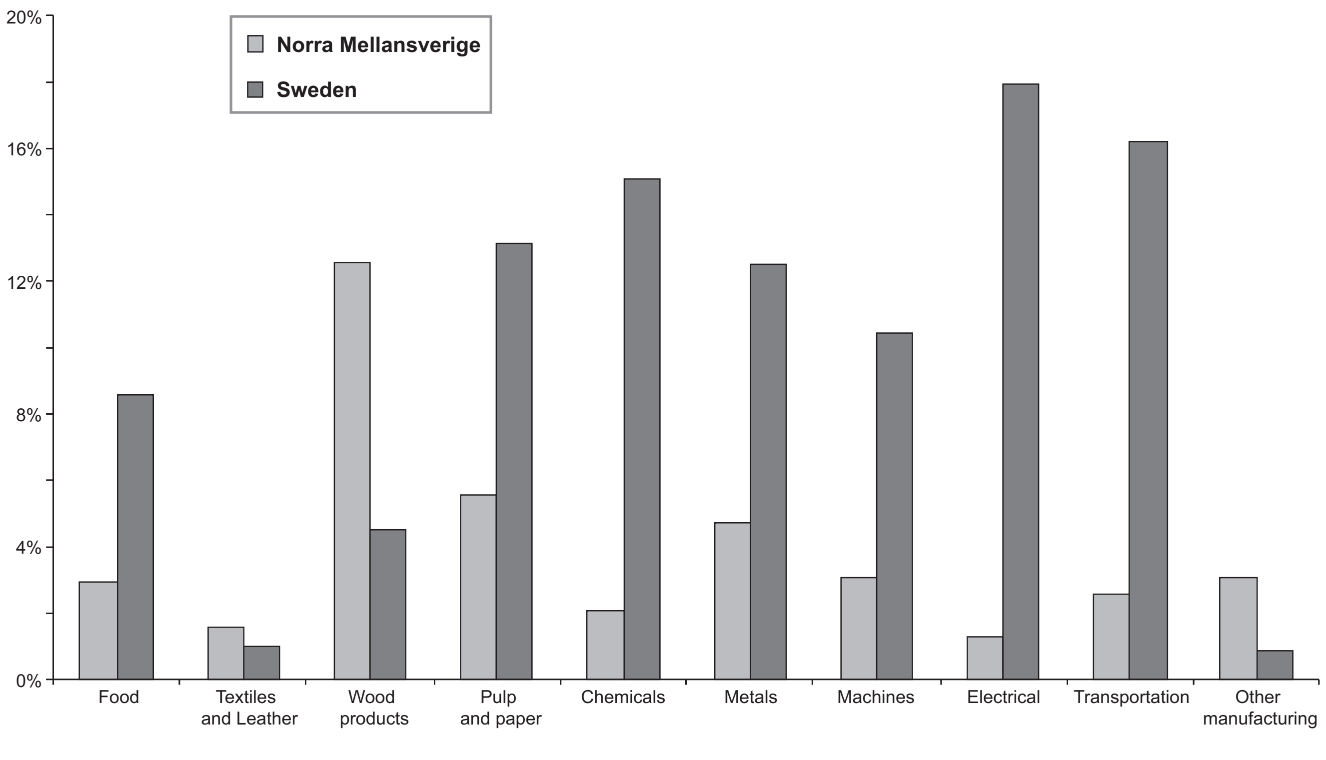


Figure 5.38. 'Mellersta Norrland' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000

