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Norwegian Institute for Urban and Regional Research

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Preface

This report is one part of the dissemination from the project "City regions, knowledge bases and innovation support system" (CKI)(2006-2009) which has been funded by the Research Council of Norway within the program "Demokrati, styring og regionalitet". Data, analysis and text to this report have been produced by Heidi Aslesen (Nifu-Step/BI), Frants Gundersen (NIBR), Arne Isaksen (University of Agder), Ove Langeland (NIBR) and Knut Onsager (NIBR). Onsager has been the project manager.

Oslo, October 2010

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Summary

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The reinforced economic globalisation, changes in national policies and an increasing share of higher educated employees, have over the last decades contributed to a more knowledge-based and innovation-driven economy. An increasing focus in innovation policy has been directed towards the enhancing of the endogenous capacity of clusters, agglomerations and city regions. One implication alongside many of these trends has been a more cluster- and city-based economic growth underpinning an increasingly uneven territorial development in many countries.

This report focus on some of the regional implications of a more knowledge based economy in Norway and describe empirically the characteristics of advantage, innovation and growth patterns and performances in main types of small and large city regions. Firstly, based on national register and survey data the report describe innovation resources and performances in five main region types (aggregates of all the 161 functional regions) divided by size and centrality. It is documented substantial differences in innovation resources in favour of the largest regional milieus, but at the same time small regional differences in the overall innovation rates. More substantial regional differences related to size and centrality were found for radical innovation (as well as market- and product innovation), international innovation cooperation, innovation hampering factors, new firm formations, renewals of firm population and growth rates of employment in new knowledge intensive services. For all these factors the degree of performances and favourable conditions increased systematically with the size of

the regional milieu. The only nuances in this picture is that the metropolitan region (Oslo) has got a somewhat weaker performance compared to the three second largest city regions (Berge, Stavanger, Trondheim) regarding growth rates in new knowledge intensive services.

Secondly, based on eight cases of city regions with different sizes and centrality in Norway the report further shows some of the diversity also *within* the main types of city regions. The metropolitan region, and partly the other much smaller but still larger city regions, are specialised in knowledge intensive services. They also have got substantial advantages in a national context regarding human capital resources, knowlegde organisations and R&D-resources. At the same time they all experience increasingly global competition as localisation sites for international oriented firms, headquarters and knowledge intensive activities. The ability to attract experts and higher educated persons from other countries are also under increasingly global competition pressure. These city regions have also specific innovation policy challenges due to fragmentation and somewhat weak capabilities for utilising their superior innovation resources and synergy potentials. The cases of the smaller city regions vary a lot in size and centrality, but all where characterised by specialisation in export oriented manufacturing exposed to enhanced global competition. Specialization within one or few export-oriented branches make them well suited for incremental innovations to maintain international competitiveness, but also vulnerable for external shocks and fast changes in macro policy. They have common innovation policy challenges related to upgrading of knowledge bases, keeping and recruiting qualified labour for their specialized productions, as well as spurring increased diversity of their economic base and local labour markets.

In spite of the very different starting points of the case regions all of them have developed some kinds of innovation policies and strategies over the last decade. At a general level much of the same recipe is chosen, but the large city regions have primarily focused on entrepreneurship and commercialisation of innovation through TTOs, incubators and matchmakers, while the smaller city regions to some greater extent have concentrated on cluster development, upgrading and competence building.

The regional differences in the overall innovation capabilities and rates within the existing firms are much weaker than one would expect given the substantial differences in innovation resources between small and large city regions. It is also much weaker than one would expect taken the messages in much international literature as a point of departure. One of the main reasons for this are a scattered localisation pattern of innovative industries in Norway where some of the most innovative branches and miliues are found in small city regions. Another reason is some other conditions which dampen the potential large differences in regional innovation capabilities related to size and centrality. A lot of the huge innovation resources in the larger city regions are embedded in national institutions which not only have local links and effects, but also external links and effects which benefit also smaller milieus within different localisation sites in the national innovation system. Secondly, the largest city regions seems also to have somewhat limited capabilities in utilising their resource advantages and synergy potentials due to complex and fragmented milieus. Thirdly, public innovation and regional policy instruments and funding may also influence the regional innovation pattern. The innovation and regional policy should stimulate and support innovation and entrepreneurial activities in all types of regions. However, both intended and non-intended effects of the innovation policy seem to result in a strong support for innovation activities in firms and clusters outside of the largest city regions. The national innovation policy has been directed towards strong national manufacturing clusters and, these are mainly localized in small- and medium sized city regions. The regional innovation and development policies in Norway are also characterized by a strong redistribution of public funding from the largest city regions to the smaller urban and rural regions in more peripheral areas.

Besides some regional differences in innovation forms but insignificant differences in overall innovation rates, is the fact that large and small regions have complementary roles and functions in the development of knowledge intensive industries in Norway. The report is finished with a draft of the different innovation challenges that small and large city regions are facing in the year to come, and gives some few policy recommendations in that respect.

1 Introduction

1.1 Background and topics

The reinforced economic globalisation, changes in national policies and the increasing shares of higher educated employees, have over the last decades strongly contributed to a more knowledge-based and innovation-driven economy, particularly in high-cost countries. One implication has been a more cluster- and city-based economic growth underpinning an increasingly uneven territorial development in many countries.

Alongside these trends and challenges there has been an increasing interest and focus in politics and science towards the assumed important relationship between regional resources and capabilities on the one hand and, localised firms' and industries' innovation capabilities and development on the other hand. These aspects are treated in theories of "competitive advantage" (Porter 1990) and "constructed advantage" (Asheim et.al. 2006). The former focuses on the endogenous capacity of firms, clusters and agglomerations which create and sustain competitive advantages in particular fields. The second focuses on elements that create regional advantages and put more emphasis on the role and impact of the public sector and policy support, particularly on public-private partnership.

This report sheds light on topics related to the following questions:

- What implication does the knowledge economy have for regional innovation and development ?
- What kind of advantages, patterns and performances of innovation characterize the main types of regions in Norway, and how can these patterns be explained?

- What roles and innovation relations characterise the different kinds of city regions in the development of knowledge intensive industries in Norway?
- In what sense are regional patterns and performances of innovation in Norway concurrent with trends in other comparable countries ?
- What kind of regional innovation policy challenges do small and large Norwegian city regions face in the years to come?

1.2 Methods and data

The analysis is based on a qualitative research design containing both qualitative information (documents) and quantitative data (register- and survey data). It starts with a presentation and discussion of theories and concepts relevant for regional advantages, innovation and development. This forms the basis for an analytical framework and for the main issues which are analysed in the empirical investigations. The empirical analysis is two-folded. The first part is an empirical analysis of regional advantages and innovation in five main types of Norwegian regions. This analysis is based on extensive national register- and surveydata (Statistics Norway) containing characteristics of human capital and employment, firms and industries and, it focuses explicitly on innovation and development. The second part of the empirical analysis is an intensive case study delimited to eight regions. This analysis uses a combination of documents (research literature etc.) and register- and survey data with an explicit case focus. The final section summarises theoretical perspectives and international literature and the empirical findings from the Norwegian context and, it also discusses possible conditions and causes of lacking concourse. The section ends up with a discussion of innovation policy challenges for small and large city regions in Norway.

1.3 The composition of the report

Chapter 2 presents and discusses some of the theoretical concepts and develops an analytical framework for empirical investigation. Chapter 2,4, and 5 describes the characteristics of regional advantage and innovation in Norway based on register- and

survey-data and documents. The final chapter 6 sums up the theoretical perspectives and the empirical patterns, and discusses causes and implications for innovation policies.

2 General perspectives and concepts

In this chapter we firstly describe general macro-trends and conditions which are spurring efforts and implications for regional innovation and development at subnational levels. Secondly we go further into theoretical concepts on regional advantage and innovation with specific focus on the properties that characerize small and large city regions respectively, and their different roles and capabilities regarding the development of a more knowledge-based national economy. The chapter is completed by a summary of the overall analytical framework and main issues for empirical analysis.

2.1 The knowledge economy and the "urban turn"

In much of the international regional literature there has, for some time, been widely shared ideas about the emergence of knowledge-based economies and a new urban era in advanced economies which relates to a set of pervasive forces in a more globalised economy (Buck et.al. 2005).

The globalisation process is related to the increasing international mobility of capital and more open national markets making economies more closely connected through rising exports and imports and increasing foreign direct investments. This is a result of declining trade barriers, falling transport costs, improved telecommunication and growth of transnational corporations.

With increased economic globalisation and competition the knowledge intensive parts of the economy are supposed to be of

greater importance particularly in the high-cost countries, as knowledge is a key factor in the competitiveness of regional and national economies. The increased globalisation and competition have already stimulated readjustments in many high-cost countries towards more knowledge intensive economies, and the concept of a knowledge economy has already influenced industrial and regional policies in advanced economies in recent decades (Asheim and Coenen 2005, Cook and Leydesdorff 2006).

Different concepts about the knowledge economy have in common that *knowledge* is regarded as the most important production factor in advanced and globalising economies, and *learning and innovation* are considered to be the most significant processes (Lundvall 1992). They also have in common the fact that economies are assumed to be socially, culturally and territorially embedded institutions and therefore play an important role in the development of regions and nations.

There are, however, also obvious differences between the concepts. The *knowledge economy* concept focuses primarily on the composition and quality of the labour force, whereas the term knowledge-based economy supplements the human capital focus with structural aspects on technology trajectories and a system perspective (Cooke and Leydesdorff 2006). The technology trajectories and the system perspective form the innovation system concept which has been applied on the national level (Lundvall 1992) and the regional level (Cooke 1992, Cooke et.al. 2004). A similar concept is the dynamic triple helix model (Etzkowitz and Leydesdorff 2000), which also has been applied on different geographical levels.

Studies of the knowledge-based economy particularly focus on knowledge-based or knowledge intensive industries. Such industries are normally defined as industries with a high level of innovation investments, intensive use of acquired technology and a highly-educated workforce. This marked high-technology focus may limit the sectoral dimension of knowledge-based economy studies, and include mainly scientifically oriented sectors and industries.

This is one of the reasons why others prefer to use the broader concept of a *learning economy* (Lundvall 1992, 2004). The learning economy opens up a wide range of industries and territories to be

innovative, not only scientifically based high-tech industries but also non-research and development (R&D)-intensive traditional industries. This implies that the division between high-, medium- and low-tech industries becomes irrelevant with regard to innovation as such. Different industries may innovate in different ways and by means of different knowledge bases and support organisations but innovation is not reserved for specific industries or firms. As such the learning economy concept may be more inclusive but also a more dynamic notion than the knowledge economy. Innovation is regarded as an embedded interactive learning process whereas the knowledge-based economy approach emphasises access to a specialised stock of knowledge. This approach may explain the scientific orientation and the associated high-tech focus in the knowledge economy concept.

However, the learning economy concept has been criticised for focusing mainly on "catching-up" learning (learning by doing and using) based on incremental innovation, and to a large extent ignoring radical innovation which entails creation of new knowledge (Cooke 2002). Small step innovation and imitation have been important for many countries when climbing up the growth ladder, not least for small open economies such as the Nordic countries but it is not a viable strategy in the long run for sustaining growth and welfare. To obtain economic growth, it is maintained that endogenous knowledge creation must supplement exogenous learning: "In a dynamic and rapidly changing contemporary globalising economy, it is necessary to pay attention to knowledge creation as a process that is of equal importance to the process of learning and competence building" (Asheim and Coenen 2005:1175). It is the combined ability of knowledge creation and interactive learning which determine the innovativeness of advanced economies, and which again influence firms' competitiveness and determine regional advantages. Innovation presupposes that firms and regions can acquire new knowledge but likewise it is important to forget old knowledge through "creative forgetting". It is not a more intensive use of new knowledge which primarily characterises the learning economy: "but rather that knowledge becomes obsolete more rapidly than before" (Lundvall 2006:8). The capacity of creating and sharing knowledge, therefore, will to a large extent determine whether

firms and regions can become learning organisations and territories which promote innovation and growth of new sectors.

To endorse innovation and growth in a globalising knowledge economy firms and regions have to develop and improve their competitive advantage through exploiting their unique competencies and resources. Whereas comparative advantage holds that countries can benefit from trade through specialisation, even if they do not have absolute advantages, competitive advantage focuses on the endogenous capacity of regions that allow firms to create and sustain competitive advantages in particular fields (Kitson et al. 2004). In a globalising economy localised knowledge is becoming an increasingly more important production factor, and: "competitive advantage is created and sustained through a highly localised process" (Maskell et al. 1998, Kitson et al. 2004). Knowledge is territorially embedded and innovation processes in firms are influenced by the type of supporting regional and national institutions and the knowledge bases of the industry to which they belong.

In the following we use the concept "knowledge economy" in preference to "learning economy", but in a broad comprehension the latter implies a focus on knowledge bases and advantages related not only to the "knowledge- intensive" industries (as is often defined according to formal R&D and education levels) but also more "learning intensive" industries.

The "urban turn" and territorial foundation of the knowledge economy

In the increasingly knowledge-based economy, economic activity seems to be more spatially concentrated and city-based, and the division of labour between large and smaller agglomerations and cities seems to develop in new ways.

A striking aspect of the knowledge economy is disequilibrium, economic and social imbalances driven by uneven growth in new ways (Cooke 2002)[1]. An important aspect of this is that the

[1] Cooke (2002) talks about fragmentary "knowledge economies" for three reasons: firstly, by its disequilibrium, economic and social imbalances are driven by uneven growth in new ways. Secondly, by the collaborative economic actions as the most important organisational aspect of the economy. Thirdly, by the systemic nature of strategic competitiveness in the capabilities of specific groups

economic growth has, to an increasing extent, become more spatially concentrated and city-based. It is enhanced economic growth in urban areas, and in particular in knowledge intensive services and large city regions. Many of the new knowledge intensive industries with a "lead role" in the development of the knowledge economy are typically clustered in large city regions, and innovation and growth of these large cities is reinforced by their attractive force and inflows of financial and human capital from outside. Large cities are also claimed to have innovation and growth advantages due to favourable conditions for information transfer, knowledge spillovers and creativity (Amin 2000, Storper and Venables 2004, Florida 2002). But while the old regional clusters in a previous period reorganised their production away from the large city regions, it seems that the new knowledge intensive clusters have a more centralised growth pattern to these large cities (Scott 1988, Isaksen 2004).

Alongside the knowledge economy and globalisation there has been a renewed interest in the territorial foundation of the economy in politics and science, and in particular in different city regions as important territorial units (Storper 1997, Maskell et al. 1998). An increasing interest has been directed towards the assumed important relationships between territorially embedded resources and capacities on the one hand, and the innovation capabilities of firms and industries on the other. Such general relationships are cornerstones in the theories of "competitive advantage" (Kitson et al 2004, Porter 2001) and "constructed advantage" (Asheim et al. 2006). The first theory focuses on the endogenous capacity of firms and regions for creating and sustaining competitive advantages in particular fields (Porter 1998; Kitson et al. 2004), but have been criticised for being too narrowly market focused. The theory of "constructed advantage" is based on the concept of "regional advantages" of agglomeration economies, knowledge bases and networks. This theory emphasises, to a larger degree, the role and impact of the public sector and policy support, preferably in public-private partnerships and in regional industrial development (Asheim et al. 2006*)*. Instead of market failure, the rationale for policy intervention here is the reduction of interaction or connectivity deficits. This

of private and public actors to produce and implement actions based on consensus, as more important than individual opportunism.

approach acknowledges, to a greater extent, the importance of institutional and economic complementarities in knowledge economies than theories of comparative and competitive advantage do.

Knowledge intensive industries

It is widely accepted that knowledge is a key factor for the competitiveness of regional and national economies, and that this indicates the emergence of a 'knowledge economy'. The *knowledge intensive sector* (KI-sector) is often denoted as a 'leading sector' or dedicated to 'a lead role' in this respect, and the rise of knowledge intensive industries in production and services is seen as a main feature in this era of capitalism (Tödtling 2006). With increased economic globalisation and competition the knowledge-intensive parts of the economy are supposed to be of greater importance especially in the high-cost countries. It is also maintained that the innovation process and knowledge exchange in these industries differ quite markedly from those in other industries (op.cit). Clustering and local knowledge spill-over are frequently stated phenomena, although it is still unclear as to what extent knowledge interactions at the regional level are indeed relevant and what the exact mechanism of knowledge flows are.

KI-sectors are often delimited to industries where knowledge is the most important resource for innovation and competitiveness. Based on quantifiable criteria of scientific and formal knowledge these are often operationalized to manufacturing industries with comparatively high R&D intensity (e.g. 'high-tech industries'), and services that have a comparatively high share of workers with higher education (eg. KIBS), and are large users of embodied technology (OECD 2001).

When delimitating the knowledge economy and innovation policy one should avoid the 'high-tech trap' and the interpretation that these industries are the only way to prosperity (Smith 2000). Avoiding the high-tech-trap implicate the possibility that there may be knowledge intensive firms and branches in 'low-tech' sectors, and that 'low-tech' firms and branches may be important users of scientific knowledge generated elsewhere.

2.2 Regional advantages and capabilities of innovation

International literature about theories and concepts of regional advantages and capabilities of innovation have emphasised different aspects regarding important structures, processes and effects. From a regional policy perspective have much focus been directed towards efforts of mobilising indigenous potential in combination with how to embedding and attracting exogenous resources. In the following we will with institutional geographical as a point of departure, derive five main factors which can be treated as important, and these are: Territorial resources, agglomeration economies, knowledge networks, attractiveness and institutional capabilities[2]. In the following we will look into these factors in more detail.

(1) Territorial resources is a concept which covers the extensive human capital and its competence base, beside the cultural and natural resources of a region. The presence of *human capital* in general is crucial to regional development, but the presence of highly skilled labour, and the ability to attract and retain such labour, is of particular importance for innovation and growth in a knowledge economy (Florida 2002). The region's knowledge infra-structure is important for human capital development.

The human capital of a region may be characterised in different ways. The educational level is one aspect of importance. As the knowledge economy is getting increasingly prevalent, tertiary education becomes essential as it gives access to codified knowledge which is needed in the increasing part of the industries as well as to obtain various skills to be competitive in labour markets and in work life. However, even though the human capital's specific combination of formal and informal knowledge is utterly important, it is not so easy to describe and analyse. One relevant way to approach this are concepts of *industrial knowledge bases*[3] (Dosi 1988, Laestadius 1998, Asheim and Gertler 2005),

[2]Asheim et. al. (2006) Perspectives of building regional advantage differentiates between the three building blocks; agglomeration economies, industrial knowledge bases and knowledge networks.

[3] The knowledge base is the set of information, knowledge and capabilities that inventors draw on when looking for innovative solutions (Dosi, 1988: 1126).

which focus on how different industries are based on specific types of knowledge: Knowledge creation and flows, innovation processes and forms. A distinction has been made between three ideal types of industrial knowledge bases: Analytical, synthetic and symbolic (Asheim et.al. 2007). However, these concepts have so far not been developed for all industries, but mostly for a relatively small share of the total sectors of the economy. The human capital resources of a region are therefore more extensive than what can be derived from the concepts of industrial knowledge bases.

Other territorial resources of importance for regional innovation are R&D- investments and expenditures. The access and supply of R&D-funding is assumed to be of huge importance for the regional innovation capability in a knowledge economy. Furthermore, one should not forget natural and cultural resources (physical, cultural and heritage resources) as a possible important asset for innovation and growth. Such resources in combination with knowledge, the institutional endowment and the built structures are still valuable bundles of localised capabilities for many regions in complying with the knowledge economy as well as the experience economy (Maskell et al. 1998).

The presence and composition of the human capital in a region is also affected by attractiveness, which we will describe in more detail later.

(2) Agglomeration economies focus on advantages, dynamism and cumulative effects of regional agglomerations. Agglomeration economies imply that co-localised firms benefit from external economies through reduced transaction costs, enhanced knowledge spillovers and scale advantages in infrastructure (Marshall 1938, Hoover 1954, Jacobs 1969, Maskell & Malmberg and 1997).[4] The principal difference between localisation economies and urbanisation economies is in the literature linked to specific properties of specialised agglomerations often dominating

This is not a strict categorisation of industries but an analytical tool to capture assumed significant features of different industries and agglomerations. In the next step this is of relevance to capture important differences between e.g. small specialised, versus large heterogeneous, city regions.

[4] Much attention was earlier directed towards advantages of reduced transaction costs and common infrastructures as attention over the last decades been focused on externalities associated with "knowledge spillovers" as the "engine of growth" (Romer 1986).

smaller city regions, while heterogeneous agglomerations are more often prominent in larger city regions.

The *localisation economies* are linked to knowledge accumulation and spillovers within specialised agglomerations of firms in the same or related industries embedded in a common knowledge or industrial base (Henderson 1997a, 1997b). Some few of these may have been developed to "true" clusters. If one takes cluster-theory seriously, then a strict definition of a true cluster is thus based on the criteria that (Malmberg & Power 2006):

- There should be a spatial agglomeration of similar and related economic activity.
- These activities should be interlinked by relations and interactions of local collaboration and competition.
- There should be some form of self-awerness among the cluster participants and some joint policy action ('we are a cluster and we are determined to develop together').
- The cluster should be, in one way or another, successful (innovative, competitive).

In a strict view of clusters then we should find a mixture of certain degrees of all four criteria contained in the ideal type, and definitly all of the first three, before a cluster can be said to exist. The introduction of the success criterion is problematic also from a circular reasoning, but even if this criteria is excluded there are few 'true' clusters (op.cit.58).

In general do specialised agglomerations have limited diversity and volumes of industries and knowledge resources, though the firms may benefit from localisation economies and innovation advantages in specific branches or clusters.

In general such agglomerations are found in different regional districts and cities, but often they constitute, or dominate within, *smaller city regions*. Local knowledge sources within these specific milieus may be substantial, but also have significant limitations regarding the local offer of specialised knowledge providers, suppliers, demanding customers and markets. They may also face lock-in problems and challenges, while innovative firms in these regions may compensate for local deficits of knowledge sources

with more use of extra-regional channels. The innovation and growth capabilities of such smaller agglomerations are infrequently reinforced by attractive strengths in the same way as for many large agglomerations and cities. Their attractiveness, however, may be reinforced by more active regional policy.

Urbanisation economies are more linked to advantages of knowledge accumulation and spillovers within heterogenous milieus. The spillovers between many different knowledge bases, industries and clusters, are important drivers of regional innovation and growth (Jacobs 1984). High diversity of industries and pools of knowledge resources are more prominent in larger agglomerations and city regions. It is also assumed that in agglomerations with high diversity of knowledge resources, industries and infrastructures firms benefit from both localisation and urbanisation economies (Jacobs 1984, Fischer et al. 2001).

These kinds of territorial milieus are usually found in, and partly constitute, *larger city regions*. It has also been maintained that innovation and growth capabilities of such larger cities are also often reinforced by their attractive strengths and the inflows of financial and human capital from outside (Florida 2002). Large city regions are characterised by a high diversity of industries and large pools of knowledge resources. By possessing diversity and different specialisations, large urban areas have large advantages in offering possibilities for picking and mixing knowledge inputs as and when they are needed. The economic and social diversity packed into a limited space may also facilitate random and serendipitous contact among people (Simmie 2003, Jacobs 1969). Firms in such regions may have the possibility to draw on several local knowledge sources of related firms, suppliers and customers, knowledge organisations and services, skilled labour and venture capital, as well as the possibility to easily find new commercialisation possibilities locally. The possibilities for face-to-face contacts creates important advantages for urban areas and labour mobility among highly qualified professional and technical workers which contributes to the sharing and diffusion of knowledge, which is also more likely to occur within urban labour markets (Storper and Venables 2004, Florida 2002).

In the literature there are different spokespeople for heterogenous versus specialised agglomerations respectively. The concept of

specialised agglomerations and clusters concerns mainly *spillovers between firms in an industry or cluster*. Applied to cities (Marshall 1938) this view says that the concentration of an industry or cluster in a city helps knowledge spillovers between firms and, thereby promotes growth of that industry/cluster and of the city. This view is also supported by Porter (1990), who argues that knowledge spillovers in specialised, geographically concentrated industries and clusters stimulate growth[5]. Others claim that the most significant knowledge transfers come from outside the core industry. As a result it is the *diversity* of geographical proximate industries rather than geographical specialisation that promotes innovation and growth (Jacobs 1969)[6]. Urban variety and spillovers between industries, not regional specialisation and spillovers within industries, encourage the highest rates of employment growth (Glaeser 1992). Large city regions, therefore, are often emphasised as the most potent territorial units for innovation and economic growth in a knowledge economy. While knowledge spillovers may explain different growth rates between cities, other types of externalities than spillovers are important when explaining regional specialisation and formation of cities specialised in only a few industries.

The advantage of diversity has recently been further specified with the concepts of related variety (accounting for spillover effects) and unrelated variety (covering the portfolio effects) which involve different economic assets and effects (Boschma & Iammarino 2007). *Related variety* is here defined as sectors that are related in terms of shared or complementary competences[7], and which support spillover effects because knowledge mainly spills over from one sector to another which are complementary in terms of shared competences. Some degree of cognitive proximity is required for effective communication and interactive learning but extreme proximity may result in cognitive lock-in. Thus, it is

[5]However in contrast to the MAR-theory (Marshall-Arrow-Romer) that maintains that *local monopoly* is better for growth than local competition, Porter insists that *local competition* fosters the pursuit and rapid adaption of innovation.
[6]Jacobs (1969), like Porter, favours local competition, which she believes speeds up the adaption of technology.
[7] Related variety is thus not defined in terms of sectors having input-output linkages. This distinction between cognitive and economic dimension must be underlined, because economic networks are not necessarily the same as knowledge networks (Guliani 2005).

neither regional diversity, which may involve large cognitive distance, nor regional specialisation per se which may result in excessive cognitive proximity that stimulates innovation (Boschma 2005); it is rather *regional specialisation in related variety* that is likely to induce effective learning and innovation. Innovation is primarily driven by interaction and feedback mechanisms that cross industry borders as well as major innovations which are more likely to occur when knowledge spills over between sectors, rather than within the same sector. Building on related variety might then be an effective way to start up new growth paths (Martin and Sunley 2006). Related variety has, on the other hand, more positive effect on regional growth. The reason for this is that the co-location of complementary sectors may provide an extra source of knowledge spillover and innovation, thus causing additional economic growth. Related variety also allows for higher absorptive capacity of regions, and more rapid diffusion of innovations among related user-producer communities (Asheim 2006).

The concept of *unrelated variety* covers sectors that *do not* share complementary knowledge, and is said to represent the portfolio effects. Regions based on sectors that do not complement each other may be robust against external shocks (e.g. fall in demand in one particular sector). The risk-spreading effect may counteract fast growth in regional unemployment. When defining unrelated variety in economic terms (which is different from the cognitive-based definition) it concerns sectors that also have no substantial economic linkages. In this case a broad range of unrelated sectors in a region may be beneficial for regional growth because unrelated variety spreads risks. When a sector-specific shock occurs, it is unlikely to disturb the regional economy when the sectors are unrelated, that is when no substantial input-output linkages exist. Thus, unrelated variety dampens industry-specific shocks and stabilises regional economies in the longer run.

Urban regions based on related variety combine the strength of the specialisation of localisation economies and the diversity of urbanisation economies. That is, related variety combines the advantages of regional specialisation in complementary sectors (including knowledge spillovers) with advantages of regional diversity, dampening the risk of sector-specific shocks (Boschma 2005).

The main thesis that follows from this is that while related variety is beneficial for regional knowledge spillovers and employment growth, unrelated variety gives a weaker regional capacity for spillovers and employment growth, but a higher buffer capacity may dampen unemployment growth from external shocks[8].