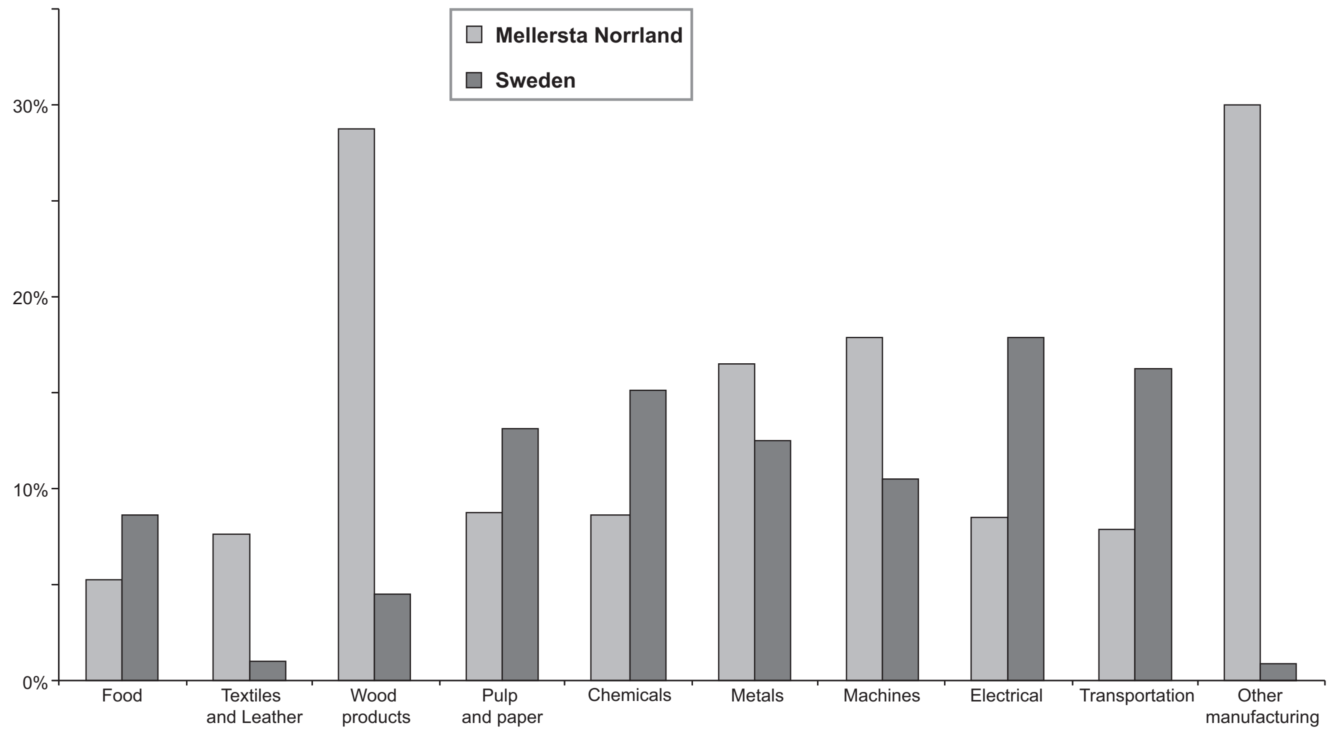


Figure 5.39. 'Övre Norrland' GRP by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000