Following these theoretical aspects it is assumed that small and large agglomerations have different prerequisites for innovation and growth based on diversity, and that related variety most likely develops and spurs economic growth in larger agglomerations compared to smaller ones. But while increasing sizes of agglomerations (i.e. number of inhabitants, employees and firms) most often also correlate with the degree of diversity measured in the numbers of different industries, this says nothing about the relative importance of related versus unrelated diversity, respectively. Further on it should be stated that firms and clusters in smaller agglomerationss may also get access to related variety by extra-regional links, and to some extent may compensate for the regional shortage of related industries and competences.

(3) Knowledge flows and networks are important assets for regional innovation and growth in a knowledge economy. These may be divided into four ideal types: Market links, formal networks, knowledge spillovers and milieu effects (Tödtling et al. 2006). *Market* relations refer to the buying of embodied knowledge in various forms. This is a rather static form of knowledge transfer. Formal *networks* are more durable and interactive relations between specific partners. Collective learning and the increase in both partners' knowledge base is seen as a product of such relations as this typically requires more and closer interaction than the information transfer taking place in market relations. Knowledge *spillover* refers to informal types of knowledge exchange. Such spillovers may occur in several ways. Firstly by mobility of workers between jobs, in which workers take their accumulated skills and know-how with them to new firms. Secondly, a similar mechanism is the spin-off of new firms from other local firms or knowledge organisations. Thirdly, knowledge spillovers are embodied in

[8] Recent empirical evidences from The Netherlands seems to give support for this thesis of regional correlation between "related variety" and "high employment growth", and "favourable unemployment rates" in regions with unrelated variety, as expected, a portfolio-effect (Frenken et al. 2007).

traded goods, patents and licenses, in which business information, technical knowledge etc. follow the traded relations as a secondary matter. Lastly, knowledge spillover occurs by persons acquiring knowledge in several types of informal settings, conceptualised as buzz (Storper and Venables 2004) or as local buzz (Bathelt, Malmberg and Maskell 2004). The idea is that firms learn by spontaneously observing and monitoring the activities and improvements of other firms, first of all nearby firms. The *milieu* effect relates to more informal links and collaboration between players. The milieu is characterised by a shared understanding often based on similar social and educational background among entrepreneurs and workers. This facilitates flow of knowledge, and a high degree of tacit knowledge exchange, among actors inside organisations and between organisations.

These four ideal types of knowledge networks and flows vary in *sensitivity to geographic distance*. Knowledge flows related to market links are less sensitive to distance, but also information transfer related to formal relations may take place over long distances. Knowledge spillovers and milieu effects are more related to tacit knowledge, informal networks and knowledge exchange, which are more sensitive to distance. Geographical proximity between the actors makes these kinds of knowledge flow easier.

Parts of the innovation literature focus on the tendencies towards more complex knowledge flows related to innovation processes. The concept of *distributed innovation processes* focuses on means and measures which allow companies to capture the distributed knowledge within a wide network of actors (users, manufacturers, suppliers, research centres, and others) to solve a technical problem and develop innovations (Von Hippel 1988). This is related to the "open innovation" model (Chesborough 2003, Chesborough et.al. 2006) assuming that firms, to an increasing extent, base their innovation activity on R&D activities, technical change and competence from external resources (input-factors), as well as carrying out much of their innovation activities through spin-offs of new firms, by investments in new firms and via licence agreements (output factors). Open innovation strategies are interpreted as the use of external knowledge and external commercialisation (Chesborough et.al. 2006). This firm strategy means more use of the environment to bring in research results, ideas and knowledge, as well as to commercialise internal

knowledge outside the firms. The assumed trend towards the increased use of open innovation strategies would entail an intensification of the firms' external knowledge relations and dependencies on available knowledge resources.

The concept of open innovation strategies has been developed with departure from large firms' innovation strategies with particular focus on their external networks (Chesbrough et.al. 2006). The tendency of firms to direct their business models so as to incorporate and manage the external knowledge relations may transform the spatial organisation of innovation. Cooke (2005) maintains that open innovation is one of the key concepts to explain how regional innovation systems, and clusters within them, have to be organised to be globally competitive[9]. More use of open innovation strategies may give innovation and growth advantages to firms and clusters located within agglomerations (op.cit). However, it is important to underline that spatial proximity is by no way a necessary precondition for open innovation strategies. Open innovation strategies on a global arena are of increasing importance for firms who should stay internationally competitive (Herstad et al. 2008). The association between urban structure and open innovation needs more investigation regarding the importance of input and output factors, as well as different kinds of formal and informal knowledge networks and channels, respectively.

Following Jacobs' externalities one could argue that sectoral lock-in at the regional level may be counterbalanced by the inflow of a high degree of variety of knowledge through inter-regional relationships. The more the region is connected to other regions, and the wider the range of knowledge that flows into the region, the more the region would benefit economically. However, it is not just a matter of being connected with a diversified set of regions or sectors (Boschma and Iammarino 2007: p.7). One also needs *regional absorptive capacity,* which is necessary to understand and transform external knowledge into local/regional innovation and economic growth. This is underlined in the cluster literature:

[9] But one recent analysis found that firms in the less urbanised areas have more open business models for innovation reflected in higher presence of co-developing innovators and outsourcing (Teirlinck and Spithoven 2008). It must be underlined that this study did not analyse knowledge spillovers and milieu effects, but primarily formal relations and cooperations.

leading firms may function as hubs or gatekeepers in a cluster, who search for and absorb non-local knowledge that may, or may not, diffuse to the other firms in the cluster, depending on their absorptive capacity (Owen-Smith and Powell 2004). What might be even more important is that these flows of extra-regional knowledge are related to, but not the same as, the sectoral specialisation of the region (Boschma and Iammarino 2007). These authors claim that *related variety in extra-regional connections* is required to ensure that knowledge flows will spark learning and innovation *in situ*.

(4) Institutional capability for innovation and development deals with properties of the institutional environment ("rules of the game"; norms, routines and regulations) which guide, constrain and control behaviour on the one hand, and the organisational forms ("actors"; firms, trade and labour unions, regulatory agencies etc.) on the other hand (Martin 2000). Institutional economic geography is concerned with both of these aspects of the "institutional regime" of the economy, and especially the interaction between them. In this field there have been introduced different concepts of "institutional thickness", "learning regions", "triple helix" and "innovation systems". Following the latter, regions have developed different forms and degrees of functional systems tailored to their specific industrial base and knowledge infrastructure. A regional innovation system (RIS) consists of two subsystems (Cooke et al. 2000: p.104–105). The first consists of firms in the main industries or clusters in a region. The second includes the knowledge infrastructure of education and research institutions as well as technology centres, science parks, incubators, and so on. A RIS may include various industries and clusters in a region, that is, the knowledge infrastructure can be relevant for several regional industries (Asheim and Coenen 2005). It is important also to underline that a RIS is open, which means that knowledge employed in the innovation process can come from sources both inside and outside the region. Actors in the two subsystems can thus partake in interactive learning processes with local and external knowledge organisations, and they can be part of both local and more extended supply chains.

Based on these clarifications, one may distinguish analytically between two types of RIS. The first type is called a *regional integrated innovation system* (Asheim and Isaksen 2002) where the two

subsystems are mainly found inside the region. This type is found in some high-tech industries, or industries based on the Science, Technology, Innovation (STI) mode of innovation (Lorenz and Lundvall 2006). These are firms that need to be in contact with advanced research institutions. Although the contact may involve partners in different parts of the world, some firms benefit from close geographical distance to research institutions, both to gain early access to new research results and to recruit highly educated labour. Such advantages partly explain why firms in new, knowledge intensive) industries, such as biotechnology, often cluster close to some universities and research institutes (Cooke 2002: p. 130–131). Regional integrated innovation systems are often found in large cities with a concentration of knowledge creation and diffusion institutions and knowledge intensive firms with the capability of cooperating with such institutions (Table 1).

The second type of RIS is a *regional part of national innovation systems* (Asheim and Isaksen 2002). In this case, parts of the regional industry are more functionally integrated in national (or international) innovation systems, which means that innovation collaboration, to a large extent, takes place with companies and universities outside the region. A typical example is firms embedded in a regional production system but where the knowledge sources that support firms' innovation activities are mainly found outside the region. Innovation collaboration takes place between R&D departments in large corporations or advanced smaller firms and external R&D institutions or strategic customers and suppliers. This type of RIS is seen to dominate in smaller regions without a strong knowledge generating and diffusion subsystem.

(5) Attractiveness. The presence and composition of regional resources and innovation capabilities are also affected by the quality of "people climate" and "business climate" in a region (Florida 2002), and its forces of attraction regarding human and financial capital from outside. Human capital and talents attracted by local qualities i.e. "people climate", are today seen as more basic than industrial structure and the "business climate" for attracting and developing knowledge intensive industries (op.cit). The forces of attraction are also strongly influenced by factors such as the types of agglomeration economies, institutional capability as well

as the concrete functional and geographical situation of a region within (inter-) national economy and city-system.

2.3 Regions in different roles and relations functions

Regions' innovation and growth capabilities are also strongly influenced by exogenous and relational conditions within national and inter-national economies.

The traditional innovation and growth theories have previously been combined with different spatial theories of central-place-hierarchies and growth poles. In a main bulk of thought it was asserted that innovation and growth in large cities later on diffuse in space to smaller towns and spearsly populated areas. This perspective also, to some extent, resembles the classical theory of the *spatial division of labour* (Massey 1984) where the notion of locational hierarchies is in focus. While the control and development functions are mostly found in the capital and large cities, the standardised production is located in peripheral areas nationally and globally containing pools of cheap, unskilled labour.

The middle stage of production is more advanced production activities typically found in the old centres of skilled labour. This ideal-typical spatial division of labour still appears evident in particular on an international level with the outsourcing of routine production to low-cost countries. However, the knowledge based economy shows signs of a more complex spatial division of labour, including unlikely spots for high tech development outside the large cities (Cooke & Piccaluga 2006). While the traditional spatial division of labour typifies in particular the Fordist standardised production in large firms, are the knowledge-intensive industries archetypical examples of post-Fordist industries. These are characterised by more flexibly networked production and display other location dynamics than the typical Fordist industries (Scott edt. 2001).

The traditional theories of the spatial dimension of innovation have been challenged by perspectives which emphasise a more complex *innovation pole landscape* than previously (Tødtling 1994). Changes in the organisation of production and innovation with an

increasing variety of actors and institutions involved at the local and regional as well as the supranational levels, have resulted in a more complex innovation pole landscape than existed in the past. Most of the large metropolitan regions remain important centres of innovation, but on the other hand, new patterns of innovation are emerging (op. cit.). These are partly adjacent or near to large metropolitan areas but partly also in newly industrialised intermediate locations, sometimes in restructured small cities and even some in more peripheral locations.

As described in the previous chapter small and large city regions have advantages of different kinds regarding diversity and specialisation. In a national innovation and economic approach is both regional specialisation and diversity important (Duranton and Puga 2000). Specialised industries and knowledge are important for innovation capability and competitiveness in specific fields; while diversity of industries and knowledge are important to get new ideas and technologies able to enter regional and national economies, to avoid "lock-in" and develop new industries (op.cit). Linked to a national innovation system concept as such, diversified large cities and specialised small cities, therefore, may both represent important units and elements in the national capabilities of innovation and economic growth in a globalised knowledge economy. This conceptual aspect is also relevant for the hypothesis that different types of city regions support the development of different kinds of more knowledge intensive industries.

2.4 Analytical framework and issues for empirical investigation

The literature emphasises different aspects of structures and drivers which contribute to regional innovation and growth. We have divided these into the following five building blocks or main factors: Territorial resources, agglomeration economies, knowledge flows, attractiveness and institutional capabilities. These are not mutually excluding factors, but partly overlapping categories which influence each other.

Different properties and combinations of these main factors leads to a huge variety of regions regarding specific advantages,

innovation capabilities and potentials. But at the same time, in much of this theoretical literature it is claimed that the properties of these main factors are characterised by systematic differences between large city regions, small city regions and rural regions. In other words, it is maintained that the different sizes of the regional milieus not only gives different amounts of resources but also systematically different qualitative properties with relevance for innovation performance and challenges. Based on the international literature this can be summarised in this way (illustrated in the Figure1):

Large city regions are characterised by superior innovation resources and structures related to human capital, knowledge institution and R&D-investments, advantages of diversity (and related variety) and

extensive spillovers stimulating high rates of innovation (including radical innovation) and entrepreneurship, as well as additional regional growth. Innovation deficits are mostly related to complexity, fragmentation and weak links between knowledge providers and users.

Small city regions are more characterised by limited innovation resources and structures bound to advantages of specialisation, spillovers and innovation effects within one/few branches or clusters. This implies limited rates of innovation and entrepreneurship as well as additional regional growth. Innovation deficits are related to insufficient access to human capital, knowledge institution and R&D-resources, as well as challenges related to "lock-in" problems and the need to broaden the economic base.

Small place regions and rural regions are mostly characterised by very limited innovation resources due to the shortage of human capital, knowledge institutions and R&D-resources as well as one-/few-sided specialisation in mature industries. Thin organisational and institutional milieus give low innovation capabilities and rates.

Figure 2.1 *General aspects on regional advantage, innovation and challenges.*

Region-types:	Regional advantages and support structures:					Outcomes : (often found)	Innovation deficits and challenges :
	1.Territorial resources	2. Agglomeration economies	3.Knowledge flows	4. Attractivity	5.Institutional conditions within the regional innovation system		
Large city-regions :	Large volumes and diversities of human and financial capital. Shares of higer educated people and creative works over average.	Urbanisation & localisation economies. Heterogenous specialization in knowledge intensive industries. Related variety often found.	Substantial intra-regional knowledge spill-overs between different branches, and inflows of knowledge from global networks and migration often found.	Strong centripetal forces on human and financial capital Attractive "people climate" often found.	High density and variety of organisations and "light institutions". The degree of regional system integration varies a lot.	High rates of innovation, new firm establishments and job-growth in new industries	Complexity and fragmentation. Linking knowledge producers and users. Trigger of new industry development.
Small city-regions :	Small volumes and diversities of human and financial capital in general, but often substantial within specific fields and others	Localization economies related to one/few industries (the types varies a lot)	Some intra-regional knowledge spillovers and inflows of knowledge from national og global links within a spesific branch or cluster ofte found.	Centripental forces on human and financial capital varies a lot, but general weaker than large city regions. Attractive "business climate" often found.	"Institutional thichness" around specialised agglomerations often found. The degree of regional system integration varies a lot.	Medium rates of innovation and new firm rates, weak job-growth in new industries.	Frail diversity. Negative lock-in. Extra-regional links. Attractivity. New industries, firms and jobs.
Small place regions :	Frail human and financial capital - but often substantial natural resources	Weak or no agglomeration economies. Specialization in one/few industries utilizing dissagglomeration economies may be important.	Tiny intra-regional spillovers, but extra-regional support-links of some importance	Leakage of human and financial capital, and often weak attractivity forces for immigration	"Institutional thinness". Regional system integration seldom found.	Low innovation and new firm rates, and decline in jobs	Thiny miliues. Frail diversity. Extra-regional links. Attractivity. New job opportunities.

Issues for the empirical analysis

With the previously mentioned literature and the derived overall analytical framework as our point of departure, we will in the next chapters look at properties of regional advantages, innovation and growth in Norway based on empirical data. The chapters to come will shed light over the following issues:

- What kind of advantages, patterns and performances of innovation and growth characterize the main types of regions in Norway, and how can these patterns be explained ?
- What functions and roles do different kinds of city regions have in the development of more knowledge intensive industries in Norway ?
- What kind of innovation challenges are small and large city regions facing in Norway, and how can regional innovation policy contribute to meet these challenges in the years to come ?

3 The national context

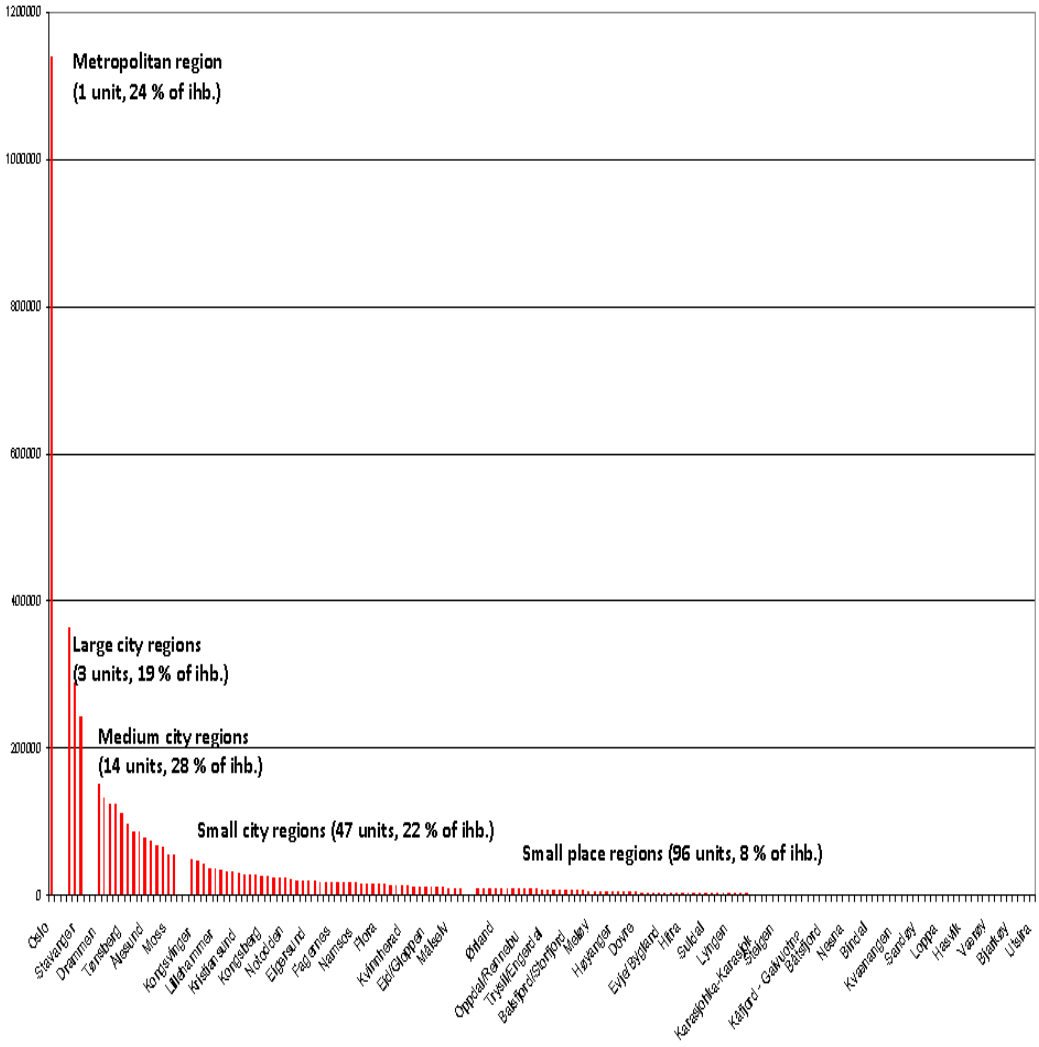
3.1 Territorial structures and population trends

Norway is a small country regarding its population size (4.6 million), but a very large country in geographical terms (1800 km from north to south, which is further than between Oslo and Rome). The impact of distance is increased by topographical features, and coupled with a relatively harsh climate communication has never been very easy.

The small population is distributed all over the country, but mostly (78%) in urban setlements ("byer og tettsteder") and therefore the urbanisation level is about the European average (Foss et.al. 2006). When looking at the urban hierarchy ranked by size (Figure3.1) we see a somewhat monocentric structure with a dominating metropolitan region beside very many smaller city regions. In addition very few of these smaller city regions are integrated in polycentric city regions.

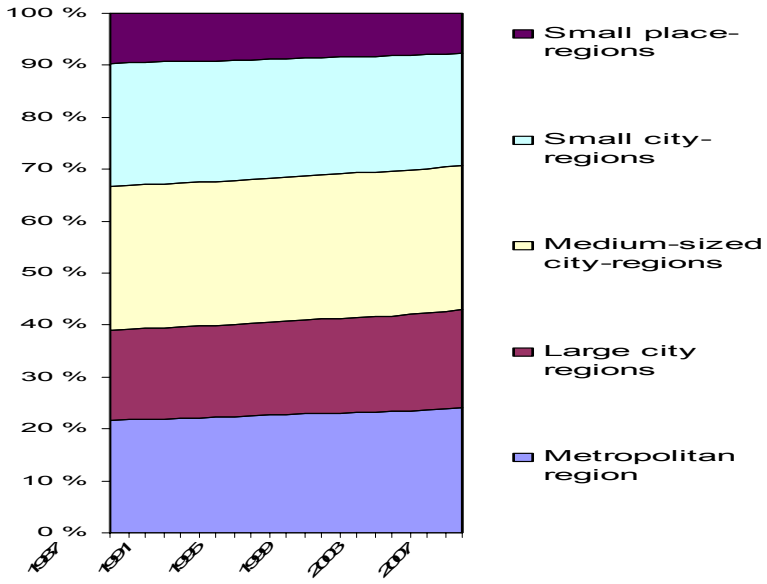
A main part of the total population (42%) lives in the four largest city regions, but an even larger part (50%) lives in smaller city regions (cf. Figure3.1 and 3.2). This part is distributed among 61 small and medium sized city regions. The rest of the population (8%) live in small place regions, of which there are 96 units.

Figure 3.1 *The 161 functional regions[10] ranked after population size 2008 (Datasource:Statistics Norway).*



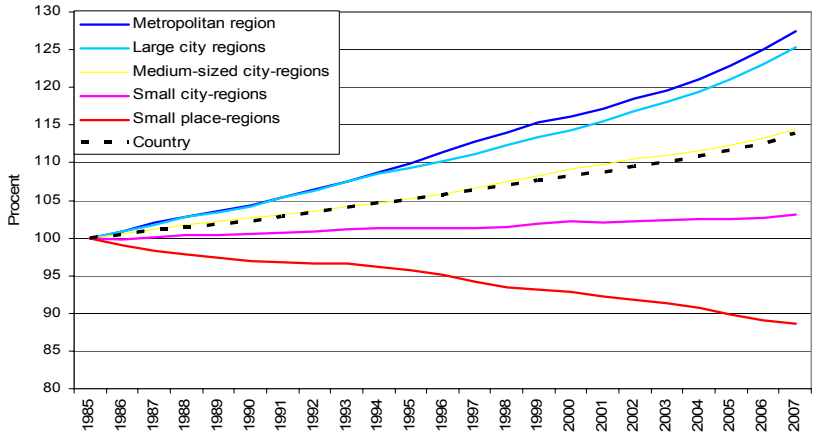
[10] Functional city regions consists of a central place and its local labour marked (Juvkam 2002). We use this as the main territorial unit in this report. We distinguish between five classes of these functional regions according to their number of inhabitants: metropolitan regions (more than 1.0 mill. ihb), large city-regions others (200.000 – 999.999 ihb.), medium-sized city-regions (50.000 – 199.999 ihb.), small city-regions (10.000 – 49.999 ihb.), small place regions (less than 10.000 ihb). In general this is in line with international classification standards (United Nations Centre for Human Settlements) except for the metropolitan region and small place regions which we have separated as distinct categories.

Figure 3.2 *The population distributed (%) in different main region types 1987-2009 (Datasurce:Statistics Norway)*



The population growth rates over the last decades substantially favoures the largest city-regions, while small city regions have marginal growth and the population in the small place regions is declining (cf. Figure3.3).

Figure 3.3 *Population growth rates (%) in different region type s 1995-2008 (Datasource:Statistics Norway) .*



3.2 Economic structures and trends

National structure and trends

The Norwegian economy is a small open economy specialised in low-tech exports and trajectories related to resource extraction and transport-related services[11] (Grønningen et al. 2008). The country is characterised by relatively low R&D- and innovation intensity[12]. When looking at the employment it is a *service economy* with 84% of the total employment in services (cf. Table 3.1). The employment within the knowledge intensive industries[13] make up a share of 25 precent of the total employment, which for the most is related to services.

Over the last decade *the employment growth* in rates and numbers has been most substantial in these knowledge intensive industries. It is particularly knowledge intensive service (ICT-consulting, consulting others), finance and creative services which have had the highest growth rates, beside a substantial growth in the public sector.

[11] The scientific specialisation is also related to the mentioned trajectories, and most of the patenting is related to activities taking place in related sectors (shipbuilding, machine tools, pumps/turbines, oil rigs/drilling techniques etc.).
[12]OECD 2008 Reviews of Innovation Policy – Norway. In OECD-terms Norway's position is below the EU25 average regarding R&D and innovation intensity, while other Nordic countries are at the very top of the list (European Innovation Scoreboard 2006, European Commission, Brussels).
[13] The *knowledge intensive industries* is in this report used as a general concept for medium R&D-intensiv and R&D-intensive manufacturing (medium high tech and high tech), knowledge intensive business service (KIBS) (consulting, ICT, finance, R&D), creative services and universities/colleges (higher education). We exclude welfare services and public administration from the concept in this report.

Table 3.1 *Industrial structure and growth rates in Norway 1998–2008 (Source: Statistics Norway/Firm register)*

		Number of firms 2008	Employment 2008		Changes in employment 1998-2008	
			Number employed	Relative distribution (%)	Relative changes (%)	Absolute changes
1	All sectors	477 399	2 439 292	100	24,1	474 340
2	Primary industries	72 878	71 984	3	-23,2	-21 710
3	Low R&D-intensive manufacturing	12 274	117 236	5	-11,6	-15 386
4	Medium R&D-intensive manufacturing	11 168	162 515	7	5,0	7 709
5	R&D-intensive manufacturing	1 008	19 357	1	0,8	153
6	Knowledge intensive business services	57 428	224 357	9	63,1	86 769
7	Creative services	22 489	31 115	1	47,9	10 081
8	Finance & estate	56 403	83 710	3	47,2	26 826
9	R&D	661	12 798	1	23,0	2 396
10	Universities/colleges	1 082	73 973	3	18,4	11 508
11	Lesser knowlede intensive privat service	182 794	883 408	36	16,4	124 729
12	Public dominated services	59 214	758 839	31	46,6	241 263

In OECD-terms the "Norwegian paradox" deals with the fact of the country's high economic performance in spite of low R&D investments in the private sector, weak innovation inputs and outputs. Norway has weaknesses related to expenditures below OECD- and EU-averages, presenting even a slightly negative trend, and innovation output and high-tech exports at much lower levels compared to the EU25[14]. On the other hand Norway has strengths regarding innovation driver indicators related to tertiary education, lifelong learning, broadband penetration and public funding for innovation.

Regional structures and trends

In Norway the work places are relatively evenly distributed amongst different main types of city regions with about one half in largest city regions and the another half in small- and mediumsized city regions . However, there is a substantial difference in the average number of work places within the largest city regions and the smaller city regions .

[14]OECD Territorial Reviews 2007 – Norway .

Table 3.2 *Shares and avarage numbers of workplaces in main types of regions 2008. (Datasources: Statistics Norway)*

	Metropol	Large city-	Medium	Small city-	Small	Country
Share (%) of all national workplaces	28	20	26	20	7	100
Number of regions (local labormarkets)	1	3	14	47	96	161
Average number of workplaces per region	683 466	160 333	44 829	10 276	1 711	15 151

As previously mentioned Norway is a service economy measured by employment. In all region types the employment in services is much higher than in goods production. However, when looking at main patterns of *regional specialisations* [15]we have a very significant pattern (cf. Table 3.3). The larger city regions are specialised in different kinds of service industries while smaller city regions are more specialised in different kinds of goods production. The *metropolitan region* is first and foremost specialised in knowledge intensive and creative services, while the other *larger city regions* are specialised both medium high-tech manufacturing (maritime and offshore related) and knowledge intensive services. The medium and small city regions are in generally more specialised in different manufacturing industries (both low-and high-tech), while the small place regions are mostly specialised in primary industries and low-tech manufacturing.

Table 3.3 *Main structures of regional specialisation and division of labour in Norway (localisation quotients 2008). (Datasource: Statistics Norway)*

		Metropol region	Large city regions	Med.sized city regions	Small city regions.	Small place regions
1	Primary industries	0,3	0,7	0,9	1,7	3,3
2	Low R&D-intensive manufacturing	0,8	0,8	1,1	1,1	1,6
3	Medium R&D-intensive manufacturing	0,3	1,5	1,3	1,1	1,0
4	R&D-intensive manufacturing	1,1	1,1	0,9	1,1	0,1
5	Knowledge intensive services	1,6	1,1	0,8	0,6	0,4
6	Creative services	1,9	0,9	0,7	0,4	0,4
7	Finance & estate	1,4	1,1	0,8	0,7	0,6
8	R&D	1,7	1,9	0,4	0,3	0,3
9	Universities/colleges	1,0	1,3	0,9	1,0	0,7
10	Lesser knowlede intensive privat service	1,1	1,0	1,0	1,0	0,9
11	Public dominated services	0,9	0,9	1,0	1,1	1,2

[15]Measured in the overrepresentation of an industry in a region type compared to the national industrial distribution.

Table 3.4 *Development trends in sectors and region type s 1998–2008 (Source: Statistics Norway).*

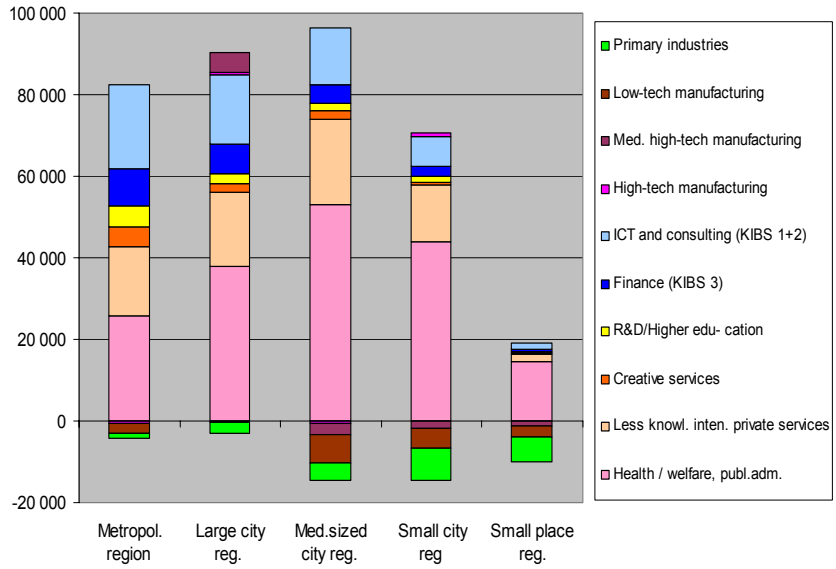
		Metropol reg	Large city-reg	Medium city-reg	Small city-reg	Small place reg	Country
Procent changes 1998-2008 :							
1	All sectors	25,1	35,4	22,9	19,8	9,6	24,1
2	Primary industries	-10,5	-21,1	-21,6	-24,2	-27,8	-23,2
3	Low R&D-intensive manufacturing	-6,5	1,3	-14,4	-16,0	-20,1	-11,6
4	Medium R&D-intensive manufacturing	1,8	26,1	-1,9	-1,8	-7,3	5,0
5	R&D-intensive manufacturing	-15,7	24,8	-14,1	41,7	2,8	0,8
6	Knowledge intensive services	54,6	82,6	70,3	57,2	44,7	63,1
7	Creative services	46,1	76,3	40,9	31,7	37,5	47,9
8	Finance & estate	45,2	83,5	40,3	33,4	10,6	47,2
9	R&D	41,7	10,4	2,4	5,9	104,2	23,0
10	Universities/colleges	25,2	17,5	19,3	14,9	0,8	18,4
11	Lesser knowlede intensive privat service	15,1	21,2	17,0	16,0	8,3	16,4
12	Public dominated services	34,7	62,6	49,4	47,4	43,1	46,6
Absolute changes 1998-2008:							
1	All sectors	137268	125820	117079	79852	14321	474340
2	Primary industries	-625	-2780	-4451	-7754	-6101	-21710
3	Low R&D-intensive manufacturing	-1726	245	-5741	-5046	-3118	-15386
4	Medium R&D-intensive manufacturing	259	9961	-998	-681	-830	7709
5	R&D-intensive manufacturing	-1155	802	-765	1266	5	153
6	Knowledge intensive services	35114	21912	18651	9338	1753	86769
7	Creative services	5261	2347	1609	656	208	10081
8	Finance & estate	10536	8132	5022	2827	309	26826
9	R&D	1747	442	28	40	140	2396
10	Universities/colleges	4050	2908	2696	1825	29	11508
11	Lesser knowlede intensive privat service	35068	29018	33445	23199	4000	124729
12	Public dominated services	48737	52832	67583	54184	17926	241263
Regional shares (%) of the national growth (=100):							
1	All sectors	28,9	26,5	24,7	16,8	3,0	100,0
2	Primary industries	-0,1	-0,6	-0,9	-1,6	-1,3	-4,6
3	Low R&D-intensive manufacturing	-0,4	0,1	-1,2	-1,1	-0,7	-3,2
4	Medium R&D-intensive manufacturing	0,1	2,1	-0,2	-0,1	-0,2	1,6
5	R&D-intensive manufacturing	-0,2	0,2	-0,2	0,3	0,0	0,0
6	Knowledge intensive services	7,4	4,6	3,9	2,0	0,4	18,3
7	Creative services	1,1	0,5	0,3	0,1	0,0	2,1
8	Finance & estate	2,2	1,7	1,1	0,6	0,1	5,7
9	R&D	0,4	0,1	0,0	0,0	0,0	0,5
10	Universities/colleges	0,9	0,6	0,6	0,4	0,0	2,4
11	Lesser knowlede intensive privat service	7,4	6,1	7,1	4,9	0,8	26,3
12	Public dominated services	10,3	11,1	14,2	11,4	3,8	50,9

When looking at *main feature of the regional development* in work places the last decade (cf. Table 3.4) we see that the large city regions had the highest growth rates (+35%), substantially higher than the metropolitan region (+25%), medium-sized city

regions (+23%), small city regions (+20%) and much higher than the small place regions (+10%). The most unexpected pattern here is the relatively weak growth of the metropolitan region comparing to the other larger city regions. The metropolitan region have weaker growth in almost all sectors except R&D and higher education.

The substantial growth rates of the larger city regions are mainly due to Stavanger, Bergen and partly Trondheim, and their high growth rates within knowledge intensive business services (consulting, ICT, finance etc.), medium-high manufacturing (oil/gas, maritime, machines etc.) as well as within less knowledge intensive services (hotel/ restaurant, constructing, personal service etc.). These cities have had particular advantages of the high national activity in offshore, maritime and marine industries which also have stimulated above average growth within knowledge intensive business services and other consumption services in these regions.

Figure 3.4 *Changes in number of jobs in different industries and region types 1998-2008 (Datasource: Statistics Norway, CRE).*



3.2.1 Innovation and regional policy trends

The R&D-, industrial and innovation policies in Norway have over the last decades been noticeably changed. The policy is still based on different theoretical fundations and objectives, but has in general to an increasing extent been more influenced by modern innovation theory implying stronger instruments for enhancing learning and knowledge interaction within networks, clusters and innovation systems (Jakobsen and Onsager, 2008). At the same time important parts of the national innovation policy has appeared with a stronger

regional focus and can be labelled as a (i) national, but regionally differentiated innovation policy[16]. Beside this we have a (ii) national, territorially neutral policy in the meaning of universal innovation instrumentst[17], and at last (iii) regional development policy which are linked to a national rural and regional policy based on redistribution of national funding in advantage of small urban and sparsely populated regions.

In the early 1990s all firm-oriented instruments (loans, guarantees for investments and entrepreneurship) became nationwide. This implied that all firms and industries also in the largest cities, and not only in more lagging regions, in principal got access to the universal governmental funding support for investment in knowledge, innovation and entrepreneurship. Within the national regionally differentiated innovation policy, and the national rural and regional policy, it has later on been introduced some instruments with particular focus on smaller towns and rural regions. The urban focus, however, is not strongly reflected in the different innovation programs that have been launched in the past decade. None of the nationwide schemes to promote regional innovation are particularly fit for or directed at the larger cities, and they contain no specific large city policy measures. The increased focus on the significance of large cities for economic development and growth which has characterised international literature and policy in the past decade has only in limited ways been echoed in innovation and regional policy programs in Norway. On the other hand *regional advantages* and *competitiveness* have come to the fore in regional policy, and here even the large cities are given special attention in recent policy documents as engines of national and regional growth[18].

Further, while the tendency has been that innovation and development policy has been more regionalised[19], competence is gradually moved from central to regional level, and accordingly more resources have been allocated to the regional level. Simultaneously, the innovation policies to a larger extent, are formulated and implemented by the regional partnerships of private and public actors and organizations.

[16]Norwegian Center of Expertise (NCE), Innovation in network program (Arena), Instruments for Regional Innovation (VRI) etc.
[17]For excample by tax-reduction of R&D-investments (SkatteFunn).
[18]See Report to the Storting No.31 (2002–2003) and No.31 (2006–2007).
[19] The establishing of regional research funds from 2010 confirms this trend.

4 Regional advantage, innovation and performance

In this section we describe characteristics of regional advantage, innovation and performance in the five main types of regions. Firstly, we will look at advantages regarding human capital and innovation inputs. Then we describe dominating innovation forms and networks, innovation and entrepreneurial performances in the main types of regions. At last we look at hampering factors in the different region types.

4.1 Human capital

In general is competence the most crucial resource for productive activity and innovation. Competence is a concept which means individuals' and groups' skills to accomplish tasks in a proper or a creative way. It consists of different combinations of formal and informal forms of knowledge, from codifiable scientific and analytical knowledge to more tacit knowledge forms acquired through practical work and experience. Therefore, the competence in a region, is a complex matter to describe and analyze. In the following we use some simple indicators which describe important aspects of the competence bases of different main types of regions.

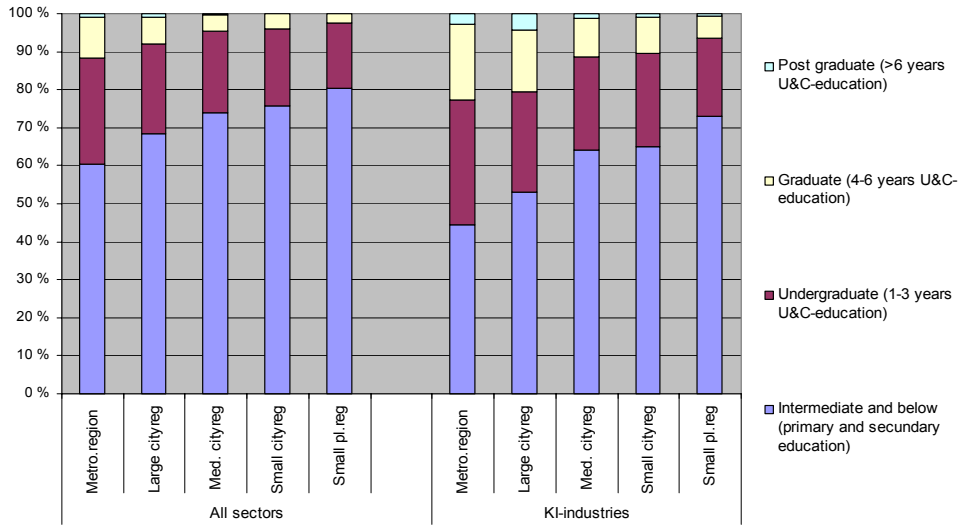
Education levels and groups

The *formal education* level in a region is a rough indicator for an important regional resource for economic development, and in particularly for development of knowledge intensive industries and economic growth in a knowledge economy. The education levels say something about the regional resources and potential capabilities to obtain, transfer, adapt and utilise scientific knowledge for local purposes. The education level influences the abilities and opportunities to acquire and use codified and scientific knowledge,

not only from the Internet and professional institutions but also through cooperation with knowledge organisations in different parts of the world. As the knowledge economy is becoming increasingly prevalent, people with tertiary education become essential as they give access to codified knowledge that is needed to obtain various skills in order to be competitive in business and labour markets. The educational level also says something about regional competitive advantages and potentials for obtaining R&D-resources from national and international programs, and as such getting R&D-funding from sources outside the own region.

When looking at the regional educational levels we see that the levels increase systematically with the size of the city-regions; the larger the city-region the larger the share of people with higher education (university-level education) (cf. Figure4.1).

Figure 4.1 *Educational levels in different region types 2008 (Datasource:Statistics Norway).*

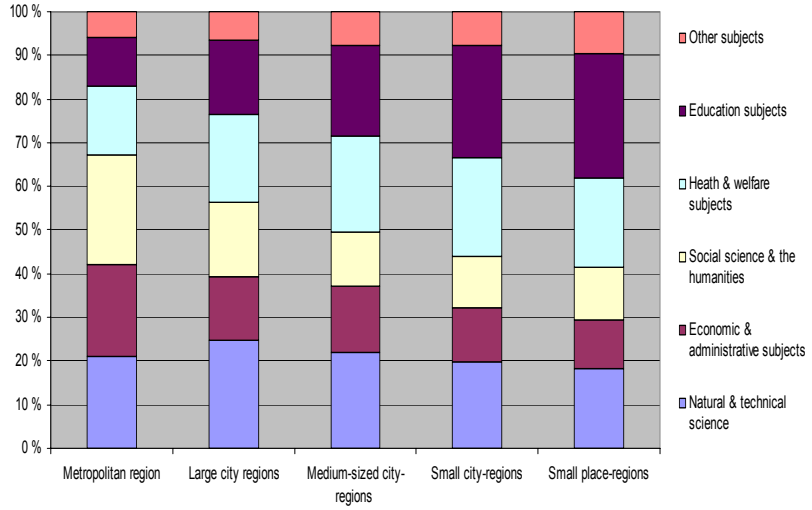


These regional differences apply to all sector-employment, but in particularly to knowledge intensive sectors.

When only looking at the higher educated people according to their educational subjects we see that the larger city regions have a more even distribution of different subjects than smaller city regions (cf. Figure4.2). The share of higher educated people with economic,

administrative or social science competences decrease with the decreasing size of the city region, while the is the case opposite for educational subjects and other subjects (agricultural subjects etc).

Figure 4.2 *The higher educated people according to educational subjects in different region types 2008. (Datasource:Statistics Norway).*



Creative workers

The share of creative workers may also indicate some important characteristics of industries and regions (Florida 2002). Creative workers consists of persons who in their jobs identify problems, devise new solutions or combine existing knowledge in new ways. These may be engineers, artists, musicians, designers, scientists and other persons in knowledge based professions[20].

Starting with the industries, the share of creative workers[21] is much higher in the knowledge intensive sectors than in the rest of the economy (Isaksen 2005). Creative workers make up as much as 61%

[20]Florida's definition of the "creative class" has been met with critique, among other things for delimiting creativity only for certain occupational groups.
[21] Creative workers are here defined in accordance with Florida's definition of the creative class, and based on work in a European collaborative project on "Technology, Talent and Tolerance in European Cities: A Comparative Analysis". Creative workers belongs here to occupations like senior officials and managers, scientists and engineers, life science professionals, education teaching professionals, administrative professionals, writers and performing artists, photographers, designers.

of all employees jobs in knowledge intensive services, and only 28% and 16% in knowledge intensive manufacturing and other industrial sectors, respectively. Table 4.1 shows the more complicated picture of relative numbers of creative workers in both industries and regions. A distinct pattern emerges. The share of creative workers rises markedly with increasing size of the regions, and that is the case in all three industrial categories. The pattern demonstrates a familiar and typical division of labour between city regions; much administration, research and development take place in larger cities, while more routine-based production and service activities dominate more in smaller regions.

Table 4.1 *Percentage of creative workers in main types of industries and regions 2005 (Source: Statistics Norway).*

	High-tech and medium-high tech manu-facturing	Knowledge intensive services	Other sectors	Total industry
Metropolitan region	40.5	65.1	25.3	37.6
Large city regions	27.3	65.1	18.4	29.1
Med. sized city regions	26.9	56.5	13.5	21.3
Small city regions	25.6	54.4	11.7	17.9
Small place regions	13.6	50.6	8.6	12.6
Country	28.4	61.3	16.4	25.8

Development trends

When looking at the development over the last decade there has been a substantial absolute and relative growth of employed persons with higher education in Norway. The growth has been much higher than for the employment of person without higher education (cf. figures 4.3 and 4.4).

Figure 4.3 *Percent total employment growth according to educational groups in different region types 1998-2008 (Datasource: Statistics Norway)*

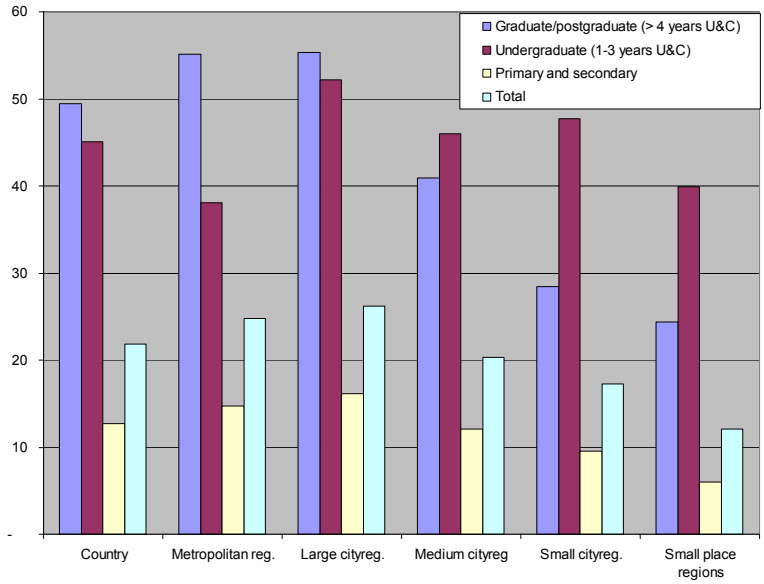
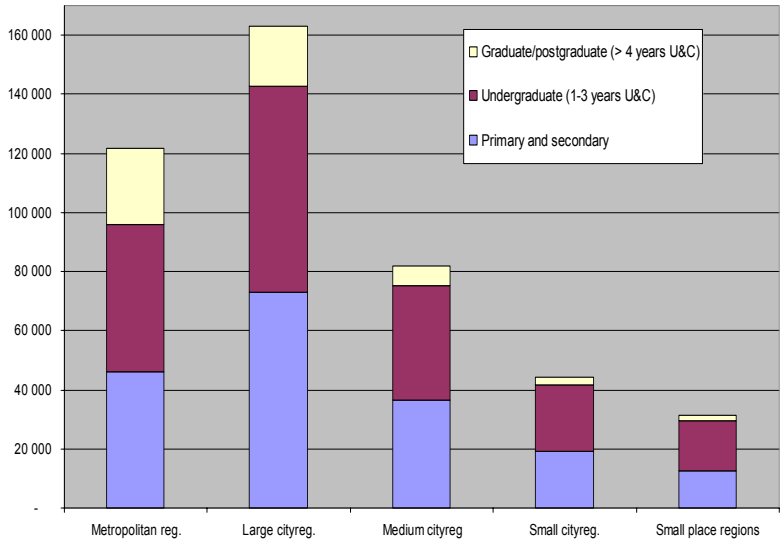


Figure 4.4 *Growth in absolute number of employed in different educational groups and region types 1998-2008 (Datasource: Statistics Norway)*

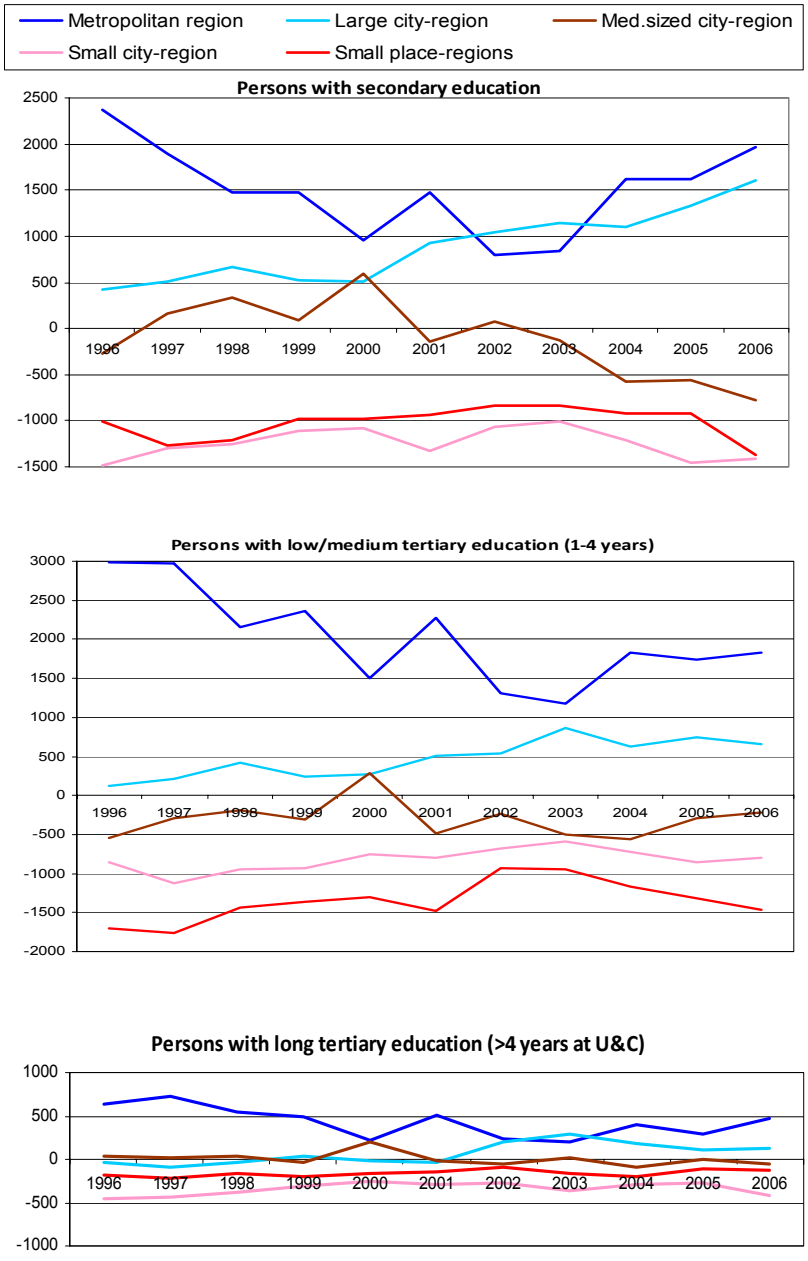


The growth rates of the higher educated employees have been substantial in all the region types, but in particularly within the larger city regions. The most territorially differentiated growth pattern is found among employees with the longest education. For these groups the growth rates have been much higher in the largest city regions than in smaller ones, in spite of the initially higher share of such employment in the larger city-regions.

The presence of higher educated labour, and the ability to *attract* and retain such labour, is of particular importance for development and growth in a more knowledge based economy. One indicator of the regions' ability to attract labour with higher education is the net-mobility flows. In the last decade we find a substantial net-inflow of people into the larger city-regions and net-outflow from the smaller city-regions (cf.Figure4.5). This is the case for all educational groups.

These patterns are due to the higher net-job-growth rates in the larger agglomerations compared to the smaller ones, and the fact that the larger city regions are attractive places with their diversity of jobs, services, educational and adventural offers. Human capital and talent attracted by such local qualities and a specific "people climate" are regarded by some as more basic than industrial structure and the "business climate" for attracting people and developing knowledge intensive industries (Florida 2002).

Figure 4.5 *Regional net-mobility for different educational groups 1995-2006 (Datasource:Statistics Norway).*



4.2 R&D and innovation funding resources

R&D-investments are usually seen as important for the capability to innovate and develop existing and new industries. As such regions with large R&D-investments will have resources advantages for innovation and economic growth in a knowledge economy.

In Norway the regional R&D-resources (measured in costs) and R&D-intensities (investments per employed) are increasing substantially with increasing size of the city-region (cf. Table 4.2). This is due both to the fact that the R&D-intensity is increasing in almost all industries with increasing sizes of the agglomeration, as well as the share of R&D-intensive industries of all industries also is increasing with the size of the agglomeration.

Table 4.2 *The R&D expenditurees and intensities of different industries and regions in Norway[22] (Datasource: Statistics Norway: R&D and Innovation survey 2006).*

		Metropolitan region		Large cityregions		Med.sized cityregions		Small cityregions		Small place regions		The country	
		Total R&D-expenditures in mill. NOK	Total R&D-expenditures per employed in thousand NOK	Total R&D-expenditures in mill. NOK	Total R&D-expenditures per employed in thousand NOK	Total R&D-expenditures in mill. NOK	Total R&D-expenditures per employed in thousand NOK	Total R&D-expenditures in mill. NOK	Total R&D-expenditures per employed in thousand NOK	Total R&D-expenditures in mill. NOK	Total R&D-expenditures per employed in thousand NOK	Total R&D-expenditures in mill. NOK	Total R&D-expenditures per employed in thousand NOK
0	All sectors	8 523	4 385	4 965	3 616	3 496	2 056	2 666	2 240	484	1 272	20 135	3 056
1	Primary (only aquaculture)	0	0	179	42 626	8	3 327	132	13 877	82	5 506	402	12 916
2	Low-tech manufacturing	432	1 793	290	1 470	368	1 046	231	842	163	1 316	1 485	1 249
3	Med.-high-tech manufacturing	923	6 874	2 479	6 388	1 644	3 729	1 384	4 404	179	2 008	6 610	4 837
4	High-tech manufacturing	1 491	25 479	441	13 033	554	12 848	406	11 385	20	7 333	2 912	16 747
5	Knowl.intensive services	3 223	9 250	1 217	8 087	578	5 730	353	5 683	30	5 727	5 401	8 096
6	Creative services	16	1 319	1	129	0	0	2	482	0	0	19	649
7	Finance and Insurance	1 402	7 140	117	1 295	39	528	6	147	0	0	1 564	3 775
8	R&D	181	58 865	119	41 421	49	12 413	23	43 366	1	3 283	373	34 541
9	Less knowl.int.private services	854	899	121	243	258	379	128	286	8	62	1 369	506

The most R&D intensive industries[23] in Norway are high-tech manufacturing, aquaculture and knowledge intensive services. The

[22] See more details in Table A7 in Appendix.

[23] Measured in total R&D-expenditures per employee.

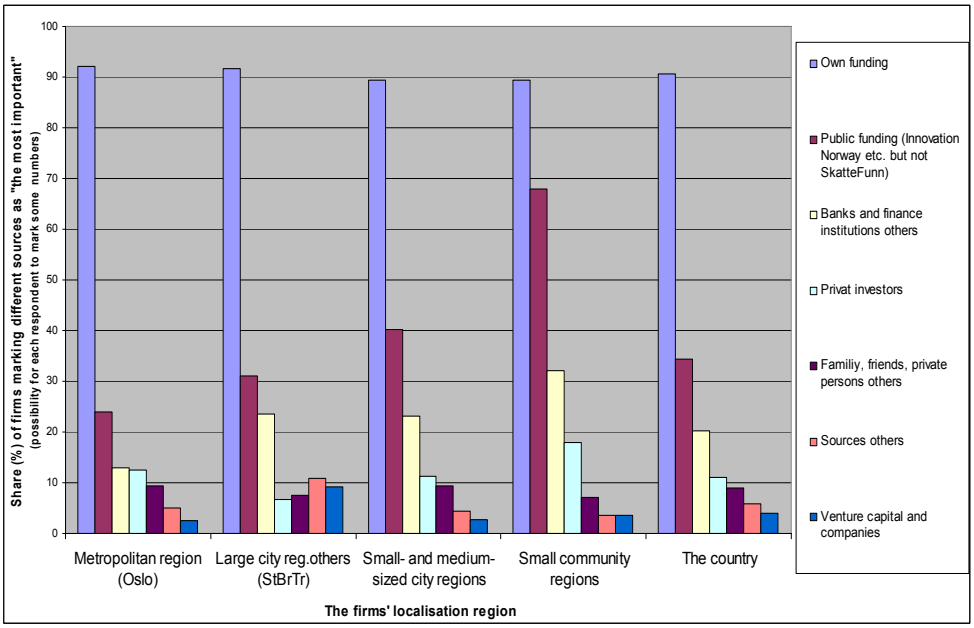
But it is medium-high-tech manufacturing (maritime, oil/gas, machines etc) and knowledge intensive services (ICT, consulting etc) which contribute most of all in total R&D- expenditures.