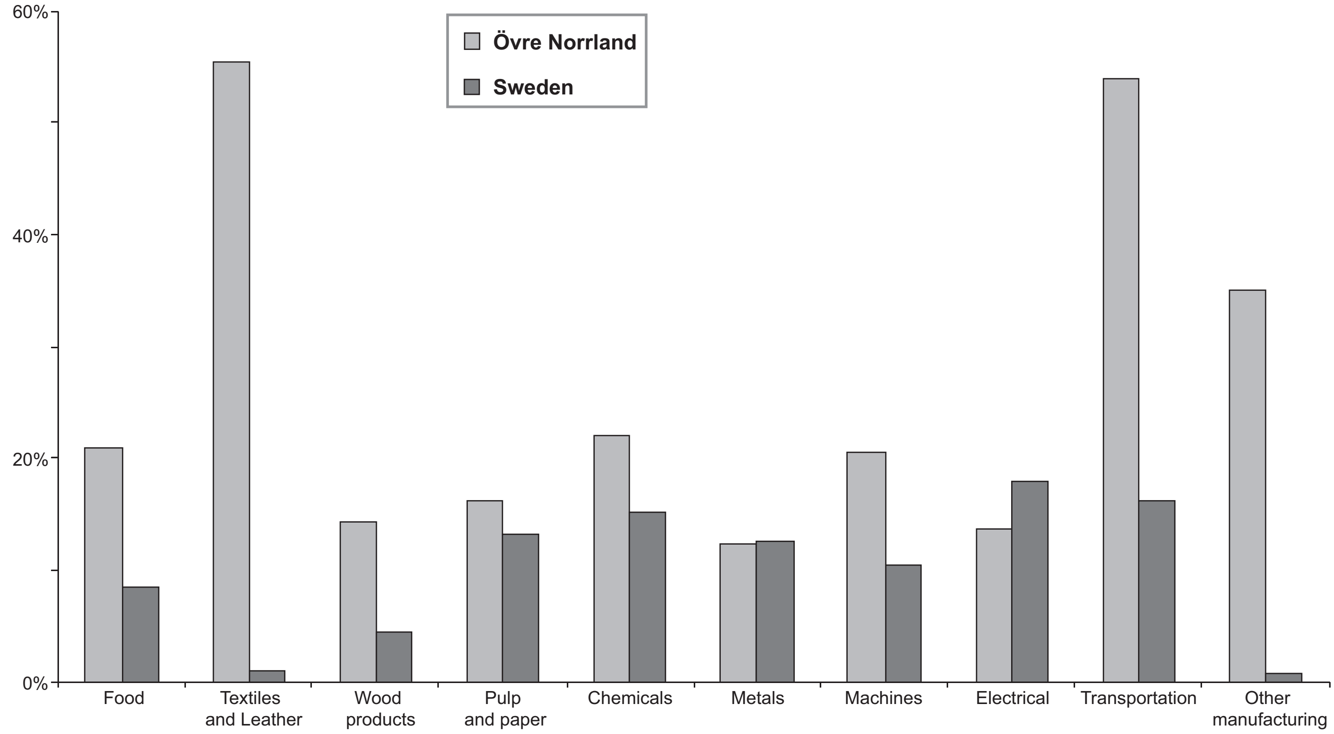
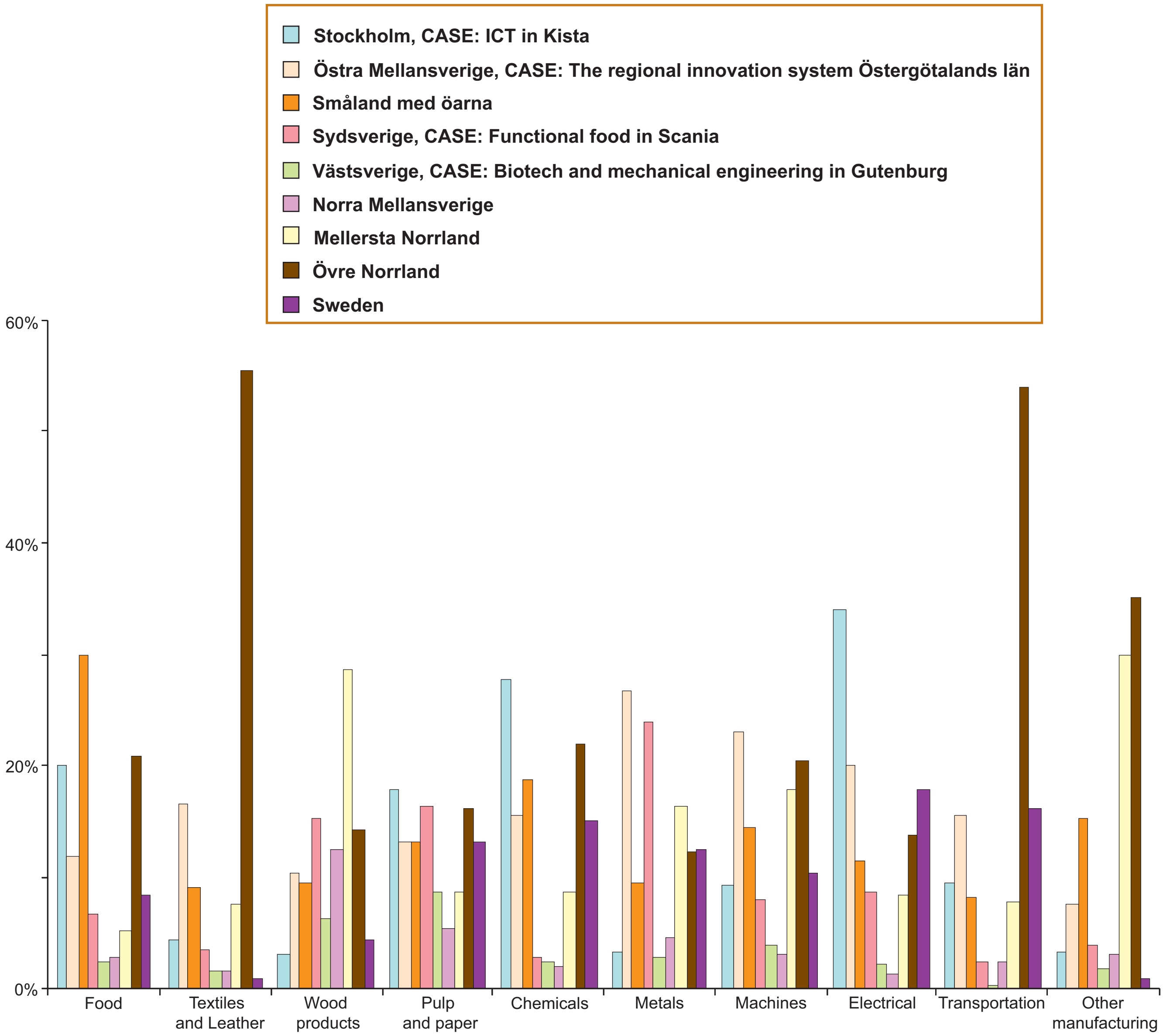