As mentioned it is an uneven regional distribution of private R&D investments and funding. This pattern is only to some extent being compensated for by a higher public R&D funding to regions outside the larger city regions (cf. Figure4.6).

Figure 4.6 *The distribution of R&D-funding resources in different main regions. (Datasource: Statistics Norway)*

When looking at sources of funding of innovation in knowledge intensive industries we find that this is mostly funded by the firms themselves in all types of regions (cf. Figure4.7). However, firms in the large urban regions have more one-sided and private funding that relies on their own means, while firms in other regions have more diversified funding and public sources are more important. The public funding of innovation activity is more important the smaller the agglomeration is.

Figure 4.7 *The founding sources of innovation in knowledge intensive sectors*[24] *(N=604). (Datasource:NIBR-survey 2007).*



4.3 Industrial specialisation and diversity

As illustrated in Chapter 2 the properties of industrial diversity and specialisation may be regarded as important preconditions for innovation and economic growth. Chapter 3 showed a very significant main pattern of regional specialisation and division of labour between large and small city regions, urban and rural regions in Norway. In the following we look into some more details of industrial diversity and specialisation in the main categories of regions.

Main types of the regional industrial bases

(1) The metropolitan region (Oslo) is the most prominent *service region*[25] in Norway[26] and is first and foremost *specialised* in knowledge

[24]For example, medium-high, and high-tech, manufacturing and knowledge intensive services (telecommunications/ICT-consulting and consultancy).
[25]86% of total employment in services.
[26]We distinguish between: *(1) service-region* (>75% of total employment in services); (2) *mixed manufacturing- and service-region* (75% of total employment in services, most of the rest in manufacturing); (3) *mixed primary-, manufacturing- and service-region* (75%

intensive sectors like knowledge intensive *business services* (ICT, consulting, finance, R&D), *creative services and high-tech manufacturing* (pharmaceutical). But the region is also specialised in *less knowledge intensive services* (wholesale, retailing, storage, transport etc.) which in numbers of jobs are as large as the knowledge intensive sector.

This has to do with the size of the regional market and the role as the capital of Norway with many first order service functions serving clients and markets in the whole country. An important additional advantage is the high *diversity* of industries and sectors, and in particular related variety of functions and industries in knowledge intensive services as well as less knowledge intensive services. This diversity may stimulate additional regional growth effects.

(2) The larger city regions (Stavanger, Bergen, Trondheim) are also service regions[27]measured in employment shares of sectors, but are simultaneously specialised in oil/gas and maritime manufacturing beside knowledge intensive business service KIBS (ICT, consulting) and R&D (natural science and technology). In

of total employment in services the rest equally shares in primary and manufacturing); (4) *mixed primary- and service-region* (75% of total employment in services, most of the rest in primary industries). Regions only defined as: (5) *manufacturing region* or (6) *primary regions* have more than 50% of the employment in the mentioned sectors.

[27]75% of total employment in services.

Table 4.3 *Regional specialisation and diversity in different region type s 2008 (localisation quotients after employment and national distribution =1,0) (Datasource:Statistics Norway)*

			Metropol reg	Large city-reg	Medium city-reg	Small city-reg	Small place reg
1	*All sectors*		1,0	1,0	1,0	1,0	1,0
2	*Primary industries*		0,3	0,7	0,9	1,7	3,3
		Agriculture, Forestry	0,3	0,8	0,9	1,7	2,7
		Fisheries	0,0	0,2	0,8	1,7	6,2
		Aqua-culture	0,1	0,6	0,4	1,7	6,6
3	*Low R&D-intensive manufacturing*		0,8	0,8	1,1	1,1	1,6
	7	Food, pulp/paper, etc.	0,5	0,9	1,2	1,3	1,7
	8	Publishing, printing, tanning, furniture	1,2	0,8	1,0	0,8	1,2
4	*Medium R&D-intensive manufacturing*		0,3	1,5	1,3	1,1	1,0
		Oil, Gas	0,2	3,7	0,4	0,4	0,5
		Maritime	0,2	1,8	1,0	1,4	0,7
		Plastic, metallic, mineral product etc.	0,3	0,9	1,5	1,4	1,3
		Automotive, machines, chemicals etc.	0,5	0,9	1,7	1,0	0,9
5	*R&D-intensive manufacturing*		1,1	1,1	0,9	1,1	0,1
		ICT	1,0	1,0	1,2	1,0	0,2
		Pharmacy, instruments, aircraft/space	1,4	1,1	0,5	1,3	0,0
6	*Knowledge intensive services*		1,6	1,1	0,8	0,6	0,4
		Telecom and ICT-consulting	2,1	1,0	0,6	0,4	0,2
		Consulting Others	1,4	1,1	0,9	0,6	0,4
7	*Creative services*		1,9	0,9	0,7	0,4	0,4
		Architectural, design, advertising etc.	1,9	0,9	0,8	0,4	0,2
		Cultural activities	1,9	0,9	0,6	0,5	0,5
8	*Finance & estate*		1,4	1,1	0,8	0,7	0,6
		Finance and Insurance	1,6	1,1	0,7	0,6	0,5
		Estate Agents	1,2	1,0	0,9	0,8	0,7
9	*R&D*		1,7	1,9	0,4	0,3	0,3
10	*Universities/colleges*		1,0	1,3	0,9	1,0	0,7
11	*Lesser knowlede intensive privat service*		1,1	1,0	1,0	1,0	0,9
		Hotels and Restaurants	1,1	1,1	0,9	1,0	0,9
		Wholesale and retailing	1,2	0,9	1,0	0,9	0,7
		Construction, energy/water supply	0,8	1,0	1,1	1,1	1,2
		Transport services	1,2	1,0	0,9	1,0	0,9
		Other private services	1,2	1,0	0,9	0,9	0,9
12	*Public dominated services*		0,9	0,9	1,0	1,1	1,2
		Public Administration	1,1	0,8	1,0	1,1	1,2
		Health care& social work	0,8	0,9	1,1	1,1	1,1
		Other Education	0,7	1,0	1,1	1,2	1,4
		Defence	1,6	0,8	0,3	1,2	1,0

Particularly Stavanger and partly Bergen are today characterised by a stronger manufacturing base than the other large city regions in Norway.

The largest one, Bergen (190,000 employed), is a service region[28]. It has a substantial diversification of service industries but is specialized in KIBS (consulting, finance, R&D), maritime and offshore

[28]78% of total employment in services.

industries and partly high-tech manufacturing (ICT). The manufacturing (including oil/gas) share of employment in Bergen is slightly above the national average (13% and 12% respectively).

The second largest, the Stavanger region[29] (161 000 employed) is a mixed manufacturing- and service- region. The region has a very strong manufacturing base (22% of all employment), and is to a much larger extent than the other larger cities specialised in oil/gas and maritime manufacturing, but also in high-tech manufacturing, agriculture and partly in consulting industries. This city is the petro-capital of Norway with most of the oil/gas-industry (55% of the national employment) and a large share of the maritime industries (18%).

The third largest, the Trondheim region (130,000 employed), is a more prominent service region[30]and has a weak manufacturing base (11% of all employed) than the other larger city regions and the national average. Trondheim mostly specialises in knowledge intensive services (in particular ICT) and R&D. Trondheim and Bergen have in common large natural science and engineering R&D milieus with institutions which serve industries and sectors on the national arena, and in particular the national clusters of maritime and energy industries.

These three large city regions in the western and middle parts of the country have in common economic bases which are embedded in the strong national clusters of maritime and energy industries. But over recent years Trondheim and Bergen have also developed a stronger hold in the ICT software industry, and to some extent challenged the earlier hegemony of the Oslo region in this sector.

(3) The medium-sized city regions (14 regions) are *mixed manufacturing- and service regions*[31] which are characterized by *specialisations* in different kinds of *manufacturing*. The largest subgroup of medium-sized city-regions (11 units) are specialised in manufacturing, and most of them in medium-high-tech manufacturing (i.e. oil/gas, maritime, automotive, machines, metal products) in combination with low-tech manufacturing (i.e. food, pulp/paper, wearing/tanning). Three

[29]67% of total employment in services.
[30]81% of total employment in services.
[31] 74% of the total employment in services, i.e. 13 regions with 69–77%, and one region (Tromsø) with 86% of total employment in services. Three are denoted as *serviceregions* while 11 are denoted as mixed *manufacturing- and service regions*.

of these regions have such specialisations in combination with high-tech manufacturing (ICT).

Only one medium-sized city region diverges from this pattern of manufacturing specialisation. Tromsø, which is the largest city region in Northern Norway, has several higher order service functions and specialises in public knowledge sectors (R&D, university and university colleges) and tourism industries (i.e. hotel/rest). The city has a much weaker manufacturing base than the other medium-sized regions.

All of the medium-sized city regions are then specialised in some kind of knowledge intensive industries, mostly in medium-high-tech manufacturing and some in R&D and education sector.

(4) The small city regions (47 regions) are mostly *mixed manufacturing and service regions*[32]. This type of city regions has an overrepresentation of *primary industry and manufacturing*. Most of the regions are specialised in primary industries (38 regions) and/or low-tech manufacturing (24). Though a substantial part is also specialised within medium-high-tech manufacturing (19) and/or high-tech manufacturing (14). As many as 29 small city regions have then some kind of knowledge intensive agglomeration of medium-high-tech manufacturing (19), high-tech manufacturing (14), ICT-services (10) and R&D/ education (9). Besides the two main subgroups of small city regions specialised in resource-based industries and knowledge intensive industries respectively, there are also some of the small city regions which are specialised also in some other types of industries (tourism, construction/energy and transport/shipping). As such, this is a very heterogeneous group of regions regarding industrial bases and forms of specialisations.

(5) Small place regions (96 regions) are also mostly mixed *manufacturing- and serviceregions*[33]. This is also a very heterogeneous group of regions regarding their forms of specialisations, though the group has a

[32] 72% of the total employment in service (range from 55–89%), i.e. 42 regions with 55–78%, and five regions 81–89% of total employment in services. Eleven are denoted as *service-regions, 30* are denoted as *mixed manufacturing and service regions, 3* are mixed *primary, manufacturing and service regions, and 3 as mixed primary and service regions.*

[33] 66% of the total employment in services. 19 are denoted as *service-regions, 57* are denoted as *mixed manufacturing- and service regions (nb. manufacturing also includes construction, energy supply), 16* are mixed *primary, manufacturing- and service regions, and 4 are mixed primary and service regions.*

substantial overrepresentation of primary industries and manufacturing. Almost all the small place regions are also first and foremost specialised in different kinds of *resource-based industries* (primary industries and low tech- processing manufacturing), but this is a very heterogeneous group of regions not only regarding different kinds of resources-based specialisations, but also with regions specialised in medium-tech manufacturing, construction/energy, transport/shipping and tourism[34]. In spite of the fact that almost all the small place regions are first and foremost specialised in resources-based industries, as many as 42 of these regions also have some type of specialisation within more knowledge intensive sectors[35]. Of these one main subgroups has public knowledge sector specialisation as the only one (13 regions), another main group has a medium-high-tech manufacturing specialisation (12 regions), while a third main group has both a medium-high-tech, and a high-tech manufacturing, specialisation in the same region (10 regions).

Sector specialization and industrial knowledge bases

The properties of industrial diversity and specialisation of regions may also be characterised by their specific composition of sectors embedded in different *knowledge bases*[36] (Dosi 1988, Laestadius 1998). A sector is here a group of industries emdedded in the same main type of a industrial knowledge base, which implies specific forms of knowledge use and types of innovation. A distinction has been made between three ideal types of industrial knowledge bases; analytical, synthetic and symbolic (Asheim and Gertler 2005, Asheim et.al. 2007). This is not a strict categorisation of industries but an analytical tool to capture assumed significant features of different industries. These three knowledge bases are characterised in the following ways (op.cit).

The *analytical knowledge base* (science-based) is found in R&D intensive industries such as biotechnology, nanotechnology and information technology. Scientific knowledge is the most important knowledge form, and the innovation process is characterised by

[34]Small place regions (96 regions) have the following numbers of specialised agglomerations: 92 primary industries, 50 low -tech manufacturing, 48 construction/energy, 30 tourism, 24 medium-high manufacturing, 14 high-tech manufacturing, 13 knowledge sectors (R&D/universities), 3 ICT-services.
[35]Within medium-tech and high-tech manufacturing, ICT-services, consulting, R&D, higher education.
[36] A *knowledge base* is the set of information, knowledge and capabilities that inventors draw on when looking for innovative solutions (Dosi 1988: p.1126).

transforming scientific knowledge while the results of the innovation process are often new knowledge and may take the forms of publications, licenses, patents and spin-offs from existing firms or institustions. The innovation process are often organised through a defined R&D project carried out in a R&D department often in collaboration with external actors. Learning is based on interaction with the knowledge infrastructure and on the use of new scientific or technological, codified knowledge. Workers will often be highly educated with skills linked to abstract thinking. Knowledge linked to "know-what" (knowledge of scientifically-based facts) and "know-why" (knowledge of scientific principles explaining how things work in certain ways) dominate. However, this does not mean that "learning-by-doing, using and interacting" is not important but that other types of knowledge are even more important.

The synthetic knowledge base (engineering-based) dominates in more traditional industries. Firms' development relies mostly on practical skills, and learning occurs mainly in the form of applied research and development, and by "learning-by-doing, using and interacting". Important types of knowledge are "know-how" (knowledge related to how things work in specific ways) and "know-who" (knowledge of who knows what) as much of the relevant knowledge resides in persons. Knowledge is gained through experiences in the workplace, and through practical solutions based on accessible practical and tacit knowledge.

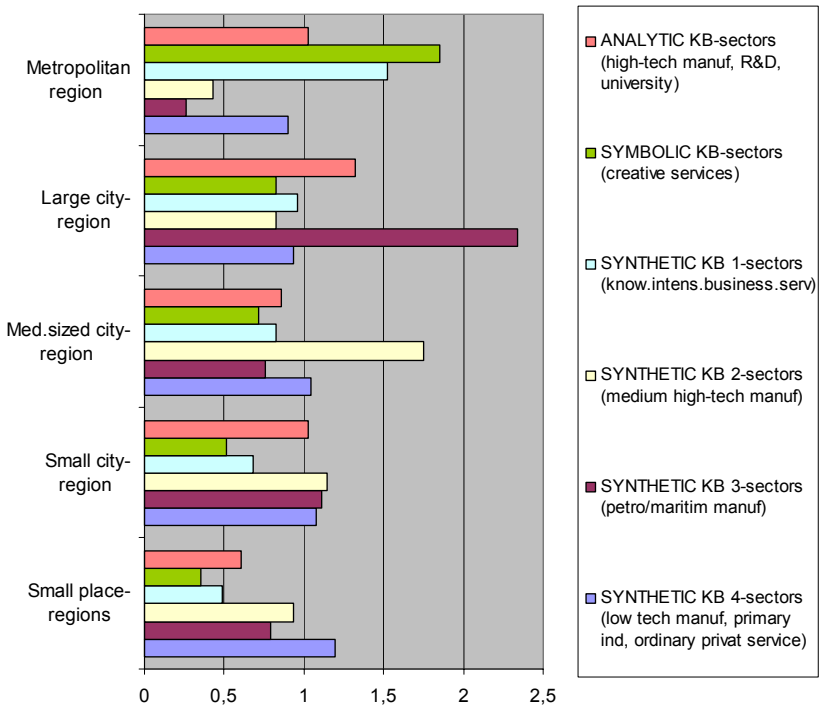
Industries based on synthetic knowledge are active users and adopters of existing technologies to solve concrete problems (i.e. firefighting) and the most important external relations in innovation processes are suppliers and customers. Continuous incremental learning makes these industries competent buyers who put pressure on suppliers of technology with regard to improvements and new technical solutions, and much advanced knowledge is generated through user-producer relationships. External relations with the knowledge infrastructure exist, however not to the same degree as within industries based on analytical knowledge (Asheim et.al. 2007). Innovation results are dominated by process innovation and incremental innovation, the output being patents, technical solutions and prototypes taken in use or that can be taken directly in use.

The s*ymbolic knowledge base* dominates in so-called creative or cultural industries, e.g. film, theatre, publishing and advertising. These are typically project-based industries consisting of "one-off" products. The innovation process involves "creating" new ideas and images,

and the innovative elements can often be difficult to identify. Innovations can be seen as market-oriented innovations. The knowledge used in these industries is linked to a type of "know-how" that is highly complex, dynamic and tacit, and knowledge generation mainly takes place as on-the-job learning-by-doing. "Know-who" is also important to establish new project constellations.

Aesthetics is one important production component, and an important skill is the ability to incorporate aesthetic symbols, pictures, design and stories into products and services. The external knowledge interaction is with similar or adjacent activity, and face-to-face communication, "buzz" and practical, experienced-based knowledge is important.

Figure 4.8 *Regional sector-specializations (localization quotients) by industrial knowledge bases in different region type s (the national LQ=1)*[37] *.(Source: Statistics Norway/NIBR database of firms).*



[37]The figure is based on a grouping of industries by their dominating knowledge bases following international literature.

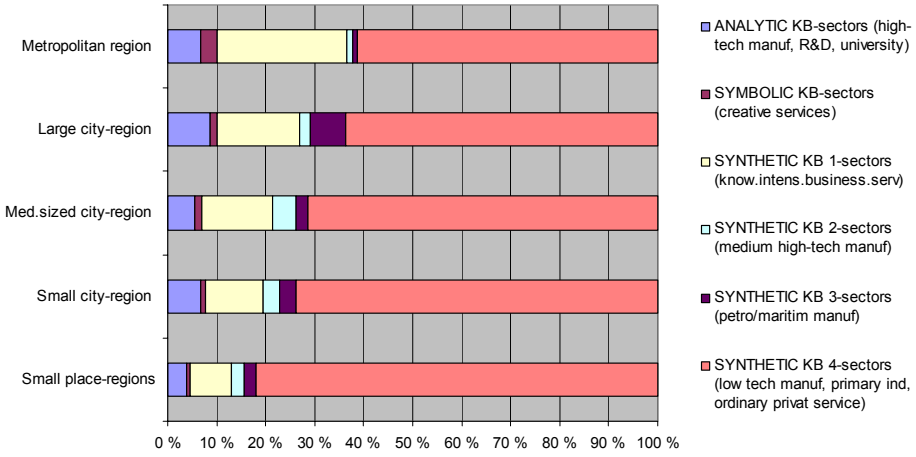
When looking at the regional composition of sectors embedded to these three main types of knowledge bases[38] in Norway we find that the region types are very dissimilar (cf. figure below). Firstly we see that larger urban regions are specialised in different

industrial knowledge bases than smaller ones. The metropolitan region specialises in sectors embedded in symbolic knowledge bases (in particular creative services) and synthetic-1 knowledge bases (in particular knowledge intensive business services), while the larger city regions others specialise more in manufacturing sectors embedded in respectively in analytical knowledge bases (high-tech manufacturing) and synthetic-2 knowledge bases (in particular maritime manufacturing). The smaller city regions specialise in sectors embedded in synthetic 2- and 3 knowledge bases, while small place regions specialise in sectors embedded in synthetic 3-type (different low-tech industries).

When looking at intra-regional shares of different knowledge bases we see a distinct differentiated pattern dividing large and small city regions (cf. figure 4.9). The synthetic knowledge-based industries have the largest share of the employment in all regions, but in different ways. In the large city regions most of the employment is in the synthetic 1-types of industries (medium-high-tech manufacturing and KIBS), which is the most knowledge intensive of the synthetic industries. A significant share of the employment

[38]Excluded here are most of the public sector and standard private services (retailing, hotel/restaurant, transport, energy supply etc.).

Figure 4.9 *The employment shares (%) of sectors[39] embedded in different types of knowledge bases within different region types (Datasource:Statistics Norway).*



in large cities, however, is also in analytical and symbolic knowledge-based industries. In small city regions on the other hand, most of the employment is in the third type of synthetic knowledge-based industries, which for the most part are low-tech manufacturing and primary industries. The share of employment in analytical knowledge-based industries is much smaller in small city regions compared to large city regions, and the share of symbolic knowledge is almost insignificant for the aggregation of small city regions.

Knowledge intensive region (KIR)

In spite of the fact that the knowledge intensive industries are most accumulated and overrepresented in the largest city-regions, the strain of knowledge intensive agglomerations also in small city regions and small place regions illustrates a rather scattered localisation pattern of the knowledge intensive sector in Norway. This is underlined when we summarise the number of regions with any type of regionally specialised knowledge intensive agglomeration.

However, the number of KIR is more limited. The number of these regions is of course influenced by the criterions one use in defining them. In this empirical analysis we have defined a KIR as a region

[39]Private industries plus R&D and higher education (i.e. other types of public sector is not included in spite of often large share of higher educated employers).

with employment of more than 500 persons and a LQ of over 1.1 in one of three main types of the most knowledge intensive sectors[40] or for all in total. As such we have got 28 regions specialised in knowledge-intensive manufacturing (KIM), 5 regions specialised in knowledge-intensive business service (KIBS) and 10 regions specialised in higher education activities (UE). All of these are also amongst the 12 regions which satisfy the KIR criterions for all knowledge intensive sectors. This last number is low because the largest knowledge intensive sector is KIBS, which is also heavily concentrated in the largest city regions which are also few.

Table 4.4 *Number of different main types of knowledge intensive regions.*

	Number of regions specialised in different knowledge intensive sectors*				Total number of all type of regions
	KI-manufacturing (KIM)	KI-business service (KIBS)	Universities/ collages (UE)	Total for the KI-sectors (KIM, KIS, UE)	
Metropolitan region	0	1	0	1	1
Larger city-regions others	2	3	2	3	3
Medium-sized city-regions	11	0	1	1	14
Small city-regions	13	1	7	5	47
Small community regions	2	0	0	2	96
The country	28	5	10	12	161

*The criterion for defining knowledge intensiv region is that the LQ>1,1 and the employment > 500 persons in the KI-sector which the region is specialised in. KI-manufacturing consists of upper parts of medium-hightech pluss high-tech-manufacturing, while KIBS consists of ICT, consulting, finance and R&D.

From this overview we see that the metropolitan region and all the other larger city regions are all KIR but first and foremost as KIBS regions. Most of the medium-sized city regions are also KIR but first and foremost as KIM regions. About one third of the smaller city regions are KIR as KIM regions, while approximately no small place regions can be termed KIR according to this definition.

4.4 Innovation patterns and performances

In general innovation rates and forms vary among different industries (cf. Figure4.4). In general we see that there is, to some extent, a systematic correlation between high R&D intensity and

[40]These are (1) knowledge-intensive manufacturing (KIM), medium-R&D-intensive and R&D-intensive manufacturing;, (2) knowledge-intensive business service (KIBS) (consulting, ICT, finance, R&D); and (3) universities and higher education (UE).

high innovation rates within different industries. However, when looking in more detail we see several exceptions to this rule.

Innovation rates and forms in different industries

In general have primary sector (aquaculture) and secondary sector higher shares of firms with innovation, and higher shares of employees in innovative firms, than in tertiary sector (cf. Table 4.5). However, within knowledge intensive services are the innovation rates higher than in most the other sectors and industries while the opposite is the case for less knowledge intensive services.

Table 4.5 *Innovation rates (all innovation types)[41] in different industrial sectors in Norway. (N=26595 firms). (Datasource: Statistics Norway Innovation survey 2006)*

		Firms with all innovation	Innovation rates (% firms with innovation)	Employed in innovative firms	Innovation rates (% employees in innovative firms)
All sectors		*9 984*	*37,5*	*340 389*	*51,7*
Primary sector		*113*	*47,7*	*1 819*	*58,5*
Secundary sector		*4 197*	*43,6*	*159 969*	*58,6*
	Low-tech manufacturing	2 258	43,8	70 739	59,5
	Medium-high-tech manufacturin	1 716	41,7	75 598	55,3
	High-tech manufacturing	223	62,5	13 632	78,4
Tertiary sector		*5 674*	*33,9*	*178 600*	*46,7*
	Knowl.intensive services	1 596	57,3	45 409	68,1
	Creative services	64	26,0	710	24,5
	Finance and insurance	643	42,2	26 981	65,1
	R&D	35	68,0	631	58,4
	Less knowl.int.private services	3 336	27,5	104 868	38,7

Primary industry (aquaculture), high-tech manufacturing and knowledge intensive services are both most R&D intensive and innovative of the main industries (cf. Table 4.6). ICT manufacturing and ICT services are top within the two last mentioned sectors, with high rates of product and market innovations (cf. Table in appendix). ICT manufacturing also tops the list of radical innovation rates (measured in patents). But it should be noted here that the primary industry of aquaculture is one of the most R&D intensive and innovative industries in Norway; oil/gas is also amongst the most R&D intensive industries, but with a medium level of innovation rate.

[41] *See note 39.*

Table 4.6 *R&D and innovation rates and forms[42] in different industrial sectors in Norway. (N=26595 firms). (Datasource: Statistics Norway Innovation survey 2006)*

		R&D-intensity:	Innovation intensity:							
			Firms (%) with :						Employment (%) in firms with :	
		Tot. R&D-expend. per employed (thousand NOK)	All types of innovations (1-5)	1.Market innovation	2.Product innovation	3.Process innovation	4.Organi-zational innovation	5.Radical innovation (patent)	All types of innovation	Product- and/or process
0	All sectors	3 056	38	25	20	16	13	5	52	40
1	Primary (only aquaculture)	12 916	48	21	21	37	17	2	59	47
2	Low-tech manufacturing	1 249	44	33	20	18	10	5	60	44
3	Medium-high-tech manufacturing	4 837	42	24	25	19	13	11	55	46
4	High-tech manufacturing	16 747	63	43	47	31	25	24	78	73
5	Know.intensive business services	8 096	57	40	41	27	16	7	68	59
6	Creative services	649	26	18	9	13	3	0	25	16
7	Finance and Insurance	3 775	42	31	23	18	24	1	65	53
8	R&D	34 541	68	53	55	45	25	45	58	49
9	Lesser knowl.int.private services	506	28	16	11	11	11	3	39	25

On the other hand, it may be somewhat surprising that creative services seems to be one of the weakest R&D and innovation sectors of all, in spite of its high growth rates of employment in the last decade. In this context it is also worth underlining that the sector called lesser knowledge intensive services, and in particular retailing, despite low R&D intensity, has a fairly high innovation rate at the same level as medium-high-tech manufacturing.

Innovation rates and forms in main types of regions

When looking at the *innovation rates* for different region types we find *some territorial differentiation related to agglomeration size* (measuring share of employment in innovative firms or share of innovative firms). In general the innovation rates for all types of innovation only increase a little from small to large city regions, but increase more substantially when looking at market, product and patent innovations (cf. Table 4.7). Process innovation rates are at the same level among the region types.