Figure 5.40. All NUTS 2 regions GRP in Sweden by manufacturing sectors (Nace 15–37) in percent of total GDP in the specific manufacturing sector and total sector specific GDP in percent of total GDP in manufacturing in Sweden, in 2000, and case regions (nuts 3), Manufacturing (Nace 14–37), in 1 000 Euro



lersta Norrland' shows that the dominating manufacture sector is 'Wood products', with as much as 29 percent of total manufacturing in this sector in Sweden. This is the region with greatest GRP in this sector. The region also manufactures nearly 16 percent of 'Metals' and 18 percent of 'Machines'. In absolute figures these sectors have the largest GRP in this region.

'Övre Norrland' is the northernmost region in Sweden and border on Finland. We see that 'Textiles and leather' has over 55 percent of total manufacturing in this specific sector in Sweden. But still 'Transportation' is the dominating sector in this region. With nearly 54 percent of total manufacturing in 'transportation', which is one of the largest manufacturing sectors in Sweden, this is the far most dominating sector in a region measured in absolute figures. This region also manufactures over 22 percent of total 'Chemicals' in Sweden and over 20 percent of 'Machines'. This is the region in Sweden with largest GRP in manufacturing sectors.

For Sweden it looks like each region is dominated of manufacture specific sectors.

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Appendix

NUTS regions

Code	Country	Level 1	Level 2	Level 3
DK	**DENMARK**			
DK0		DENMARK		
DK00			Denmark	
DK001				Copenhagen and Frederiksberg municipalities
DK002				Copenhagen County
DK003				Frederiksborg County
DK004				Roskilde County
DK005				Vestsjælland County
DK006				Storstrøms County
DK007				Bornholms County
DK008				Fyns County
DK009				Sønderjyllands County
DK00A				Ribe County
DK00B				Vejle County
DK00C				Ringkøbing County
DK00D				Århus County
DK00E				Viborg County
DK00F				Nordjyllands County
DKZ		EXTRA-REGIO		
DKZZ			Extra-Regio	
DKZZZ				Extra-Regio