[42] *Market innovation* means substantially improved or new "design, packaging, marketing, promotion", *product innovation* means substantially improved or new goods/services/deliveries, *process innovation* means substantially improved or new production/distribution, and *radical innovations* means patents. The innovation must have been *introduced or put to use over the last three years.*

Table 4.7 *R&D and innovation intensities in different region types. (N=26595 firms). (Datasource: Statistics Norway Innovation survey 2006)*

	R&D-intensity:	Innovation intensity:								The survey sample (number of firms)
		Firms (%) with :						Employment (%) in firms with :		
	Tot. R&D-expend. per employed (thousand NOK)	All types of innovations (1-5)	1.Market innovation	2.Product innovation	3.Process innovation	4.Organi-zational innovation	5.Radical innovation (patent)	All types of innovation (1-5)	Product- and/or process	
The country	3 056	38	25	20	16	13	5	52	40	26 595
Metropolitan region (Oslo)	4 385	40	29	21	16	13	7	56	44	6 497
Large city regions (Stav, Berg,Trond)	3 616	37	23	21	16	13	7	50	37	4901
Medium-sized city regions	2 056	38	25	20	18	13	5	51	39	7466
Small city regions	2 240	36	22	18	15	13	4	51	39	5486
Small place regions	1 272	34	19	15	17	10	2	41	31	2247

This is the territorial pattern of innovation forms and rates is partly in accordance with our previously mentioned hypothesis and expectation derived from the international literature (Chapter 2). Nevertheless, if one look at all types of innovation, the territorial differentiation of rates in favour of the larger urban regions seems to be quite small in general in Norway. Looking only on market, product and patent innovations the territorial differentiation is more in line with internationally reported patterns.

However, when comparing regional innovation rates (total all types) within different industries we see also *few prominent, systematic territorial differentiations* which are common for all industries (cf.Table 4.8). It is first and foremost in lesser knowledge intensive services (retailing etc) and creative services where there are substantial territorial differences with higher innovation rates with increasing regional agglomeration size. But in knowledge intensive services there is no territorial differentiation in innovation rates. In manufacturing we see a somewhat messy and unsystematic territorial pattern. Though, it is worth underlining that low-tech and high-tech manufacturing have the highest share of innovative firms in the smallest agglomerations.

But when we are only looking at radical innovations (patents) there is a remarkable territorial differentiation in almost all industries (but

in particular for high-tech industries) where the rates are increasing with the size of the regional agglomeration.

Table 4.8 *Share (%) of firms with all innovation and radical innovation (i.e. % with patents in parenthesis) in selected sectors (Datasource: Statistics Norway-Innovation survey 2006).*

	Share (%) of firms with all innovation* and radical innovation** in parenthesis				
	All sectors	Low-tech manufacturing	High-tech-manufacturing	Knowledge intensive services	Lesser knowledge intensive service
Metropolitan region	40 (7)	40 (6)	68 (25)	57 (7)	32 (5)
Larger city-regions others	37 (7)	38 (5)	46 (25)	56 (7)	28 (4)
Medium-sized city-regions	38 (5)	46 (6)	65 (21)	58 (5)	28 (3)
Small city-regions	36 (4)	47 (5)	59 (7)	58 (7)	26 (2)
Small place regions	34 (2)	47 (4)	94 (6)	58 (2)	17 (0)
The country	38 (5)	44 (5)	63 (24)	57 (7)	28 (3)
*Marked- and/or product- and/or process- and/or organizational innovations.					
** Patents					

Range of innovation performance within the main types of regions

As previously described there are rather small expanding innovation rates for the five main types of city regions related to their increasing sizes. The range of regional innovation rates (measured in share of firms with all innovation) between the five main types of regions are much smaller than the range amongst individual regions within each main type of region.

When measuring the regional share of firms with all innovation, we find that as many as 17 small place regions (of 48 regions), 10 small city regions (of 47 regions), and 3 medium-sized city regions (of 14 regions) have higher innovation rates than the metropolitan region (40%) and also over the national level (38%)[43].

[43]In this analysis we have excluded all regions with under 20 firms in the selection (to avoid extremes related to the sensibility of too few firms in each regional selection).

Figure 4.10 *The shares (%) of firms with innovation of all firms in privat sector within each main region type ranged after rate levels. (Datasource:Statistics Norway Innovation survey 2006).*

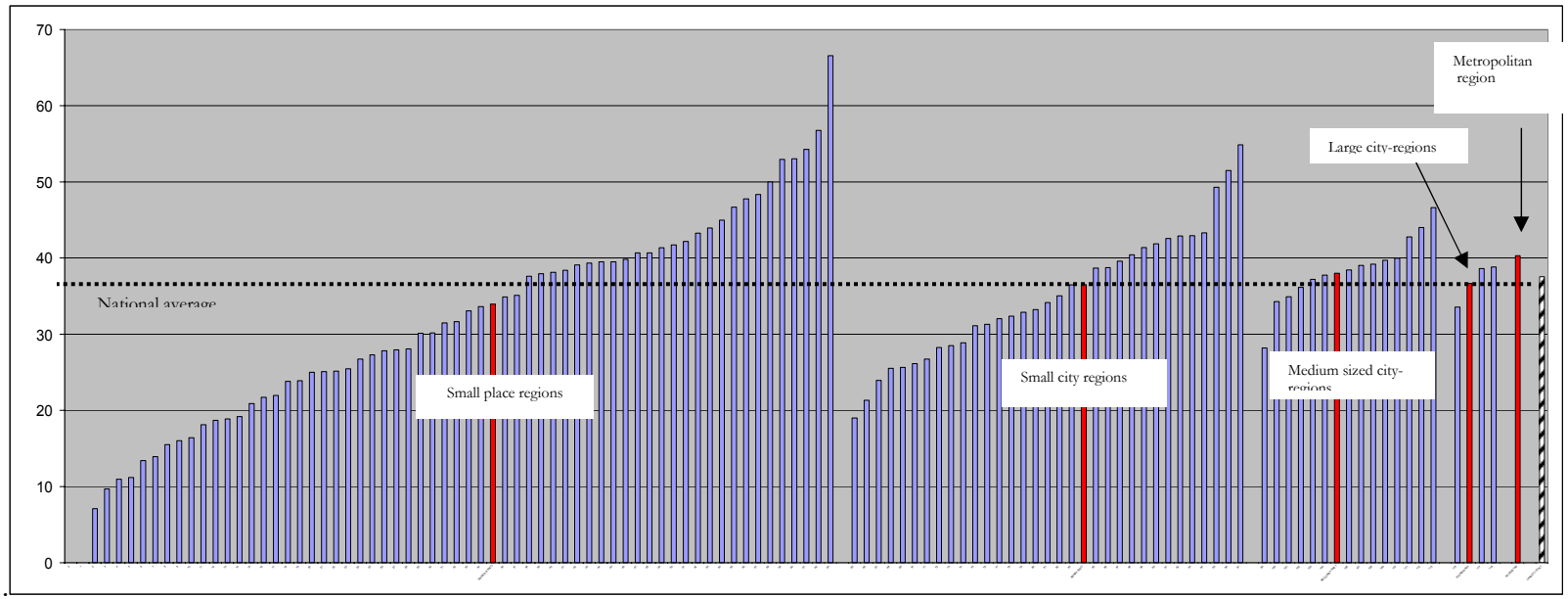
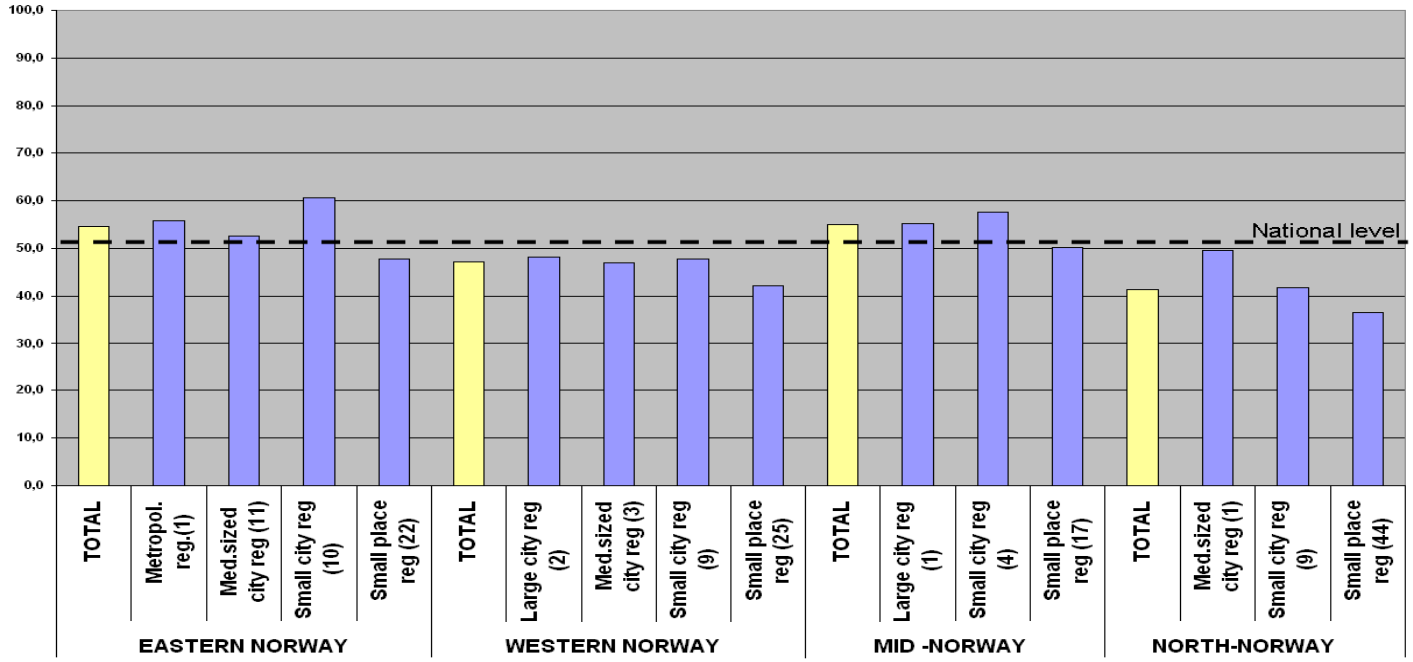


Figure 4.11 *The share of employment in innovative firms of total employment in private sector for different regiontypes and parts of the country (Datasource: Statistics Norway Innovation survey 2006).*



However, within the groups of small place regions and smaller city regions there are simultaneously more regions with much lower innovation rates and which drag down the group level some beneath the innovation rate level for the larger city regions as group. But as long as there are as many as 30 smaller regions in total, which have higher innovation rates than the metropolitan region, this indicates that not only regional size influences the regional innovation rates.

What characterises these smaller innovative milieus? The *most innovative small- and medium-sized city regions*[44] are characterized by specialisations in different kinds of knowledge intensive sectors like KIBS, high-tech manufacturing and higher education. The *less innovative small- and medium-sized city* [45]regions are characterised as old manufacturing cities and/or dominated by public services.

The *most innovative small place regions*[46] are either characterised as high-tech manufacturing regions, or as tourism industry regions, and in both cases they are characterised as well-known success stories from recent years. The *less innovative small place regions*[47] are characterised as traditionally primary industry and public sector-based regions of two types, either agriculture/forestry-based regions or fishery-based regions.

4.5 Innovation partners and spatial scopes

When looking at the overall *innovation cooperation patterns regarding types of partners in different industrial sectors (cf. Table 4.5),* we see that value chain partners are most important for all industries. However, there are some important sectorial distinctions regarding

[44] The eight small- and medium-sized city-regions at the top are: Tromsø, Lillehammer, Steinkjer, Hamar, Molde, Horten/Tønsberg, Harstad, Askim/Eidsberg (with over 45% of innovative firms).
[45] The four medium-sized city regions at the bottom are: Fredrikstad-Sarpsborg, Drammen, Sandefjord-Larvik, Haugesund (with under 35% of innovative firms), and the four small city regions at the bottom are: Notodden, Lenvik, Narvik,, Sogndal (with under 25% of innovative firms).
[46] The four small place regions at the top are: Meløy, Høyanger, Røros, Trysil (with over 55% of innovative firms).
[47]The four small place regions at the bottom are Evje/Bygland, Sirdal, Vadsø, Vardø (with under 15% of innovative firms).

the relative importance of suppliers versus clients, as well as knowledge organisation (as universities).

High-tech manufacturing is the sector with the largest share of firms that have innovation cooperation, and it is here where clients, suppliers and knowledge organisations are most important. In knowledge intensive services there are also relatively high rates of cooperation, and the main partners here are clients and suppliers. It is also interesting to see that aquaculture also has very high cooperation rates in particular with suppliers, but also to some extent with knowledge organisations and clients as well. It is creative services which have the lesser share of firms with innovation cooperation and, as mentioned previously, this is also the industry with the weakest R&D and innovation intensity (cf. Table 4.2).

The Table also shows that international innovation cooperation is of huge importance for high-tech (48%) and medium high-tech manufacturing (44%), R&D (45%) and knowledge intensive services (37%). On the other side of the range are local/regional innovation cooperation of particular huge importance for primary industries (48%), creative services (40%) and lesser knowledge intensive private services (39%).

Looking at the *overall innovation intensity and the innovation cooperation intensity* in the main region types, we find that the share of cooperation increase with the falling size of the regional agglomeration (Table below). This may indicate that "open innovation" strategies and processes related to informal knowledge links and spill-overs may be of greater importance for innovating firms located in the large city regions than in smaller milieus where formal innovation cooperation is more important amongst the innovating firms.

Table 4.9 *The most important innovation partners and areas for different industrial sectors. (Datasource: Statistics Norway Innovationsurvey 2006)*

		Share of firms with cooperation (% of total)	Important innovation cooperation partners (% partner- and cooperation types of all)									Important innovation cooperation areas (% cooperation areas of all)						
			Suppliers	Clients/customers	Internal of company	Consulents	Universities and collages	R&D-institutes	Private labs. and R&D	Competitors	Total	Locale/regional	Rest of country	Norden others	EU/EFTA (excl.Norden)	USA	Globaly others	Total
0	*All sectors*	19	20	18	13	12	11	10	9	8	100	33	33	14	12	5	3	100
1	Primary (aquaculture)	40	18	14	8	11	14	12	14	9	100	48	44	2	4	2	0	100
2	Low-tech manufacturing	20	20	16	12	11	10	11	10	10	100	32	36	16	11	3	2	100
3	Medium-high-tech manufacturing	26	20	18	11	10	13	11	9	8	100	27	29	15	20	7	1	100
4	High-tech manufacturing	44	16	22	12	10	14	11	10	6	100	22	30	14	23	9	2	100
5	Knowl.intensive services	30	19	24	12	12	11	9	7	6	100	33	30	12	13	7	5	100
6	Creative services	8	32	12	6	21	9	10	2	8	100	40	42	6	5	0	7	100
7	Finance and Insurance	79	18	16	18	20	11	6	3	8	100	33	41	20	5	0	0	100
8	R&D	23	15	15	15	8	19	13	11	4	100	24	31	16	19	8	2	100
9	Less knowl.int.private services	12	21	15	15	13	11	10	8	8	100	39	34	11	7	5	3	100

Table 4.10 *Innovation intensity and innovation cooperation intensity for firms in different region types. (Datasource: Statistics Norway Innovation survey 2006). (N=5012 firms with innovation partners of the total 26595 firms in the survey).*

	Share (%) of all firms with :		Innovation cooperation index*
	1.Innovation (all types)	2.Innovation cooperation	
The country	38	19	50
Metropolitan region	40	17	43
Large city regions	37	18	48
Medium-sized city regions	38	19	51
Small city regions	36	21	59
Small place regions	34	20	57

**Share of firms with innovation cooperation (2) in procent of shares of firm with innovation (all types) (1).*

The overall *innovation cooperation patterns regarding types of partners there are few substantial and systematic territorial differentiations* (cf. Table below). But there are some minor differences regarding the importance of partners in-house of the company, which are more important the larger the agglomeration is. This can be explained by the fact that the average firm size increases with the city region, and large firms do in general have more internal human resources for innovation than smaller firms do have. The overall weak territorial differentiation of important partners for innovation is not very surprising because most learning and innovation take place within value chains, and through relations and networks among firms and their suppliers and customers independent of localisation.

Looking at the *geographical cooperation areas,* there are substantial regional differentiations. The larger the regional agglomeration the more extended the spatial scope of their innovation cooperation networks. While a large share of the firms in the metropolitan region have innovation partners abroad (42%), the shares are not the same for firms in larger city regions (35%) and the smaller city regions (33%), while firms in small place regions have less (22%) international cooperation. The larger city regions are more internationally-oriented than the smaller ones in mostly all industries, but the territorial differences are most substantial in low-tech manufacturing and lesser knowledge intensive services.

In summary this shows that most industries, but in particular knowledge and innovation intensive industries, are integrated in complex multi-level and sectorial innovation networks. But the larger city regions are more internationally-oriented than the smaller ones. The local/regional and national area are most important for firms in the small place regions.

Table 4.11 *Important innovation partners and areas for firms in different regions. (Datasource: Statistics Norway Innovation survey 2006) (N=5012 firms with innovation partners of the total 26595 firms in the survey).*

	Share (%) of firms with cooperation	Important innovation cooperation partners (% partner cooperations of all types) :									Important innovation cooperation areas (% cooperation areas of all types) :						
		Suppliers	Clients/customers	Internal of company	Consulents	Universities and collages	R&D-institutes	Private labs. and R&D	Competitors	Total	Locale/regional	Rest of country	Norden others	EU/EFTA (excl.Norden)	USA	Globaly others	Total
The country	18,8	20	18	13	12	11	10	9	8	100	33	33	14	12	5	3	100
Metropolitan region	17,1	19	17	15	12	12	10	8	7	100	32	26	17	15	7	4	100
Large city regions	17,7	19	19	12	11	12	10	9	8	100	30	33	12	15	7	3	100
Medium-sized city regions	19,5	20	18	12	12	11	10	9	8	100	32	35	15	12	4	2	100
Small city regions	21,2	21	17	13	13	12	10	6	8	100	32	36	14	11	4	2	100
Small place regions	19,5	19	16	11	14	11	11	10	8	100	40	37	8	8	4	2	100

4.6 New firm formation and renewal of firm populations

One aspect of innovation output is differences in *new firm formation rates*. When firstly looking at *industries* we see that the rates have been highest in finance (in particular in estate agency), creative services (in particular in advertising, recreational and cultural activities), knowledge intensive services (in particular in ICT-consulting) and R&D (cf. Table 4.12). While some of the firm-growth has been linked to the financial and estate bubbles in the period, other parts have been stimulated by general high activity in the private sector. This has, over the last decade, given a high demand for ICT and knowledge intensive services, as well as culture-oriented experiences. There has also been a remarkable growth rate of new firms in public dominated services, which can be explained by reorganisation and privatisation.

Table 4.12 *Changes in the firm population per year (1999–2008) in different industries. (Datasource: Statistics Norway: CRE[48])*

		Number of firms 31.12 2008	Net-changes in number of	Net-growth-rates of firms per	New firm rates per year	Closed firm rates per year	Brutto-dynamism per year
	Country	**477 399**	**5 830**	**1,3**	**12,1**	**10,8**	**22,8**
1	Primary industries	72 878	-2 622	-3,1	3,5	6,6	10,1
2	Low-tech manufacturing	12 274	-310	-2,2	9,4	11,6	21,0
3	Medium-high-tech manufactur	11 168	-89	-0,8	8,9	9,7	18,6
4	High-tech manufacturing	1 008	-10	-1,0	8,4	9,4	17,9
5	Knowl.intensive services	57 428	2 459	5,1	23,3	18,3	41,6
6	Creative services	22 489	1 077	6,6	26,1	19,5	45,5
7	Finance and Insurance	56 403	3 266	8,4	18,6	10,1	28,7
8	R&D	661	26	5,3	14,6	9,3	23,9
9	Less knowl.int.private services	182 794	-71	0,0	10,9	11,0	21,9
10	Public dominated services	60 296	2 104	4,2	11,9	7,6	19,5
	All rates are in % per year (1999-2008) of the avarage firm population per year (1999-2008)						

When looking at new firm formation rates in different *region types* we see that the rates in general are increasing with the size of the regional agglomeration (cf. Table 4.8). Additionally we see that the metropolitan region not only has the highest new firm formation rate but also the most obvious closing down rate of all types of regions. This gives the metropolitan region the highest firm population dynamism and renewal of all region types, in spite of the fact that the overall net growth of firms has been somewhat weaker in the period compared to the larger city regions.

Table 4.13 *Changes in the firm population per year (1999–2008) in different region types. (Datasource: Statistics Norway: CRE).*

	Number of firms 2008	Net-changes in number of firms per year	Net-growth-rates of firms per year	New firm rates per year	Closed firm rates per year	Brutto-dynamism per year
Country	477 399	5 830	1,3	12,1	10,8	22,8
Metropolitan region	120 617	2 673	2,5	16,3	13,8	30,1
Large city regions	77 031	1 849	2,7	13,9	11,2	25,1
Medium-sized city regions	122 087	1 481	1,3	11,8	10,5	22,4
Small city regions	109 053	183	0,2	9,1	8,9	18,0
Small place regions	48 611	-356	-0,7	7,4	8,1	15,4
All rates are in % per year (1999-2008) of the avarage firm population per year (1999-2008)						

[48] *Central Register of Establishments and Enterprises (CRE).*

This territorial main pattern of new firm formation rates and net growth rates is also valid when looking in more detail on different knowledge intensive, and less knowledge intensive sectors (cf. Table A9 in appendix). The most substantial differences in new firm rates and net growth rates seems to be between the city regions on the one hand, and the small place regions on the other hand. However, in general are these empirical patterns in line with the assumptions in agglomeration theory which maintains that larger agglomerations have higher capabilities than new firm formations and renewal of the firm population compared with small urban regions and rural regions? This has to do with the diversity of industries and local markets spurring new firm formations in new growth sectors, as well as the high number of knowledge organisations, and firms, functioning as "incubators" for spin-offs.

4.7 Hampering factors

Innovation capabilities are not only influenced by promotive factors but also by specific hampering factors. But is there any industrial or territorial differentiation of hampering factor related to main types of city regions ?

Based on the National innovation survey (Statistics Norway-2006) we find that the most important hampering factors are related to "economical conditions" and "personnel conditions" for almost all of the industrial sectors (cf. Table 4.14). The economic hampering factors are mostly "high innovation costs" and "the lack of internal funding", while the "personnel conditions" are related to problems with "recruiting qualified employees" or "keeping qualified employees".

Table 4.14 *Hampering factors to innovation in different industrial sectors.* (Datasource: Statistics Norway Innovation survey 2006)

	Share (%) of firms with different hampering innovation factors									
	All sectors	Primary (aquacult)	Low-tech manu-facturing	Med.high-tech manu-facturing	High-tech manu-facturing	Knowledge intensive business services	Creative services	Finance and Insurance	R&D	Lesser know-ledge intensive private service
1. To high innovation costs	28	48	36	33	48	45	28	22	61	19
2. Problems with keeping and recruiting qualified persons	24	29	25	32	47	37	14	18	48	17
3.Lack of internal funding	22	32	29	27	38	38	26	17	44	14
4.Demand insecurity	22	21	30	25	35	30	23	19	42	15
5.Lack of external funding	18	46	23	22	32	33	18	7	39	12
6. Other firms' marked dominance	18	17	25	19	25	24	16	17	25	14
7.Problems with finding innovation partners	15	26	20	17	23	22	17	6	12	10
8.Lack of marked information	13	21	19	16	22	19	6	8	12	9
9.Lack of technological information	12	28	16	17	18	11	7	6	10	9
Average shares of firms with barrieres (all factors)	19	30	25	23	32	29	17	13	33	13

Looking at different industrial sectors the highest shares of firms which state hampering factors (both measured in several individual factors and the average level of all factors) are found in primary industries[49], manufacturing (low- and high tech) and knowledge intensive services (cf. Table 4.14). However, these are also some of the sectors with the highest innovation rates.

The *territorial pattern of hampering factors* has a very systematic pattern of increasing hampering levels the smaller the regional agglomeration is (cf.Table 4.15). The intra-regional rankings of the importance of the different factors seem to follow the national ranking.

[49]For this sector the survey only covers aquaculture.

Table 4.15 *Hampering factors against innovation in different regions.* (Datasource: Statistics Norway Innovation survey 2006)

	Share (%) of firms with different hampering innovation factors:					
	The country	Metropol.reg	Large city reg	Med.sized city reg	Small city reg	Small place reg.
1. To high innovation costs	28	25	25	29	32	32
2. Problems with keeping and recruiting qualified persons	24	21	23	23	26	25
3.Lack of internal funding	22	22	19	22	24	26
4.Demand insecurity	22	18	21	22	23	27
5.Lack of external funding	18	16	16	19	21	23
6. Other firms' marked dominance	18	15	17	18	21	23
7.Problems with finding innovation partners	15	12	13	14	17	18
8.Lack of marked information	13	10	12	14	14	18
9.Lack of technological information	12	9	10	13	14	16
Average shares of firms with barrieres (all factors)	19	17	17	19	21	23

When looking at some more details at different regions and industries (cf. Table A10 in Appendix), we see the most substantial differences within manufacturing industries. In these industries the share of firms that state hampering factors increases substantially with the falling size of the regional agglomeration.

In general these hampering patterns are not very surprising, and can be explained by dissimilar agglomeration and cluster advantages in disfavour of the smallest regional milieus. In the literature the advantages of co-localisation are focused on reducing firms' transaction and innovation costs, and giving better access to knowledge infrastructures and a broader diversity of specialised input factors.

The knowledge intensive firms consider the most significant factors hampering innovation to be economic, such as excessive risks and costs and lack of appropriate funding. There is no substantial regional difference with regard to factors hampering innovation, with one exception. The keeping and recruiting of qualified employees is a much more significant factor hampering innovation in the small urban regions and rural regions than in the large urban regions. In the large urban regions 33% of the knowledge intensive firms regard this as a hampering factor compared with 40% and 46% in the small urban regions and rural regions, respectively.

4.8 Similarities and dissimilarities of regional advantages and innovation

In this chapter we have described properties of advantage and innovation characterizing five main categories of regions in Norway. We have documented similarities and dissimilarities of the region types regarding:

- innovation resources,
- innovation performances,
- dominating innovation forms,
- functional and spatial innovation networks,
- hampering factors against innovation.

The empirical analysis reveal not surprisingly that the volume and variety of *innovation resources* increases substantially with the centrality and size of the regional milieu. Not only the numbers and amounts, but also the shares and diversities of higher educated people, creative workers, R&D-institutions and universities, knowledge intensive firms and R&D-investments, increases substantially with the size of the regional milieu. Beside human capital differences are substantial differences related to dissimilar industrial diversity and specialisation. While the larger city regions are specialised in diversified knowledge intensive services and creative services, are the smaller city regions most often specialised in one or few kinds of good production.

Simultaneously we found on the other hand that there are only minor differences in the *overall innovation rates* amongst the main region types[50], i.e. only in a marginal favour of the largest city regions. But when delimiting the focus only to radical innovations (patents), the total rates are increasing substantial in favour of the larger regional miliues[51]. This spatial pattern was also to some extent valid for market innovations and product innovations.

[50] The overall innovation rates (share of firms with all innovation) were as such, metropolitan region: 40%, large city regions 37%, medium-sized city regions: 38%, small city regions: 36% and the smaller place regions: 34%.
[51] However the analysis also showed that within each region type was market, product and process innovations the most important innovation forms irrespective of the size of the regional miliue.

The overall innovation rates in favour of the large city regions were only to some extent prominent within lesser knowledge intensive services, while within knowledge intensive services and manufacturing it was not diversified innovation rates in correlation with the size of the regional miliue.

Innovation may also be measured in *new firm formation rates and renewal* rates of the firm population. These indicators demonstrated a more territorially differentiated pattern with substantially increasing rates with increasing size of the regional milieu[52]. Looking at employment *growth rates within the new knowledge intensive services* we also found substantially increasing rates with the size of the regional milieus[53]. The higher rates of radical innovation, market and product innovation in the larger city regions, as well as their higher new firm formation rates as well as net-growth rates of firms, are all factors which likely contribute to growth of jobs and *employment and the tendency towards* higher employment growth rate within new knowledge intensive services in the larger city regions in particular.

While about one third of all firms have innovation (38%)[54], only one fifth of the firms cooperate when they innovate (19%), i.e. *half of the innovative firms cooperate with innovation partners*. However, an interesting territorial pattern on this issue was found. While the overall innovation rates (and new firm formation rates) increases to some extent with the size of the regional milieu, the innovation cooperation rates simultaneously are declining with the size of the milieu. This may indicate that "open innovation" strategies, processes and effects related to informal knowledge spill-overs may be of greater importance for innovating firms in the large city regions than in the smaller milieus.

In the chapter we have also described what kind of innovation partners which are most important and what spatial scopes the

[52] The overall new firm rates and gross dynamism rates (new firm rates+closed firms rates per year) were as such : metropolitan region:18% and 34%, large city regions: 16% and 28%, medium-sized city regions: 13% and 25% , small city regions : 10% and 20%) and the small place regions: 8% and 17%.
[53]The only exception is for the metropolitan region which had some lower growth rates than expected related to size over the last decade This may be explained by the initially very high overrepresentation and shares of employment in the knowledge intensive services in the metropolitan region.
[54]With 52% of total employment.

innovation cooperation networks have. Customers and suppliers are the most important innovation partners for most of the firms irrespective of the localisation site or size of the regional miliue. This is valid for most industries, but within some smaller industries (aquaculture, high-tech manufacturing, R&D industry) are knowledge organisations also very important partners. However, the spatial scope of these innovation cooperation networks have some similarities, but also some substantial dissimilarities, related to the size of the regional miliues. For firms in all the region types about one third of the innovation cooperations are to partners within their own regions, while two-third of the cooperations are extra-regional. But firms in the large urban regions rely, to a much larger extent, on extra-regional cooperations on international, and partly global levels, compared to innovating firms in smaller city and place regions, which to an larger extent rely on national networks. The reason for these differences most likely is related to the dissimilarly firm structures and industrial specialisations in large and small city regions respectively.

However, these survey-data (Statistics Norway-2006) reveal that most of the firms with innovation cooperation are integrated in multi-sectoral and multi-level systems of innovation. This is valid irrespective of localisation site or size of the regional miliue.

The empirical analyses also showed that both economical factors and personnel factors are the most prominent factors hampering innovation in all region types. However, the general hampering level for all factors (measured in the shares of firms which experience different kinds of barriers) increase substantially all the more the size of the regional miliue decline. This in spite of the fact that the public funding support for innovation in firms increase with declining centrality and size of the regional milieu. The most reasonable cause of this spatial hampering pattern is that the advantages of agglomeration economies including lower levels of innovation barriers, are to some extent increasing with the centrality and size of the regional milieu. This is much in line with the theses in agglomeration theory previously described in Chapter 2.

As previously described the regional differences in overall innovation rates are much smaller than could be expected with the departure of the corresponding substantial regional differences in

innovation resources. It is also much smaller than often is reported as the common rule in much international literature. The main reason for this pattern in Norway is related to :

- A scattered localisation pattern of innovative industries. Primary industries (aquaculture) and manufacturing industries have higher innovation rates than service industries. Manufacturing industries are over-represented in small and medium-sized city-regions, while service industries are overrepresented in the larger city regions.
- Knowledge intensive services have high innovative rates while less knowledge intensive services have low innovation rates. Both of the branches are overrepresented in the larger city regions, but the last one is twice as big as the former in employees in these region types.
- The innovation rates within each branch are differing less according to the size and centrality of the regional industrial milieu.

5 Cases on regional advantage, innovation and challenges

In chapter 4 regional advantages and innovation properties in the five main categories of region types was described. The analysis was based on register- and survey-data from all the 161 functional regions in Norway. Substantial regional differences was found regarding innovation resources, radical innovation and new firm formation rates, but smaller differences regarding the overall innovation rates.

In the following section we will look into some more details on advantages, innovation and policy in eight selected regions. Besides the four largest city regions we also look at four substantially smaller city regions. While the large city regions are specialised in diverse knowledge intensive industries, the smaller city regions are specialised in medium-high and high-tech manufacturing. These caseanalysis is based on documents, research literature as well as register and survey data. The chapter describe empirically the eight regions before completing with a comparative summery of the similarities and differences between these two main groups of city regions.

5.1 Large city regions

5.1.1 General characteristics

The *four largest city regions of Norway* are the metropolitan region of Oslo (1.1 million inhabitants), and the three larger city regions of Bergen (0.36), Stavanger (0.28) and Trondheim (0.24). All the larger city regions have been *population growth areas* over the last

decade with much higher growth rates than the rest of the country. The reason for this is a combination of high natural increase and immigration. Stavanger has had the strongest growth pronounced ahead of Oslo, Trondheim and Bergen.

Table 5.1 *Population size and changes in Oslo, Bergen, Stavanger and Trondheim regions (Datasource: Statistics Norway)*

		Number inhabitants 2007	Changes in per cent 1997-2007
COUNRTY		4 737 171	7,2
Metropolitan region (Oslo)		1 138 436	13,0
Large city-regions others		896 094	12,8
	Bergen	363 616	11,4
	Stavanger	288 176	15,2
	Trondheim	244 302	12,2

The larger city regions have a human capital characterized by a *higher education level* than the rest of the country. The Oslo region is in a special class with a high share of tertiary educated people (41%)[55], while the three others are some below this (aprox. 33%) but all substantially above the country level (25%). The larger city regions are also more *R&D-intensive regions* compared to other regions measured in total R&D expenditures per employed.

The larger city regions are first and foremost *service regions* with a diversified specialisation in knowledge intensive business services (KIBS). But the four large city regions are also different from each other. In particular Stavanger region is a specific case as a mixed primary, manufacturing and service region. The region is diversified specialized within agriculture, offshore-activities, manufacturing and partly knowledge intensive services.

Over the past 10 years the *employment growth* has been higher in these larger city regions than in the rest of the country, with one exception; the Oslo region, surprisingly, only has a growth rate in line with the national level. The Oslo region had a stronger economic recession and precent decrease in employment between 2002-2004 than the other larger city regions. In the last decade it is the other larger city regions which have been the "regional

[55] Tertiary education refers to university education up to, and over four years.

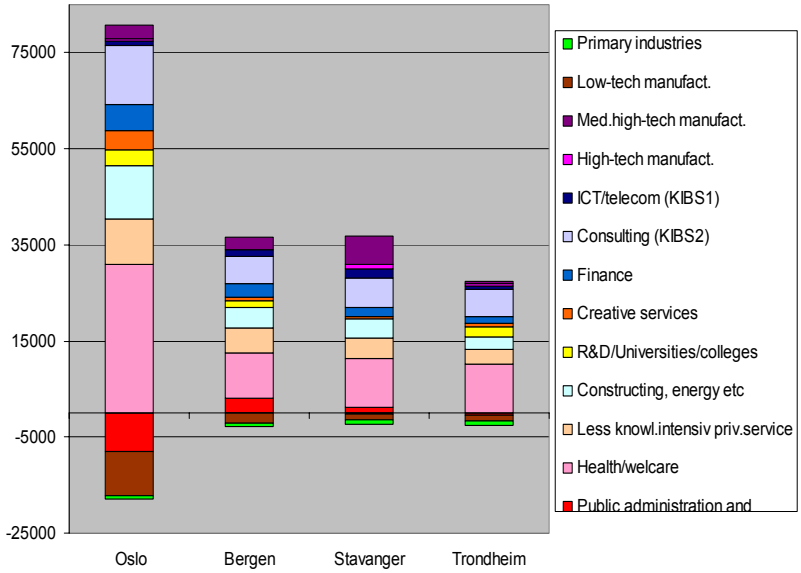
winners" regarding (net) growth rates in jobs well above the national average, with Trondheim at the top.

Table 5.2 *Industrial and sector structures and changes in the Oslo, Bergen, Stavanger and Trondheim regions 2008. (Datasource: Statistics Norway).*

	1Primary	2 Manufacturing				3 Infra-structure industries	4 Knowledge intensive service				5 Exper-ience industries	6 Private service others	7 Edu-cation	8 Public sector others	Total
		Low tech	Medium tech	High tech	Total		ICT and consultin g others	Finance	R&D	Total					
Employment 2008															
Metropolitan region (Oslo)	5 309	24 672	14 838	6 179	45 689	44 411	99 411	21 974	5 932	134 995	35 119	208 796	44 970	164 177	683 466
Larger cityregions others	10 367	19 557	48 075	4 041	71 673	36 718	48 429	10 820	4 676	66 478	20 345	118 571	42 336	114 511	480 999
Bergen	1 880	7 448	15 363	1 405	24 215	14 959	18 456	5 210	1 996	26 583	7 948	48 442	17 081	48 904	190 013
Stavanger	6 029	6 378	26 769	1 867	35 014	11 376	16 977	2 701	539	20 976	6 533	37 393	10 989	32 649	160 959
Trondheim	2 457	5 731	5 943	769	12 443	10 383	12 995	2 916	2 140	18 919	5 864	32 735	14 266	32 958	130 027
Localisation quotient 2008															
Metropolitan region (Oslo)	0,3	0,8	0,3	1,1	0,5	0,8	1,6	1,6	1,7	1,6	1,2	1,2	0,8	0,9	1
Larger cityregions others	0,7	0,8	1,5	1,1	1,2	1,0	1,1	1,1	1,9	1,1	1,0	0,9	1,1	0,9	1
Bergen	0,3	0,8	1,2	0,9	1,0	1,0	1,1	1,4	2,0	1,1	1,0	1,0	1,1	1,0	1
Stavanger	1,3	0,8	2,5	1,5	1,8	0,9	1,1	0,8	0,6	1,1	1,0	0,9	0,9	0,8	1
Trondheim	0,6	0,9	0,7	0,7	0,8	1,0	1,1	1,1	3,2	1,2	1,1	1,0	1,4	1,0	1
Relative changes (%) in employment 1998-2008															
Metropolitan region (Oslo)	-11	-7	2	-16	-5	32	55	28	42	47	35	13	31	35	25
Larger cityregions others	-21	1	26	25	18	40	83	58	10	70	25	20	43	60	35
Bergen	-25	-5	27	-10	13	38	89	81	43	82	26	21	34	34	31
Stavanger	-16	14	27	81	27	49	72	56	-21	65	20	18	46	56	33
Trondheim	-29	-3	19	19	8	34	88	31	-1	61	28	22	54	134	46
COUNRTY	-23	-12	5	1	-2	33	63	20	23	51	18	15	41	44	24

Bergen, Trondheim and Stavanger have higher growth rates than Oslo in mostly all sectors except in experience industries and the R&D sector. Bergen, Trondheim and Stavanger have strengthened their position versus Oslo in particular with much higher growth rates in manufacturing (including oil/gas), knowledge intensive services, other private services and the public sector. Also in relation to the total country Bergen, Trondheim and Stavanger have strengthened their position substantially in manufacturing (including oil/gas) and all kinds of private and public services.

Figure 5.1 *Changes in number of work places in different industries in Oslo, Bergen, Stavanger and Trondheim 1998-2008 (Datasource: Statistics Norway, CRE).*



All the four large city cases have some higher overall innovation rates and new firm formation rates than the national average (cf. Chapter 4 and Table 5.3). The Oslo region is at the top for overall innovation rates and radical innovation rates, new firm formation rates and firm population dynamism, compared to the other larger city regions. On the other side Oslo have some weaker net growth rates of firms due to higher close down rates than the other larger city regions.

Table 5.3 *R&D, innovation intensity and new firm rates in the Oslo, Bergen, Stavanger and Trondheim regions (Datasource: Statistics Norway-Innovation survey 2006).*

	R&D-intensity*		Innovation intensity**						Firm population changes ***		
	Tot R&D-expenditures in 1000 NOK	Tot R&D-expenditures per employees in 1000 NOK	Share employed in firms with innovation	Share (%) of all firms with different types of innovation					New firm rates per year (% of firm population)	Closed firms per year (% of firm population)	Net-growth rates of firms per year (% of firm population)
				All types of innovation	Market innovation	Product/ services innovation	Process innovation	Patents			
Country	20 134 534	3 056	52	38	25	20	16	5	12,1	10,8	1,3
Metropolitan region (Oslo)	8 522 749	4 385	56	40	29	21	16	7	16,3	13,8	2,5
Large cityregions others:	4 965 009	3 615	50	37	23	21	16	7	13,9	11,2	2,7
Bergen	1 484 022	2 743	49	34	22	17	14	7	14,8	11,8	3,1
Stavanger	1 686 413	3 391	48	39	23	24	17	8	13,0	10,4	2,5
Trondheim	1 794 574	5 484	55	39	26	22	17	7	13,6	11,1	2,4

* In 2006 (Statistics Norway-Innovation survey 2006), ** In 2003-2005 (Statistics Norway-Innovation survey 2006), ***Per year in the periode 1999-2008 (Statistics Norway - CFR)

5.1.2 The Oslo region

The Oslo region has 1 140 000 inhabitants in 30 municipalities. The population has grown substantial above the national average over the last decade. The population size of the city are substantial larger than any other city region in Norway. The region has three distinct roles that supplement a national function: the role as the capital region, as creative centre and as international locality (Vatne 2004, Onsager et.al. 2010).

The industrial structure

The Oslo region specialises in several knowledge intensive industries. The region has industrial clusters with high competence in life science, maritime and offshore, environment and energy technology, ICT, creative industries, finance, consulting and R&D industries. The region also has large milieus and specialised clusters within more ordinary private services as well as in the health care and higher education.

The employment growth in the region follows the national average and is dominated by service industries, especially consulting, finance, telecommunication and creative services. Close to half the workforce in firms offering business services work in the Oslo region. The rate of new firm formation in the region is high. This is partly due to the dominance of service industries which usually have a higher formation rate.

Knowledge infrastructure and innovation system

The Oslo region is characterised by a large and diverse knowledge infrastructure with institutions that contribute to the development of analytical, synthetic and symbolic knowledge bases. The region has altogether 27 universities and university colleges (public and private). In 2006, the region was home to 60,000 students of which half studied at the University of Oslo (UiO). Oslo University College which is the largest state owned higher education institution in Norway, and the Norwegian University of Life Science (UMB) are also located in the Oslo region. In 2007, 43% of total R&D expenditure was distributed to study institutions in the Oslo region. The UiO has the largest research centre in information technology and informatics. It also has large activities within technology, energy and environment related to future technologies, particularly nanotechnology, chemistry, bio-chemistry, physics and biology. In life science, the large hospitals also play an important role.

In addition to university, colleges and large hospitals, there are 59 institutions which carry out R&D activities in the region. The region also has a large and diverse sector of research institutes, and the amount of labour in this sector is almost as much as in the university sector. More than half of the R&D labour per year in the technical-industrial and medical sector is carried out in the Oslo region. Some of the largest research centres and institutes are SINTEF,[56] the Oslo Centre for Interdisciplinary Environmental and Social Research (CIENS), the Norwegian Defence Research Establishment (FFI), and Institute for Energy Technology (IFE). Employees in the region also have the highest educational level in Norway. The Oslo region inhabits, to a very large extent, all the regional endowments, such as good universities and higher education institutions and clusters of R&D, which are important in the knowledge economy.

The Oslo region plays a distinct role in the Norwegian innovation system and there are a number of institutions that contribute to

[56]SINTEF is the full name of today, but until 2007 it was "Selskapet for industriell og teknisk forskning ved Norges tekniske høgskole". SINTEF is the largest R&D-company in Skandinavia with over 2000 employees. The headquarter is sited in Trondheim, but subsidiaries are located by others in Oslo (350 employees), Stavanger and Bergen.

this, such as Technology Transfer Offices (TTO), science parks, innovation centres and different firms providing consulting and/or financial services. The region is also special in that it locates 75% of the head offices for the largest enterprises in Norway and that it delivers services related to production, trade and government administration to the rest of the country (Vatne 2005). Important actors (authorities and public/private partnerships and networks) taking part in developing business and innovation policy in the Oslo region are Akershus County Council, Oslo municipality, Oslo Teknopol, Innovation Norway in Oslo, Akershus and Østfold, the Oslo region alliance (Samarbeidsalliansen for Osloregionen) and the Eastern Norway County Network (Østlandssamarbeidet) (cf. Table A1 in the Appendix for further details).

In the Oslo region there has been an increase in the number of actors that work towards innovation through a diverse set of TTO, science parks/incubators and innovation agents (Lillekjendlie 2005 p.7., Onsager & Haraldsen 2009). Lillekjendlie (2005) registered 23 innovation actors in the region in 2005, ranging between the public institutions (such as Innovation Norway) and the private ones (like private consultants) working directly towards ideas, projects and firms. The new actors have both brought new services into the innovation system as well as more specialisation as each actor now carries out fewer tasks in the system. Overall, there seems to be a complex innovation system in the region, consisting of both private and public actors working together.

The most important commercialisation entities in Oslo are; Forskningsparken AS, Birkeland Innovasjon AS, Medinnova AS, Simula Innovation AS and Bio-medisinsk Innovasjon (Borlaug and Hansen 2008, p. 21). There are four incubators in the region (Forskningsparkens incubator, Forskningsparkens Innovasjonssenter, IKADA, IT Fornebu incubator) and five "Matchmakers" (Connect Østlandet, VentureLab, SeedForum, Oslo Teknopol IKS, Akerselva Innovasjon) (cf. Table A2 in the Appendix for details). Oslo Teknopol works to strengthen the collaboration between the knowledge infrastructure, industry and authorities in the Oslo region through a cluster strategy where they have defined five clusters for the Oslo region. One of the clusters (Oslo Cancer Cluster) has received status as a NCE.

Innovation policy and governance challenges

The government aims to strengthen value creation in the Oslo region and to make it an internationally competitive region. The authorities in the region, led by Oslo Kommune (the municipality of Oslo), work towards further value creation and innovation in the region. The main policy document for Oslo and Akershus is "Regionalt innovasjonsprogram 2008 for Oslo og Akershus (RIP)" which is the municipality of Oslo and the county council of Akershus' main industry policy document. A common policy document was decided since the challenges perceived by the business community in these two counties are congruent and as such need a common strategy. The RIP for 2008 had a budget of 45.1m NOK divided into the following strategic priority areas:

(1) to mobilise and develop clusters;

(2) to organise entrepreneurship and to stimulate commercialisation of business ideas;

(3) to profile the Oslo region internationally through the region's knowledge-based industries.

To mobilise and develop clusters is the main strategy. Development of the region's clusters happens through entrepreneurship and commercialisation and international profile.

In the Oslo municipality plan ("Oslo mot 2010") under the theme "Knowledge city for value creation" ("Kunnskapsby for verdiskaping") the main goals linked to the Oslo region are to exploit its potential as the country's leading industry area and strengthen its position as an international industry/business area and to create good collaboration between schools/higher education institutions and industry with regard to education and career counselling.

The challenge for the Oslo region is how to make the innovation system based on R&D and knowledge-based innovation perform better. The governance challenges are seen to be greater and more complex in the Oslo region than in other parts of the country in that the melting together of a greater Oslo region leads to more interfaces between governance agencies and as such overlapping areas of responsibility between many actors (Dølvik et al. 2005) and also those working towards innovation policy. The region also

has a national role, meaning that national innovation policy is also directed towards the region, adding to the continuous increase in the number of actors serving the innovation system of the region. This suggests a complex governance structure with several initiatives, many focusing on the same broad goals with overlapping areas of responsibility. The commercialisation system in the region is represented by several actors and there seem to be parallel commercialisation systems directed at the same subject area. Meeting places in the region, both between regional business and research milieus as well as between regional business and the policy actors in the region, may be important to improve the innovation performance. An initiative for regional business to make better use of the knowledge creating subsystem in the region has been initiated.

5.1.3 The Bergen region

The Bergen region has 365 000 inhabitants in 14 municipalities, and the population has grown above national average the last decade. The city is situated in the strongest export region in Norway (Hordaland) and has for long time been an important region for production and support activities related to maritime, oil/gas and seafood industries.

The industrial structure

The Bergen city region is specialised in the oil and gas manufacturing industries and knowledge intensive services. Hordaland County, of which Bergen is the capital, produces 80% of the Norwegian raw oil export, and the city possesses a complete cluster of suppliers to the major oil and gas companies (OECD 2007). Financial and business services are also particularly strong in the city region, and in 2006 approximately half of the total employment in finance, insurance and estate services in the three large cities Trondheim, Bergen and Stavanger together were found in Bergen (7,194 of 15,066). Bergen is also a stronghold in marine science, maritime industries and environmental research, and may have the potential to developing a cluster of the sea, coast and energy industries. Creative industries such as film and media have also developed well in recent years since the Bergen Media City was established 1993, and Vestnorsk Filmsenter in 1994.

Knowledge infrastructure and innovation system

Hordaland county and Bergen city host several education and research institutions. Most important are the University of Bergen (UiB), Norwegian School of Economics and Business Administration (NHH), Institute for Research in Economics and Business Administration (SNF) Chr. Michelsens Institute (CMI) and Chr. Michelsens Research AS, Institute of Marine Research (IMR), NUTEC AS (Norsk undervannsteknologisk senter) and Bergen University College. The Bjerknes Centre is the largest climate research centre in the Nordic countries, with a focus on the natural science aspects of climate change. The centre is a NCE and partners are the University of Bergen, the private research company Unifob AS, the Institute of Marine Research (IMR) and the Nansen Environmental and Remote Sensing Center (NERSC). The UiB is a medium-sized European university, with 17,000 students and more than 2,500 staff, it covers most scientific fields and is organised in six faculties and approximately 60 institutes and scientific centres. In addition there are three scientific colleges and several private colleges. Bergen has altogether around 30,000 students.

Business and innovation policy in the Bergen region are formulated and developed by authorities and through public/private partnerships and networks. Key actors are Business Region Bergen AS (BRB), Bergen Chamber of Commerce and Industry (Bergen CCI), Hordaland County Council, Bergen municipality and Innovation Norway Hordaland. Business Region Bergen AS (BRB) stands out as the main actor in the years to come.

Commercialisation of knowledge is central in innovation, and the following main actors are found in the Bergen region. Commercialisation units: Bergen Teknologioverføring AS (BTO), Sarsia Innovation and Innovest, Incubators: Nyskapingsparken, Matchmakers: Connect Vest, Borea opportunity, Saria seed AS and Sarsia Life Science Fund.

Innovation policy and governance challenges

The most important document for economic development and innovation in the Bergen region is the Strategic Business Plan 2006–2009. The plan is based on Bergen scenarios, and its purpose

is to stimulate economic development in the city region and the county of Hordaland.

The plan focuses on three areas. First, creating a better culture for entrepreneurship and providing a coherent and business-oriented education for innovation and entrepreneurship; building alliances between research and business, developing innovation support structures, improving access to risk capital and attracting creative people. Second, developing sea, coast and energy industries through networking and improved cooperation between business and research and preparing for sufficient recruitment and international branding. Third, developing the creative industries and tourism by increasing competence, stimulating entrepreneurship and interaction through networking, and developing complete value chains and marketing.

The County Council plan 2005–2008 is the main strategic political document for the County Council and is normative for all other planning in and between sectors. The County Council planning is an important arena and tool for partnership in regional development. The plan 2005–2008 prioritises four areas: economic development, competence, culture, and transport, environment and communication.

The Bergen region is characterised by economic diversity (strong competence in oil and gas, the marine and maritime industries, and financial services) but it is also vulnerable due to small industrial and R&D milieus, high transport costs and low accessibility within the city region, and there is a lack of skilled labour in some industries. The strength of the leading competence milieus is threatened by a fragmented R&D system, lacking support for commercialisation, a lack of risk capital to entrepreneurship, and a lack of cooperation between R&D institutions, business and the public sector. In the creative sector a lack of knowledge and cooperation between creative industries and other industries restricts added value. According to Blomgren et al. (2007) there seems to be lack of knowledge spillover from university and colleges, and there also seems to be a lack of strategic leadership for regional business development.

As a result the innovation policy in the Bergen region is geographically fragmented (Farsund and Leknes 2005). There is no strong collaboration between the most important actors in the city

region. The Bergen municipality and the Bergen Chamber of Commerce and Industry focus mainly on the city whereas Hordaland County and Innovation Norway are oriented towards the districts. Regional cooperation is highlighted in the Strategic Business Plan and Bergen Scenarios; and the regional development agency, Business Region Bergen, was established in 2007 to strengthen the innovative interplay between the city and its hinterland.

The Bergen region faces governmental challenges in the innovation policies due to the fragmentation of the innovation system. The result is a lack of knowledge spillover between knowledge producers and users, and weak collaboration between important actors in the regional innovation coalition. These weaknesses are counteracted through networking and improved interaction between industry, R&D and the public authorities.

5.1.4 The Stavanger region

The Stavanger region has 290 000 inhabitants in 14 municipalities, and has experienced a very strong growth in population in the past decade substantial above the national average and the other larger city regions. The city is situated in one of the strongest export regions in Norway (Rogaland). It is main site for the offshore industry in the country, but the region is characterized by a very diversified industrial base.

The industrial structure

The region is dominated by oil and gas related industries which are export-oriented and highly exposed to international competition. In 2006 approximately two-thirds of the employed workforce in the Norwegian oil and gas sector were working in the Stavanger region (10,737 of 15,264). The region is an international energy centre and possesses core competence in offshore technology. Several of the world's leading energy companies are located in Stavanger together with many oil and gas supply enterprises. The Stavanger region is also the most important food producer in Norway both within agriculture and aquaculture (green and blue sector).

Knowledge infrastructure and innovation system

Stavanger has a newly established university (2005), the University of Stavanger (UiS) and several colleges with approximately 8,000 students and 1,000 administrative, faculty and service staff. The university is organised in three faculties and it also includes two national centres of expertise. The region has significant know-how within oil and gas and a strongly related R&D milieu. The International Research Institute of Stavanger (IRIS) is the main research institute with research and research-related activities within petroleum technology, marine environment, social science and business development, and gas technology. Other research centres are the Norwegian Mapping Authority (NMA) which is the national provider and administrator of geodesy, geographical and cadastre information covering Norwegian land, coastal and territorial waters; the Norwegian School of Veterinary Science and the Norwegian Institute for Agricultural and Environmental research (Bioforsk).

Business and innovation policy in the Stavanger region are formulated and developed by authorities and through public/private partnerships and networks. Key actors are the Greater Stavanger Economic Development, Stavanger Chamber of Commerce and Industry (Stavanger CCI), Rogaland County Council, Stavanger municipality, Centre of Entrepreneurship in Rogaland and Innovation Norway Rogaland.

Commercialisation of knowledge is an important part of innovation, and the main actors in the Stavanger region are the following. Commercialisation units: Innovation Rogaland (IR), Prekubator and IRIS-Forskningsinvest. Incubators: Ipark incubator, Ipark – Stavanger Innovation Park and Rogaland Inkubator. Matchmakers: Connect Vest, SåkorninVest AS and Energy Ventures.

Innovation policy and governance challenges

The Strategic Business Plan 2005–2020 worked out by Greater Stavanger Economic Development, is the most important document for economic development and innovation in the Stavanger region. The aim is to develop Greater Stavanger into Norway's foremost region in terms of competitiveness and value-creation, and to become Norway’s centre for food production and

Europe's energy capital. The plan focuses on six driving forces or investment areas: knowledge, innovation, internationalisation, quality of life, infrastructure and public services.

The County Council plan 2006–2009 is the main strategic political document for the County Council and is normative for all other planning in and between sectors. The plan prioritises four areas: competition, competence, communication and quality, and it focuses on international competitiveness, higher education and R&D, accessibility and an improved "people climate".