Code	Country	Level 1	Level 2	Level 3
FI	**SUOMI / FINLAND**			
FI1		MANNER-SUOMI		
FI13			Itä-Suomi	
FI131				Etelä-Savo
FI132				Pohjois-Savo
FI133				Pohjois-Karjala
FI134				Kainuu
FI18			Etelä-Suomi	
FI181				Uusimaa
FI182				Itä-Uusimaa
FI183				Varsinais-Suomi
FI184				Kanta-Häme
FI185				Päijät-Häme
FI186				Kymenlaakso
FI187				Etelä-Karjala
FI19			Länsi-Suomi	
FI191				Satakunta
FI192				Pirkanmaa
FI193				Keski-Suomi
FI194				Etelä-Pohjanmaa
FI195				Pohjanmaa
FI1A			Pohjois-Suomi	
FI1A1				Keski-Pohjanmaa
FI1A2				Pohjois-Pohjanmaa
FI1A3				Lappi
FI2		ÅLAND		
FI20			Åland	
FI200				Åland
FIZ		EXTRA-REGIO		
FIZZ			Extra-Regio	
FIZZZ				Extra-Regio

Code	Country	Level 1	Level 2	Level 3
SE	**SWEDEN**			
SE0		SWEDEN		
SE01			Stockholm	
SE010				The County Administrative Board of Stockholm
SE02			Östra Mellansverige	
SE021				The County Administrative Board of Uppsala
SE022				The County Administrative Board of Södermanland
SE023				The County Administrative Board of Östergötland
SE024				The County Administrative Board of Örebro
SE025				The County Administrative Board of Västmanland
SE04			Sydsverige	
SE041				The County Administrative Board of Blekinge
SE044				The County Administrative Boards of Skåne
SE06			Norra Mellansverige	
SE061				The County Administrative Board of Värmland
SE062				The County Administrative Board of Dalarna
SE063				The County Administrative Board of Gävleborg
SE07			Mellersta Norrland	
SE071				The County Administrative Board of Västernorrland
SE072				The County Administrative Board of Jämtland
SE08			Övre Norrland	
SE081				The County Administrative Board of Västerbotten
SE082				The County Administrative Board of Norrbotten
SE09			Småland med öarna	
SE091				The County Administrative Board of Jönköping
SE092				The County Administrative Board of Kronoberg
SE093				The County Administrative Board of Kalmar
SE094				The County Administrative Board of Gotland
SE0A			Västsverige	
SE0A1				The County Administrative Board of Halland
SE0A2				The County Administrative Board of Västra Götaland
SEZ		EXTRA-REGIO		
SEZZ			Extra-Regio	
SEZZZ				Extra-Regio

Code	Country	Level 1	Level 2	Level 3
NO	**NORWAY**			
NO		Norway		
NO			Finmark	
NO			Troms, Nordland and Nord-Trøndelag	
NO				Troms
NO				Nordland
NO				Nord-Trøndelag
NO			Sør-Trøndelag, Hedmark and Oppland	
NO				Sør-Trøndelag
NO				Hedmark
NO				Oppland
NO			Møre and Romsdal, Sogn and Fjordane, Hordaland, Rogaland	
NO				Møre and Romsdal
NO				Sogn and Fjordane
NO				Hordaland
NO				Rogaland
NO			Aust- and Vest-Agder, Telemark, Vestfold and Buskerud	
NO				Aust-Agder
NO				Vest-Agder
NO				Telemark
NO				Vestfold
NO				Buskerud
NO			Oslo, Akershus and Østfold	
NO				Oslo
NO				Akershus
				Østfold

Code	Country	Level 1	Level 2	Level 3
IS	**ICELAND**			
IS		Iceland		
IS			Iceland	
IS				Iceland

Industrial classification

Nace codes **2-digit level**	***Text*** **Manufacturing industry**
15–16	Manufacture of food products, beverages and tobacco
17	Manufacture of textiles
18–19	Manufacture of leather and leather products
20	Manufacture of wood and wood products (not Furniture
21–22	Manufacture of pulp, paper, and paper products; publishing and printing
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals, chemical products and man-made fibres
25	Manufacture of rubber and plastic products
26	Manufacture of other non-metallic mineral products
27–28	Manufacture of basic metals and fabricated metal products
29	Manufacture of machinery and equipment n.e.c.
30–33	Manufacture of electrical and optical equipment
34–35	Manufacture of transport equipme
36	Manufacture n.e.c.