Stavanger seems to have an efficient and business-friendly public sector, and stands out as the region which, for the longest time, has had a systematic strategy for improving the ability for regional added value (Leknes and Farsund 2007). The regional partnership is, to a large extent, characterised by a mutual understanding between the individual partners, and between the Stavanger city region and the rest of Rogaland County. The Stavanger region seems to have succeeded in its effort to achieve close cooperation within the city region, and this in spite of the fact that the differences between the city and its hinterland are larger in the Stavanger region than in the other large city regions in Norway. Through the Greater Stavanger Economic development agency the region seems to have improved its institutional capacity and developed a governance system which enables a competitive-oriented regional business and innovation policies. The main task for the agency is to be a centre for new ideas, to stimulate entrepreneurship and provide guidance, to influence policy and make the Stavanger region an attractive region for investments, and contribute to the internationalisation of regional businesses.

The Stavanger region has a high score on regional added value, competitive industries, and it is a stronghold in oil and gas, energy and food. Dependency on oil and food makes the region vulnerable to price variation in oil prices and globalisation within the agricultural sector. The region also lacks competence capital (higher education and research), and accessibility is weak due to the lack of transport corridors in and out of the region. Important policy measures for improving innovation and entrepreneurship in the region are to strengthen R&D based on regional advantages, knowledge transfer between industries, and access to risk capital,

commercialisation, knowledge parks and entrepreneurship guidance.

5.1.5 The Trondheim region

The Trondheim region has 240 000 inhabitants in 10 municipalities, and has experienced a population growth higher than the national average. The region is a heterogeneous service region specialised in R&D and higher education sectors directed towards the national maritime and energy clusters.

The industrial structure

The Trondheim region has an industrial dominated by services like retail, knowledge intensive business services, R&D/education and creative services. The manu-facturing is quite small in shares and volumes compared to Stavanger and Bergen. But the region have fairly high new firm rates and innovation rates. On the other hand the region scores relatively poorly on the internationalisation of industrial activity (Blomgren et al. 2007).

Knowledge infrastructure and innovation system

The Trondheim region today has a varied set of higher education institutions, research and competence milieus and a constantly higher share of firms belonging to the knowledge economy. The region locates the Norwegian University of Science and Technology (NTNU) which is Norway's second largest university (of a total of seven) with approximately 20,000 students spread over seven faculties with 53 institutes. Sør-Trøndelag University College (HiST) is also located in the region having approximately 8,000 students.

Business and innovation policy in this region is also formulated and developed by authorities, public/private partnerships and networks. Sør-Trøndelag County Council, Innovation Norway, Trondheim municipality, the Mid-Norway Chamber of Commerce and Industry (Næringsforeningen i Trondheim) are the most important actors that develop business and innovation policy in the Trondheim region, however it is only Trondheim Municipality and Mid-Norway Chamber of commerce and Industry that explicitly have a city focus. Other policy actors are Trøndelagsrådet.

In Trondheim there are three TTO (NTNU Technology Transfer, SINVENT and Leiv Eirikson Nyskaping); two Incubators (Innovasjonssenteret Gløshaugen, Leiv Eirikson Senter Inkubator); and four "Matchmakers" working with matching the knowledge producers with industry (Connect Midt Norge, Partner for Nyskaping, Access Mid-Norway, Utspring) (Borlaug and Hansen, 2008).

Innovation policy and governance challenges

The most important policy document in the region is the "County plan for Sør-Trøndelag and Nord-Trøndelag County Council and Trondheim municipality: 'Kreative Trøndelag' – her er alt mulig uansett. 2005–2008". The aim of the plan is to contribute to the implementation of the best regional policy for the region and the plan has become an important tool to meet the great challenges that the region has. The plan will be followed by action plans for the different strategies developed in the plan. The plan is seen as the most important instrument for regional development, coordinating the municipalities, the state and the County Council's planning. According to Teknologirådet, the most important actions to be taken in 2008 are to work for the establishment of the bio- and gasworks at Skogn, to establish strategic partnership arenas for industry, R&D institutions and public authorities in order to develop a coordinated development of innovation-related actions in the region. Further it is to strengthen the profile of the region as a destination nationally and internationally and to market food from the region, culture and identify and gain new target groups. The work for a new common plan "Trøndelagsplanen 2009–2012" is now out at hearing. In the preparatory work for this plan around 50 people representing the business community, young people, sports, culture, R&D and the public authorities have been interviewed.

The "Strategic Business plan for Trondheim 2000–2010" is the main policy document for the Trondheim municipality. The implementation of the plan is mainly based on different project-partnerships with participation from different firms, businesses and administrations. However, the implementation has not been sufficiently followed up by the actors themselves (the business community) (Farsund and Leknes 2005, p. 104). Ongoing projects originated from the strategic plan for the region of relevance to

innovation is the marketing of the regions competence base, Venture Cup and START-NTNU in collaboration with Innovation Norway, Sør-Trøndelag municipality and County Council, followed by a focus on Trondheim as a "labelled article" (merkevare) and as "The student city" – with the aim to develop Trondheim as an attractive city to study in.

There have been several examples in recent years that Trondheim has taken a new role in regional development in the city region and in mid-Norway (Farsund and Leknes 2005), however, collaboration among the policy actors is still fragmented at the project level. Important tools for knowledge-based business development seem not to be linked to the regional and local authority's business policy, but to a larger degree linked to the national authority's innovation policy. However, the commercialisation system of Trondheim can be characterised by being more specialised towards the knowledge producing institutions in the region than towards subject specific subsystems (like in Oslo) (Borlaug and Hansen 2008, p. 52). Further, none of the policy actors in the Trondheim region had implemented specific actions towards culture as an industry. However, objectives can be found in the plan for the Trondheim municipality and in the new plan for the County Council and the Mid-Norway Chamber of Commerce and Industry has also put a focus on creative and culturally-based industries. As the nation's largest research and technology region, one also could expect policy to be more directed at developing comparative advantages by strengthening innovation capacity so as to improve entrepreneurship and produce more patents.

5.1.6 Similarities and dissimilarities of the larger cities

Looking first at structural characteristics, innovation performance and development trends the four larger city regions have the following *common* properties:

- Large innovation resources (human capital, higher educated people, creative occupations, R&D expenditures).
- High diversity of industries, but mostly specialised in knowledge intensive sectors of different kinds.

- Higher than average innovation levels, patent rates and new firms formation rates.
- Higher than average growth rates in employment (in particularly in Stavanger, Trondheim and Bergen, while Oslo grows at a national average level).
- The knowledge intensive services are the strongest growth sector (some higher rates in Stavanger, Bergen and Trondheim than Oslo).

Looking secondly at what kind of factors distinguish between the larger city regions, we find the following:

- Size of regional milieus (number of inhabitants and firms), with Oslo four times larger than each of the other large cities.
- Industrial base and types of industrial specialisations varies. While Oslo mostly specialises in knowledge intensive services, finance and creative services, Trondheim specialises more in R&D, Stavanger in offshore/maritime related manufacturing, and Bergen with a mix of offshore/maritime related manufacturing and knowledge intensive services.

With regard to structural characteristics Oslo is in a special class because of its size and specific capital functions. Oslo is clearly at the top in the national city hierarchy revealing a somewhat monocentric structure, but higher growth rate of jobs and employment may indicate that the other large cities are catching up to some extent, and that a more similar growth pattern of KIBS have been emerging between the largest city regions.

Looking at the *innovation systems and innovation policy*, the four larger city regions have much in common:

- Complex, fragmented regional milieus and innovation systems with deficits.
- Several new cluster development initiatives.
- Regional innovation and development policy documents and programs highlighting innovation by cluster development, entrepreneurship, interaction between business, R&D and policy through networking, partnership and innovation

alliances. A strong focus is directed towards commercialisation of innovation through TTO, incubators and matchmakers.

At a general level it seems that much of the same recipe is chosen in all the large cities. Innovation should be stimulated and improved through cluster policies, networking, partnership and commercialisation. There are similar efforts for improving infrastructure but in partly different areas due to specialisation in the different cities. It can be questioned how well this strategy will work and how well adapted the policy is to the local/regional specificities in the different cities and, how specialisation fits in with the national division of labour. All the large cities have complex and partly uncoordinated innovation systems based on a variety of public, semi-public and private institutions. Typical are bodies for coordinating regional development projects, such as Oslo Teknopol, Business Region Bergen and Greater Stavanger Economic Development.

To improve the innovation performance it may be important to clarify the role and functions of the different actors in the innovation system, for instance the role of state versus regional actors in innovation policy making. The administrative reform in 2010 (Forvaltningsreformen) also implies a regionalisation of the industrial and innovation policy which may increase the governance challenges for innovation policies. One of the challenges is to coordinate national and regional innovation policy, their actors and their understanding of the "right" policy tools. Another challenge is how to link up global actors and national knowledge milieus to hinder the fact that clusters and networks are "locked in" in outdated modes of innovation. If the large cities are as vital to innovation as suggested in the literature and in policy documents, they must overcome both internal fragmentation and external dislocation in their innovation systems.

The governance challenges seem to be greater and more complex in the Oslo region than in other parts of the country. The melting together of a "greater Oslo region" leads to more interfaces between governance agencies and as such more overlapping areas of responsibility between many actors involved in the innovation policy. The Bergen region also faces governmental challenges in the innovation policies due to the fragmentation of the innovation

system, lack of knowledge spillover between knowledge producers and users, and weak collaboration between important actors in the regional innovation coalition. The Stavanger region seems to have succeeded fairly well in its efforts to achieve close cooperation between the city and its hinterland. However, a challenge for the region is a lack of competence capital (higher education and research), and weak accessibility due to a lack of transport corridors in and out of the region. Trondheim one of the largest research and technology region in the country, but the collaboration among the policy actors and actors within the innovation milieu is still fragmented. One of the challenge is to develop a policy that could strengthens the innovation capability of the region.

5.2 Small and medium-sized city regions

5.2.1 General characteristics

The four small- and medium sized city regions selected here reflect some of the substantial range in size of the regional milieu which is found within this category (cf. Table 5.4); from Grenland[57] (122 865 inhabitants and 9500 firms) to Ulsteinvik (22 542 inhabitants and 1984 firms). The *population growth rates are* quite different within this group of city -regions with Kongsberg above the national average and Ulsteinvik substantial below this level. These differencies in growth rates are mostly related to dissimilar net-mobility flows and attractivity of these city regions. The population growth rates vary insignificant with the size and centrality of these city regions.

[57] This city regions consist of two smaller cities (Skien and Porsgrunn) which are growing together into one city region called Grenland.

Table 5.4 *Population size and changes in Grenland, Gjøvik region, Kongsberg, Ulsteinvik (Datasource: Statistics Norway).*

		Number inhabitants 2007	Changes in per cent 1997-2007
COUNRTY		4 737 171	7,2
Medium sized city-regions (all country)		1 315 884	7,4
	Grenland	122 865	3,1
	Gjøvik	67 884	1,4
Small city-region (allcountry)		1 023 869	1,9
	Kongsberg	27 937	8,1
	Ulsteinvik	22 542	0,1
Small commity regions (all country)		362 888	-5,9

These four regions are old manufacturing industry regions and are specialised within different medium high tech, and high tech manufacturing industries.

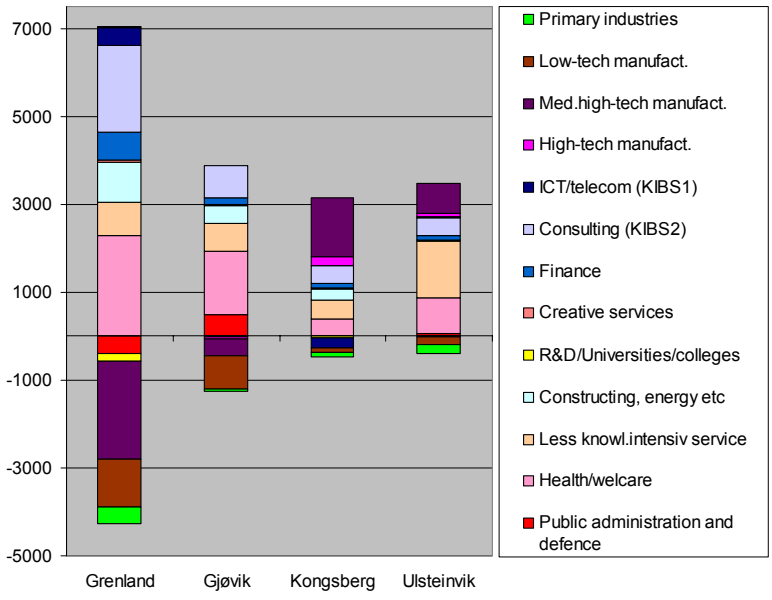
Table 5.5 *Industrial- and sector structures, specialisations and changes in Grenland, Gjøvik, Kongsberg and Ulsteinvik regions (Datasource: Statistics Norway).*

	1Primary	2 Manufacturing				3 Infra-structure industries	4 Knowledge intensive service				5 Exper-ience industries	6 Private service others	7 Edu-cation	8 Public sector others	Total
		Low tech	Medium tech	High tech	Total		ICT and consultin g others	Finance	R&D	Total					
Employment 2008															
Medium-sized city regions (all country)	16 169	34 180	52 334	4 663	91 177	55 205	45 170	9 281	1 201	58 446	22 181	163 392	49 394	171 645	627 610
Grenland	951	1 579	6 660	312	8 551	4 784	4 781	681	152	5 824	1 841	13 790	4 113	16 205	56 060
Gjøvik	1 654	2 155	3 468	81	5 704	2 416	1 833	392	59	2 363	755	6 907	2 541	9 572	31 991
Small city regions (all country)	24 294	26 453	36 751	4 304	67 508	43 017	25 676	5 599	715	33 182	17 379	114 977	42 555	140 080	482 993
Kongsberg	380	261	3 382	1 481	5 123	993	1 140	129	-	1 301	626	3 261	1 078	3 507	16 269
Ulsteinvik	327	562	2 770	43	3 374	650	637	115	2	773	241	3 645	876	2 123	12 010
Localisation quotient 2008															
Medium-sized city regions (all country)	0,9	1,1	1,3	0,9	1,2	1,1	0,8	0,7	0,4	0,8	0,9	1,0	1,0	1,0	1
Grenland	0,6	0,6	1,8	0,7	1,2	1,1	0,9	0,6	0,5	0,8	0,8	0,9	0,9	1,1	1
Gjøvik	1,8	1,4	1,6	0,3	1,5	0,9	0,6	0,6	0,4	0,6	0,6	0,8	1,0	1,1	1
Small city regions (all country)	1,7	1,1	1,1	1,1	1,1	1,1	0,6	0,6	0,3	0,6	0,9	0,9	1,1	1,1	1
Kongsberg	0,8	0,3	3,1	11,5	2,6	0,8	0,8	0,4	0,0	0,6	0,9	0,8	0,8	0,8	1
Ulsteinvik	0,9	1,0	3,5	0,4	2,3	0,7	0,6	0,5	0,0	0,5	0,5	1,2	0,9	0,7	1
Relative changes (%) in employment 1998-2008															
Medium sized city-regions (all country)	-22	-14	-2	-14	-8	34	70	2	2	50	19	15	43	48	23
Grenland	-27	-23	-13	12	-14	16	100	5	-68	59	12	14	98	55	24
Gjøvik	-9	-29	-6	-2	-16	23	53	-7	149	33	4	7	22	36	11
Small city-region (allcountry)	-24	-16	-2	42	-6	31	57	-5	6	39	-3	17	48	43	20
Kongsberg	-20	-35	132	56	82	38	-44	-12	-100	-41	45	19	109	42	32
Ulsteinvik	-42	-37	13	204	0	19	118	49	-	104	1	75	88	118	39
COUNRTY	-23	-12	5	1	-2	33	63	20	23	51	18	15	41	44	24

Looking at the medium-sized city region Grenland is specialised in medium high-tech manufacturing related to chemicals and oil/gas. The Gjøvik region is also specialized in medium high tech industries related to metal products, automotive and defence industries. Of the small city regions Kongsberg is heterogeneous specialised in different medium high-tech, and high-tech manufacturing industries (aircraft, ICT, machines, maritime etc). A LQ of 11,5 in high-tech manufacturing means that these industries have about twelve times as many jobs in Kongsberg as expected from the national average, while the number of jobs in the medium-high-tech manufacturing is more than twice as big (cf. Table 5.5). The other small city region, Ulsteinvik, is more one-sided specialised in medium high-tech manufacturing related to maritime industries.

None of these four city regions are specialized in knowledge intensive services, which they have in common with most of the smaller and medium sized city regions.

Figure 5.2 *Changes in number of work places in different industries in Grenland, Gjøvik, Kongsberg og Ulsteinvik 2001-2009 (Datasource: Statistics Norway, CRE).*



The two smallest regions, Kongsberg and Ulsteinvik, have been successful with regards development in medium-high-tech and high-tech manufacturing. These regions have managed to develop a specialisation within knowledge intensive parts of the industry, which is supposed to be internationally competitive in a high-cost country. However, the specialisation also means that these regions are dependent upon a few industrial sectors which are strongly exposed to international competition, and also thus vulnerable with regard to technological and market changes in these industries. Furthermore, both of these regions have received substantial job losses within low-tech manufacturing, more than the national rate. The two other regions, Grenland and Gjøvik, have been more characterised by industrial restructuring and substantial job losses in manufacturing industries, and in particular in low-tech manufacturing. This implies that the selected regions may have some weaknesses despite the fact that two of them seem to have a somewhat favourable manufacturing structure.

All the four cases of small- and medium-sized city regions are more R&D intensive than the national average, and substantially higher than the national average for small- and medium-sized city regions. The regional innovation rates measured in the share of innovative firms, for all the cases (34–40%) stay approximately around the national average level (38%). Measured in shares of employed workers in innovative firms there are some larger differences between the cases (47–73%) on both sides of the national level (52%). Kongsberg is a very unique case with a very high R&D intensity, very high employment in innovative firms (73%) and substantially over average radical innovation rates (patents). The new firm formation rates are below the national average in all the four case regions.

Table 5.6 *R&D, innovation intensity and new firm rates in Grenland, Gjøvik, Kongsberg and Ulsteinvik. (Datasource: Statistics Norway-2006).*

	R&D-intensity*		Innovation intensity**						Firm population changes ***		
	Tot R&D-expenditures in 1000 NOK	Tot R&D-expenditures per employees in 1000 NOK	Share employed in firms with innovation	Share of firms with different types of innovation					New firm rates per year (% of firm population)	Closed firms per year (% of firm population)	Net-growth rates of firms per year (% of firm population)
				All types of innovation	Market	Product/ services	Process	Patent			
Country	20 134 534	3 056	52	38	25	20	16	5	12,1	10,8	1,3
Medium-sized city regions (all country)	3 496 482	2 056	51	38	25	20	18	5	11,8	10,5	1,3
Grenland	425 948	2 765	49	39	26	20	22	5	11,9	10,9	1,0
Gjøvik	367 066	4 156	59	40	20	21	21	6	9,1	8,8	0,3
Small city regions (all country)	2 293 340	2 457	53	37	23	18	16	4	9,1	8,9	0,2
Kongsberg	1 087 437	19 309	73	40	23	23	15	9	10,7	9,5	1,2
Ulsteinvik	204 424	4 371	47	34	24	23	10	5	10,4	10,5	0,0

*In 2006 (Statistics Norway-Innovation survey 2006), **In 2003-2005 (Statistics Norway-Innovation survey 2006), ***Per year in the periode 1999-2003 (Statistics Norway - CFR)

5.2.2 The Grenland region

The Grenland region consists of seven municipalities with 123 000 inhabitants. The number of inhabitants has increased somewhat in recent years, and the region experiences net immigration. The region consists of the two nearby cities of Skien and Porsgrunn. Grenland is an old manufacturing region that has housed well-known, large Norwegian companies, such as the partly state owned Hydro and Union. The companies have in particular been found in different process industries (chemical industry, metallurgical industry, pulp and paper etc.). Much of the process industry is located at Herøya Industrial Park, close to the city centre of Porsgrunn. Herøya has about 3,200 workers in manufacturing plants, research institutes and administration units.

Industrial structure

Like Gjøvik/Raufoss and Kongsberg, Grenland has a high concentration of jobs in KIM industries. The region has nearly 4,600 employees in these industries and a LQ of 3.2. The region has about the same share of jobs in low-tech industries as the average of Norway (the LQ is 1.1). The region has somewhat lower shares of jobs in the rest of the manufacturing industries and in knowledge intensive services than the average of Norway.

Much of the manufacturing industry and firms in Grenland can be seen as quite knowledge intensive in the meaning of using R&D-based knowledge in the production process. Thus, two of the largest firm-based R&D departments in Norway are located in Grenland. However, Grenland is still mainly dominated by blue collar workers. Thus, Grenland has a lower level of highly educated persons than the average in Norway. A little over than 20% of the population in Grenland has higher education compared with 25.4% in Norway. The lower level in Grenland reflects the fact that the manufacturing industry in the region has traditionally recruited a large number of workers without higher education.

The industrial history of Grenland has led to a dominance of a working class culture in the region. One effect of this may be a lack of entrepreneurship. In some layers of the society persons are used to thinking that the large firms provide the jobs, however, this seems to be changing with more diversity in the region's firm and industrial structure.

Besides the traditional (but revitalised) manufacturing industry, the software industry, consisting of 20–30 firms, is also growing in the region. There seems to be close cooperation between these firms which has been supported by the national Arena programme through an "ICT Grenland"- project. It seems to be more or less incidental that an ICT cluster has developed in Grenland. However, the firms benefit somewhat from the technological and commercial competence in the traditional industry, not least that it is accepted to have high international ambitions for the development of firms in the region.

Knowledge infrastructure and innovation system

Grenland seems to have three important characteristics of relevance for the development of a KIM industry. The first is based on the fact that the region, and the Herøya industrial park in Porsgrunn in particular, is a centre for the process industry in Norway. The industrial history has produced an infrastructure, broadly defined, that is an advantage for further growth also of more knowledge-based firms in the region. The advantages are first of all a physical infrastructure including sites for factories, factory buildings and harbours. Second, the region has a number of service, maintenance and repair firms with experience and

competence in assisting manufacturing firms. By hiring such service suppliers, firms can concentrate on their core activities which reduce the risk in firms, in particular in the first phases of their life cycle. A third important advantage is a stable, competent labour force with particular experience in managing and maintaining large firms, and with a tradition of shift work. As some old firms have shut down, a "recirculation of competence" is taking place in which dismissed workers get jobs in newly established or expanding firms.

These advantages demonstrate that Grenland is able to house a demanding manufacturing industry. The advantages have contributed to the establishment of new firms in Grenland in recent years, resulting for example in a growing number of jobs at Herøya Industrial Park. The establishment and growth of two plants belonging to REC ScanWafer AS from 2003 with in all 350 jobs exemplifies the attraction of Grenland.

The innovation activity in the manufacturing industry in Grenland follows the main innovation pattern found in the Norwegian metal industry (Karlsen 2008). This industry is part of a national innovation system, which is mostly expressed in the aluminium industry. The industry is dominated by corporate R&D centres which cooperate with NTNU and large national R&D institutes, in particular. The innovation activity resembles the STI mode of innovation (Jensen et al. 2007), which focuses on research-based innovation activity in distinct innovation projects. The local university college in Porsgrunn has traditionally had a role in supplying the local industry with candidates. The University College has among other things three masters programs in technology adapted to core areas of the local process industry.

Innovation policy and challenges

The dependence on large, processing companies has traditionally dominated much of the thinking of industrial development in Grenland. The policy has been focused on maintaining the large companies and attracting external large firms of the same type. This is now partly changing as the industry in Grenland is restructuring towards new sectors and towards less dominance of the traditional big firms.

Thus, the industrial policy in Grenland seems to have two main elements. The first is that the region aims to create new jobs based on its comparative advantage as an old industrial region. The region wants to continue as a centre of manufacturing industry in Norway, which includes the restructuring of its traditional industry. However, this also includes broadening the region's industrial structure by recruiting new external firms and increasing the number of local start-ups.

The second element of the regional industrial policy is to build a local identity and strengthen the people and business climates of Grenland. The intention is to increase the attraction of Grenland as a place to live and as a place to move to, in particular for families with children. The attraction lies in increased cultural activities, revitalised city centres, good public schools and good possibilities for outdoor activities. Cultural activities and the use of art in urban spaces are important elements in the efforts of recruiting and maintaining people. The recruitment is focused on retaining students (by building moderately priced apartments amongst other ideas), withdrawing of former locals from other places and families with children. The branding also aims to change the traditional impression of Grenland as a somewhat polluted manufacturing region as this is not the case any more.

Both elements build on the comparative advantages of Grenland. The first strategy meets some challenges in new energy regimes (Karlsen 2008) and high labour costs and other costs in Norway. However, the unique competence and industrial culture in Grenland is certainly an asset. The branding of Grenland to recruit more people is also challenging due to competition from Oslo and many city regions closer to Oslo. However, the region has selected some target groups, such as families with children and former inhabitants, where the competition with Oslo may be less fierce.

5.2.3 The Gjøvik region

The Gjøvik region consists of five municipalities with 70 000 inhabitants. The number of inhabitants has been fairly stable over the last decade although some net immigration. The region has strong manufacturing traditions much originally based on a few large companies. The city of Gjøvik was in particular based on Mustad Fabrikker (fish hooks) and Gjøvigs Glasverk (glassworks),

while the nearby integrated small site of Raufoss was originally a one company town dominated by the state owned Raufoss Ammunition factory (RA). The description of the Gjøvik region focuses in particular on the development at Raufoss, and the restructuring of RA into a cluster of firms.

Industrial structure

Gjøvik region has a concentration of jobs in the KIM with 2,000 employees and a LQ of 2.4 (Table 1). The region also has many jobs in low-tech manufacturing industries (more than 3,100 employees, LQ of 1.4). Although the region has more than 3,500 jobs in knowledge intensive service industries, this sector is comparatively small with a LQ of 0.7. Thus, the industrial structure is highly concentrated on various parts of manufacturing industries.

The industrial structure will be described in more detail by focusing on the lightweight material cluster which dominates the industrial structure of the region. The core firms of the cluster are located at the industrial park at Raufoss, while other cluster firms are located in other parts of the region. The cluster consists of 50–60 firms with about 4,000 jobs. The cluster is world-leading in automated manufacturing technology and material technology, especially aluminium and composite (Johnstad 2007). The cluster was appointed as one of six NCEs in 2006 (Isaksen 2009).

The firm structure of the cluster is dominated by five large companies producing mainly components in aluminium and other lightweight materials, and which employ about 2,000 persons. The first of these firms is Nammo which produces ammunition and missile engines. Nammo is seen as the most important technology driving force in the cluster. The other four large firms develop and produce components in aluminium, brass or composite for the global car industry. They include Hydro Automotive Structures, Raufoss which produces crash systems, Raufoss Technology which produces wheel suspensions, Kongsberg Automotive with production of couplings, and Plastal with the production of exterior details in plastic. These five firms are all parts of large Norwegian or international corporations. Much of the R&D activity in the corporations takes place at Raufoss, while some production is outsourced to other countries for cost reasons and to supply customers in other parts of the world.

The other firms in the lightweight material cluster are a number of highly specialised niche firms, producers of machinery and equipment, engineering firms, and a few large and several smaller suppliers to the core companies and the niche firms. The number of firms sums up to a rather varied local production network.

Knowledge infrastructure and innovation system

Important knowledge organisations in Gjøvik region are SINTEF Raufoss Manufacturing (SRM) and Gjøvik University College. The majority of SRM is owned by the largest technological research institute in the Nordic countries, SINTEF in Trondheim, and the rest are owned by local companies. SRM, with about 75 full time employees, delivers expertise and competence within manufacturing, material technology, technology management and various laboratories and workshop services. Gjøvik University College has, among other things, study programs in engineering. The University College adapts courses to the requirements of the local industry, and is an important source of recruitment for firms.

The core of the innovation system in Gjøvik region is the five largest firms, which act as drivers for the technology development in the cluster. These firms operate in demanding global defence, space, and automotive markets, which are markets that require high quality, and also in the automotive industry constantly lower prices. These large firms, and to some extent also some smaller niche firms, cooperate strongly in innovation projects with SRM and partly with some extra-regional knowledge organisations (in particular SINTEF, NTNU and FFI). The large firms order challenging R&D projects in SRM, and they may also bring in external knowledge organisations and specialised firms as partners in these projects. The projects regard, in particular, material development, simulation technology, automation and lean production processes. SRM has similar types of projects for several local firms, which leads to the accumulation of specialised knowledge and experience in SRM, and it leads to the sharing of knowledge among local companies (Isaksen and Karlsen 2009). Such activities result in technology diffusion to SRM and other actors in the Raufoss cluster, and make SRM into a local knowledge hub. An important basis for the cross company knowledge flow is the fact that the Raufoss companies are not

competitors. Rather they rely on the same or similar technological bases and include complementary core competence.

To some extent projects that are carried out by SRM may involve several local firms. The large technology drivers and the niche firms act as demanding customers for the local, related firms, i.e. engineering firms, machine and tool builders and component suppliers. Based on local demand, several machine builders specialising in automation technology have developed. Other local firms perform subcontracting of specialised work, such as small series, and make prototypes. Such firms may also be upgraded by demands from their local customers and in projects involving SRM. The related firms do not build internal knowledge in some areas, but rely on SRM. This raises the competence in SRM further, which can be used in projects for other local and external firms.

Innovation policy and challenges

Several local policy initiatives exist at Gjøvik/Raufoss. A core of these initiatives has been, and still is, to stimulate local cooperation, networking and cluster formation, and to raise the knowledge base of individual firms and the cluster as such. Thus policy tools include two Arena programs, a NCE programme and one Centre for Research-Based Innovation. These programs have stimulated networking and cluster building initiatives in the region. One result is the TotAl group, which is a network organisation consisting of 36 firms (some found outside the Gjøvik/Raufoss region) fabricating different types of products in aluminium. The organisation focuses on joint deliveries of complete products, common marketing and competence development.

A potential challenge at Gjøvik region is the dense local collaboration and the high industrial specialisation. A specific aspect of the specialisation is the fact that four of the five core companies in the lightweight material cluster are suppliers to the global automotive industry which experienced problems in the global recession from autumn 2008. Some spin-off firms have found other market niches, however, the cluster is quite dependent on deliveries of auto parts. This points to a need to differentiate the product and market approach among the cluster firms even more. The small and specialised Raufoss cluster has by its nature low related variety, which makes extra-regional "learning"

networks particularly important in this case. According to Boschma and Frenken (2009) the extra-regional knowledge will most effectively support regional industrial growth if it is related and close to existing regional knowledge bases, but not quite similar to these. In the case of Raufoss this points to the need for the cluster firms to extend their knowledge networks beyond SRM and SINTEF found on the local and national level.

5.2.4 The Kongsberg region

The Kongsberg region consists of three municipalities with 28 000 inhabitants, and the number of inhabitants has increased somewhat in recent years due to net immigration. Kongsberg has a similar history Gjøvik region. It was a one company town, dominated by Kongsberg Våpenfabrikk (KV) until 1987. The company was then restructured and divided into several independent companies, a number of these with international owners. Kongsberg is, however, special in having a high share of persons with higher education. About 30% of the population above 16 years has higher education in Kongsberg, compared to 25% in Norway, and about 20% in Gjøvik region. This reflects the type of industry in Kongsberg, which is dominated by engineering activities and less by production work.

Industrial structure

Kongsberg has a very high concentration of jobs in KIM industries. The region has nearly 3,300 employees in these industries (Table 1). Kongsberg is also over-represented with jobs in petro-maritime industries with a LQ of 2.5. This reflects the fact that Kongsberg has more differentiated firms with regard to market niches and technology than Gjøvik/Raufoss. Kongsberg has also nearly 1,700 jobs in knowledge intensive services with a LQ of 0.7. Kongsberg has very few low-tech jobs, which underlines the fact that the region is characterised by rather knowledge intensive industries.

Kongsberg is often denoted as the number one technology city in Norway, housing a very competitive and knowledge-based manufacturing industry (Middelfart, 2002). The manufacturing industry is dominated by a few large companies that originate from KV. The five largest companies, thus, includes about 70% of all

jobs in the regional cluster (Onsager et al. 2007). The companies include the Kongsberg Group (aerospace, maritime, defence), FMC Technologies (offshore), Kongsberg Automotive (car parts), Volvo Aero Norway (aircraft parts) and Dresser Rand (turbines).

The period until 1987, when Kongsberg was dominated by the state owned KV, created the conditions for the positive industrial development thereafter. KV developed advanced products and technology, and built unique competence. This was possible as KV had a kind of protected role by the state in order to contribute to developing a more advanced Norwegian manufacturing industry, which made long-term technology development possible. The competence was further developed when new owners took over and continued the production in KV's divisions from 1987 in independent companies. New owners meant that the companies became part of national and international corporations, and the activities of the companies were included in the strategy of these corporations. Thus the companies have grown considerably since 1987, with a doubling of the number of jobs.

Knowledge infrastructure and innovation system

The growth of the manufacturing industry at Kongsberg builds on two main mechanisms:

(1) long-term development of technologically advanced firms with a unique knowledge base through the development of KV and its successors; and

(2) the fact that important local firms have found, and still find, innovation partners and knowledge sources outside Kongsberg (Isaksen 2007).

The second point means that KV and the newer companies have developed, and still develop, their core competence in collaborations with strong Norwegian, and partly international, knowledge organisations and demanding customers. National R&D institutes such as FFI, SINTEF and NTNU have been particularly important as innovation partners.

Studies point to the fact that the large companies in Kongsberg are increasingly part of international production systems and knowledge networks. The large Kongsberg firms have considerable contact with customers and suppliers in other parts

of Norway and abroad (Fraas 2005). Many of these firms produce technology advanced components, parts and modules to be incorporated in larger systems and products, and some firms have also outsourced large parts of the production to foreign subcontractors. The international networks largely reflect the firms' strategy of cooperating with the best possible actors in different fields in order for the firms to become highly competitive themselves. The main picture shows that the core firms in Kongsberg cooperate mostly with customers, suppliers and sister companies outside Norway, but in Norway cooperate mostly with R&D institutes and universities (Isaksen 2009).

The external contacts to R&D institutes, demand customers etc. build on, and require, high internal competence in the companies. The companies have in that sense had little use of the industrial milieu at Kongsberg, beyond the fact that higher educated employees are recruited to and live in Kongsberg. Fraas (2005) thus maintains that the core firms in Kongsberg do not cooperate closely with each other as regards production, i.e. Kongsberg does not contain a local production network. Velvin et al. (2002) also suggest that several of the Kongsberg companies take part in national and global innovation systems rather than local and regional ones. This study (from 2002) also found nearly no contract research projects at the university colleges in Vestfold and Buskerud (including the campus at Kongsberg) for local manufacturing customers. However, the university college at Kongsberg has developed study programs for local firms, most evident in a masters programme in systems engineering. Kongsberg also houses a Technological Institute (TI) with 75 employees, which focuses on advice and training in companies with regard to a number of technological and organisational fields. However, the main external knowledge sources for innovation activity by the core companies at Kongsberg have been the large national R&D institutes.

Innovation policy and challenges

Local initiatives in Kongsberg in recent years have aimed to strengthen the cooperation between local firms, develop the knowledge base, and raise the dynamics of the cluster. The initiatives have mainly come from the large companies in Kongsberg. Kongsberg Nærings- og Handelskammer was

established in 1990 to improve the cooperation between firms, e.g. through different arrangements and meeting places for the local industry. One meeting is the Senior Executive Forum; another organisation is Kongsberg Innovation, which aims to develop innovative manufacturing firms all over Norway. Kongsberg Systems Engineering became one of the first six NCEs in 2006, which also led to more local collaboration and joint development initiatives.

As demonstrated above, local production networks and cluster mechanisms have largely been lacking in Kongsberg. A pertinent question is then: is it really relevant to develop more local collaboration and cluster dynamics in Kongsberg, when the cluster firms mostly rely on national and global knowledge links? The answer is yes for two reasons. The first reason points to the fact that the potential for more local dynamics may exist in Kongsberg. The idea of regional clusters points exactly to the options for proactive initiatives from the industry or public authorities to strengthen the working of a cluster. The other reason to strengthen the cluster mechanisms is to embed international firms in a dynamic regional industrial milieu. Foreign owners may then see Kongsberg as an important place to be located, because of the high competence in the company at Kongsberg, but also because of unique competence, new ideas etc. found in the rest of the regional cluster.

An important challenge, however, is to provide for good conditions for long-term knowledge creation and product development in the companies. This has historically been vital for the positive industrial development in Kongsberg, through KV and later on in the companies that come out of KV. Local initiatives may generally be important to strengthen already existing industrial milieus or regional clusters, for example by stimulating local collaboration, developing joint training, projects etc. among local firms, and developing adapted study programs. The experience from the growth of the Kongsberg cluster, however, points to the importance of long-term technological development and research-driven R&D (and not just market-driven innovation activity). Such activities require long-term research projects and long-term public support. The local and regional levels often do not have sufficient resources to support such long-term and more basic R&D projects. These are projects

traditionally requiring support from national R&D funds and national R&D institutes with leading international competence. Thus, Kongsberg still seems to be very dependent on the national technology and innovation policy.

5.2.5 The Ulsteinvik region

The Ulsteinvik region is located on the north-western coast of Norway and consists of three municipalities with 28 000 inhabitants for the most settled in the Ulsteinvik town. The number of inhabitants has been stable over the last decade. Ulsteinvik is at the centre of the large maritime cluster in the county of Møre and Romsdal. Thus, Ulsteinvik cannot be analysed as a restricted local area, the region rather has to be analysed as an integrated part of the wider maritime cluster in Møre and Romsdal. The complete cluster in the county consists of about 200 firms and 20 000 jobs in a wide set of activities, including shipbuilding, ship design, component suppliers, ship owners, education, R&D, and financing (Oterhals et al. 2008).

Industrial structure

The Ulsteinvik region has a concentration of jobs in the petro-maritime industries, with more than 1,000 employees and a LQ of 4.8. The region is also somewhat overrepresented with jobs in KIM industries and in low-tech industries in general (LQs of 1.4 and 1.8). The region has, however, comparatively few jobs in knowledge intensive services, with 920 employees and a LQ of 0.5.

The industry in the Ulsteinvik region is concentrated in shipbuilding and component suppliers to yards. The region has a long history of local entrepreneurship, and the shipyards and supplier firms have traditionally been established by local entrepreneurs. The firm structure has been dominated by a few large shipyards and a number of smaller yards and component suppliers, which to some extent have been spin-offs from the large companies (Isaksen 1999). The maritime industry has, however, gone through large restructuring over recent years, among other things with new, international owners. Thus, Rolls Royce Marine has located its divisional headquarters for commercial marine in Ulsteinvik and has decided to locate its new European Education and Training Centre at Ålesund. These decisions underline the

high competence found in the maritime cluster in Møre and Romsdal.

Knowledge infrastructure and innovation system

The maritime industry in Ulsteinvik (and Møre and Romsdal) has traditionally been quite innovative, first of all with regards incremental innovations of existing products. A study (Isaksen 1999, Asheim and Isaksen 2002) distinguishes between four main ways in which such innovations take place. One way is through local user-producer interaction, in which producers have to satisfy new demands and needs by customers and users. Local shipyards are thus important sources of innovation for equipment suppliers. Local shipping consultants, who design and construct new ships, have an important and increasing role in the innovation process (Oterhals et al. 2008). Ship owners cooperate with yards and ship designers in developing new ship concepts, which have led to seminal solutions with regard to the construction of hulls and equipment (Oterhals et al. 2008). Also discussions with users, i.e. with skippers, chief engineers and other crew members, give important feedback on how the products of local firms work, and suggestions for improvements.

A second main way in which innovations have occurred in the maritime cluster is with incremental improvements on the shop floor, relying on experience-based competence by engineers and workers. This reflects a kind of drive, enthusiasm and loyalty of the workforce, seen when workers exert themselves to find better ways to do things, leading to frequent, smaller innovations (Asheim and Isaksen 2002). Wicken (1994) also explains this characteristic by the fact that entrepreneurs, firm leaders and workers share the same attitudes with a dominance of the self-employed life mode, stimulated by traditions of collective entrepreneurship through cooperatives (Wicken 1994).

Thirdly, innovation and learning is further stimulated by knowledge spillovers between local firms. The regional maritime industry contains a varied set of specialised firms along much of the value chain. Knowledge spillover takes place when firms cooperate in specific projects, obtain advice from neighbouring firms, in personal contacts between workers in different firms, and through job shifts (Asheim and Isaksen 2002). Experience-based, often tacit, knowledge is more or less a common resource base in

the maritime cluster, shared among workers, firms, and education institutions. Firms then obtain useful feedback and ideas, conditioned by their location at Ulsteinvik or in the larger regions of Møre and Romsdal.

The fourth main way in which innovation occurs is by means of cooperation through local organisations. Thus, the wider region (including Ulsteinvik, Ålesund and partly other parts of Møre and Romsdal) area includes a "thick" institutional infrastructure of vocational schools, a technical university college and the three associations, the Mechanical Engineering Association in South Sunnmøre, Maritime Nordvest and Nordvest Forum. These organisations stimulate, among other things, local cooperation, joint training and competence building and some innovation activity in production methods (Asheim and Isaksen 2002).

The maritime industry is increasingly involved in R&D-based innovation projects. Several firms put more efforts into R&D and establish R&D departments, to go beyond the mere incremental innovation activities aimed at fulfilling customers' demand (Asheim and Isaksen 2002). This activity is stimulated by the takeover of former local firms by larger national and international corporations. The innovation activity often takes place in cooperation between the R&D department and the engineering and market departments inside companies. Firms also cooperate with external R&D institutes, most often national ones, such as SINTEF in Trondheim (Isaksen 2009). Ålesund University College has developed study programs specially adapted to the local maritime industry, for example a masters programme in product and system design which focuses on the design of ship equipment and maritime systems.

Innovation policy and challenges

The maritime industry at Møre and Romsdal has, for a long time, focused on strengthening the working of the regional cluster. This is clearly seen in the strategy of NCE Maritime, i.e. a programme targeting the maritime industry at Møre and Romsdal. The programme aims to increase the interaction between regional maritime companies in joint R&D projects and in extensive conference and seminar activities. The programme also aims to increase the capacity of R&D in the region, which means to develop the cluster in the direction of a regional innovation

system. Finally, the NCE programme focuses on strengthening external relations, both through international research networks and international investments in the regions.

Three main challenges exist for the maritime industry in Ulsteinvik (and Møre and Romsdal) according to Oterhals et al. (2008). Firstly, the cluster depends on a high oil price. A lower oil price in the longer term will reduce the exploration of new oil fields, and the development of more marginal fields. This will reduce the market for seismic vessels and offshore ships, which are driving forces in the maritime industry in the region. Secondly, local ship owners increasingly order simple offshore ships from low cost countries, in particular China. This can lead to the development of knowledgeable shipyards and suppliers in China and other areas, which may become tough competitors to local yards. The third challenge is linked to the second one and includes cost competition. According to Otherhals et al. (2008) high costs, and first of all the growth in labour costs, may threaten the competitiveness of the maritime industry in Møre and Romsdal. This can be met by productivity growth, which is on the agenda in joint projects in the maritime industry, for example in projects on lean shipbuilding. However, the challenges reflect the vulnerability of the Ulsteinvik region as it is highly specialised in an industry with tough global competition.

5.3 Similarities and dissimilarities of the smaller cities

In this section we summarise similarities and differences in regional advantage, innovation and challenges within the two main groups of larger city regions and smaller city regions respectively. Afterwards we compare across these two main groups of city regions.

The small- and medium-sized city regions

Looking first at structural characteristics, innovation performance and development trends the four small and medium sized city regions have the following *common* properties:

- Specialisation in medium-high/high-tech manufacturing.

- The knowledge intensive services are the strongest employment growth sectors.

The following kind of structural factors vary a lot within this group:

- The size of the regional milieu (number of population, firms, employment), the largest medium-sized city region (Grenland) is five times larger than the smallest small city region (Ulsteinvik).
- Innovation resources (human capital, knowledge bases, R&D expenditures) and specialisation types (branches/clusters).
- Innovation rates (huge range over and under national average and large city regions).
- Employment and population growth rates.
- Attractiveness (demographic development).

The four small- and medium-sized regions are specialised within one or a few industrial sectors and clusters often dominated by a few large firms. The regions of Gjøvik and Ulsteinvik mostly specialise in the production of components for the automotive industry and ship building, respectively. Ulsteinvik is however part of a wider, and quite complete maritime cluster in Møre and Romsdal. Kongsberg also contains a regional cluster of firms, but the firms are more differentiated with regard to market niches and technology than Gjøvik and Ulsteinvik. Grenland, on the other hand, is the largest region and the most diversified with regard to type of industries, including a growing ICT industry.

The regions also differ somewhat with regard to innovation processes. Gjøvik/Raufoss seems to have the most developed local knowledge hub in SINTEF Raufoss Manufacturing, which accumulates and spreads knowledge in the regional cluster through innovation collaboration with several large and smaller local firms. The firms at Gjøvik/Raufoss also have external knowledge links, first of all to national R&D institutions, such as NTNU, SINTEF and FFI, and to global and national customers. The national and global knowledge links are, however, even more pronounced in the three other city regions. Thus, main firms at Kongsberg, Grenland

and Ulsteinvik are definitely parts of strong national innovation systems with long-term cooperation with the largest national R&D organisations. The regional resources of large importance for the firms are first of all a specialised labour market, which is supplemented by study programs at the regional university colleges that are adapted to dominate regional industries, and knowledge flows within the regional clusters.

Looking at the *innovation systems and policy*, the four larger city regions have much in common regarding:

- local/regional innovation policy with strong focuses on cluster and system development; and
- an increasing focus on attractiveness.

In spite of very different starting points, all the city regions engage in cluster building policy initiatives. At Gjøvik/Raufoss, Kongsberg and Ulsteinvik the initiatives have been accentuated by the NCE programs. The programs in these regions focus on strengthening the collaboration between cluster firms through, among other things, raising the social capital, carrying out joint projects, and stimulating the dynamics of the cluster. The initiatives also include increasing the collaboration between the regional university colleges and the local industry, mainly focusing on developing and adapting study programs to the need of the cluster firms. Policy initiatives in Grenland also aim to strengthen the manufacturing industry by building on the traditional industrial culture and competence in the region. However, the region seems to pursue a somewhat more diverse strategy than the three other regions through their NCE programs.

The regions also have somewhat different challenges. The medium-high-tech agglomerarion in the Gjøvik region is very dependent on supplies to the global automotive industry, which points to a need to differentiate the market approach among firms, such as spin-offs, in this miliue. A similar situation exists for Ulsteinvik, which is highly dependent on activities linked to oil exploration and production, and a high oil price. Kongsberg and Grenland have more diverse industrial structures with regard to dominating products and markets and, thus, seem more robust.

A general lesson from the four cases is that cluster dynamics in medium-high and high-tech manufacturing industries have supported the industrial growth in these regions. They are all facing server global competition and some of them also increasing challenges regarding the recruitment of higher educated qualified workers. The regions also suffer from some weaknesses, first of all their specialisation in manufacturing characterized by decreasing number of jobs as a consequence of the general development in these industries. The regions must meet these challenge in different ways related to:

1. how to stimulate the development of wider, extra-regional knowledge links to actors with related knowledge to the one dominating in the cluster;
2. broaden the industrial base of the clusters by stimulating the inflow of related knowledge and investments, and supporting spin-offs;
3. develop more attractive towns as living and working places.

At the same time it is very important for the established industrial clusters of these small and medium sized city regions to have links to a strong national innovation system (NIS) with sufficient resources for the long term basic research.

6 Conclusions and policy implications

This chapter confronts some of the theoretical concepts and hypotheses described in Chapter 2, with the empirical findings from Norway described in Chapter 4 and 5. Finally it highlights some of the innovation policy challenges within the different types of regions in the years to come.

6.1 Theoretical perspectives and empirical findings

In the international literature there is a tendency to emphasise that larger city regions play an increasingly important role in economic and social development in most countries by enhancing innovation and competitiveness (Acs 2002). Large cities are considered as learning places due to specific endogenous growth conditions, as central nodes in knowledge-based economies, as settings for institutional and political innovation, and as attractive places for capital and competence. Larger cities have been characterised as follow:

- Specific competitive assets due to their ability to exploit both localisation and urbanisation advantages, i.e. their advantages of both specialisation and diversity (Frenken et al. 2007, OECD 2006).
- Knowledge intensive and creative centres (Landry 2002, Acs 2002, Simmie 2001) for development and growth of knowledge intensive industries, organisational and scientific innovation, cultural expressions, R&D and commercialisation.

- International nodes for knowledge transfer, bases for export-oriented firms and industries, and homes for head offices.
- Attractive places with both favourable "people climate" and "business climate" (Florida (2002) which develop the best R&D milieus and institutions, and as a result get the best economic performance.

The focus on endogenous growth conditions, creativity and global linkages relate innovation advantages to characteristics of the *production side* in society (economies of agglomeration, cluster effects, knowledge externalities, internal interaction and resources, external relations, global nodes and linkages). All these aspects can be subsumed under the concept of "business climate" (Florida 2002). Focus on place quality and attractiveness; on the other hand, relate innovation advantages primarily to what has been denoted as "people climate" (op.cit), i.e. more "soft" factors and the well-being of people. These factors are more connected to the *consumption side* of society, and are also more in line with Amin & Thrift's concept of *circulation* (Amin & Thrift 2002). As they see it cities are not primarily engines of competitiveness but generators of demand. They also argue that cities do not primarily support firms as local economies but through the "density of light institutions" by offering collective assets (meeting places, common services, associations, informal networks) which are "not central for core business activity, but advantageous for tracking opportunity" (op.cit:72) .

There is no plain answer as to which of these different explanations are best suited to grasp the essence of regional innovative advantages, and explain the growth and development of knowledge intensive industries in large cities. When focusing on innovation advantages of large cities one should also remember that not all such cities are success stories; some are lagging behind and suffer from threats and challenges. Some are performing far below expectations due to the emergence of various diseconomies of agglomeration and fragmentation in innovation systems, congestion costs and poor-quality infrastructure.

Based on international literature discussing regional advantage and innovation, Chapter 2 concluded with an analytical framework

which focused on related aspects of territorial resources, agglomeration economies, knowledge flows, attractiveness and institutional capabilities. Much this literature emphasized that different size of the regional milieus not only give different amounts and diversities of resources, but may also result in systematic different qualitative properties of relevance for innovation capabilities, performances and challenges.

Chapter 3 and 4 gives an empirically description of the characteristics of regional advantages, innovation forms and performances in five main types of regions in Norway. This is based on national register- and surveydata (Statistics Norway), and a comparative analysis of five main region types (aggregates of all the 161 functional regions) divided by size and centrality. The analysis documented substantial regional differences in innovation resources in favour of the largest regional milieus, but at the same time revealed small regional differences in the overall innovation rates. More substantial differences in performance and conditions related to the size of the regional milieu were found when looking at radical innovation (as well as market- and product innovation), new firm formations, renewals of firm population, growth rates in new knowledge intensive services, international cooperation and hampering factors. For all these factors the degree of performances and favourable conditions increased systematically with the size of the regional milieu. The only nuances in this picture is that the metropolitan region has got a somewhat weaker performance compared to the three second largest city regions regarding growth rates in new knowledge intensive services.

Chapter 5 describes regional advantages, innovation and challenges in eight regional cases of different sizes in Norway. This analysis also reveals some of the diversity *within* the main types of regions, regarding their sizes, industrial milieus, innovation processes and challenges. The metropolitan region, and partly the other larger city regions, are specialised in knowledge intensive services. They all experience increasingly global competition as localisation sites for international oriented firms, for headquarters and knowledge intensive activities. The ability of these regions to attract experts, creative people and higher educated persons from other countries are also under increasingly global competition pressure. At the same time the larger city regions have specific innovation policy challenges due to internal fragmentation and somewhat weak

capabilities for utilising their superior innovation resources. The smaller city regions vary a lot in size and centrality, but they are all characterised by industrial specialisation in export oriented manufacturing, and as such exposed to enhanced pressure from global competition directed towards their industrial base. Specialization within one or few export-oriented branches or clusters make them vulnerable for external pressures and shocks, but also well suited to develop incremental innovations in order to maintain their international competitiveness. They also have common innovation policy challenges. These are related to upgrading of their knowledge bases and recruitment and keeping qualified labour within their specialised industrial base, as well as spurring increased diversity of their economic base and local labour markets.

In spite of the very different starting points of the case regions all of them have developed some kinds of innovation policies and strategies over the last decade. At a general level much of the same recipe is chosen, i.e. focus on entrepreneurship, cluster development, networking and enhanced interaction between business, R&D and policy. The large city regions have primarily focused on entrepreneurship and commercialisation of innovation through TTOs, incubators and matchmakers, while the smaller city regions to some greater extent have concentrated on cluster development, upgrading and competence building. However, these kinds of general policies and strategies have to an increasing extent also been tailored to the specific local and regional conditions in each of the case regions.

The regional differences in the overall innovation rates in the main types of regions we have analysed are, as previously described, much weaker than one would expect given the substantial differences in regional innovation resources. It is also much weaker than one would expect taken the the main messages in international literature as a point of departure. The assumed main reasons for this pattern are summarised below:

- A scattered localisation pattern of innovative industries. Manufacturing industries (and aquaculture industries) have higher innovation rates than in service industries. Manufacturing industries are over-represented in small and

medium-sized city-regions, while service industries are overrepresented in the larger city regions.

- Knowledge-intensive services have high innovative rates while less knowledge-intensive services have low innovation rates. Both of the branches are overrepresented in the larger city regions, but the last one is twice as big as the former with regard to employment.
- The innovation rates within different industries vary insignificant with the size and centrality of the functional region.

In addition to these main causes some other aspects seems to be important for explaining the regional even patterns of innovation rates in Norway. Firstly, one should not forget that a lot of the huge innovation resources (human capital and R&D-expenditures) in the larger city regions are embedded in national institutions. These institutions do not only have local links and local effects, but just as much have extra-regional links and innovation effects which benefit also smaller milieus within different localisation sites in the national innovation system. Secondly, the largest city regions seem to have somewhat limited capabilities in utilising their resource advantages and synergy potentials due to complex and fragmented milieus. Thirdly, public innovation and regional policy instruments and funding may also influence the regional innovation pattern. The innovation and regional policy should stimulate and support innovation and entrepreneurial activities in all types of regions. However, both intended and non-intended effects of the innovation policy seem to result in a strong support for innovation activities in firms and clusters outside of the largest city regions. The national innovation policy has been directed towards strong national manufacturing clusters and, these are mainly localized in small- and medium sized city regions. The regional innovation and development policies in Norway are also characterized by a strong redistribution of public funding from the largest city regions to the smaller urban and rural regions in more peripheral areas.

6.2 Some lessons for innovation policy in small and large city regions

This chapter will sum up some of the main characteristics of the innovation activity and some typical innovation challenges in different types of regions, based on empirical results in the report. Derived from this, the chapter discusses possible innovation policy strategies adapted to specific regional types.

Regional *innovation* policy is a rather new form of regional policy. The policy indicates a shift from the provision of "hard" infrastructures, such as providing industrial estates, buildings and basic training of employees to "soft" infrastructures (Morgan and Nauwelaers 2003). The "soft" support includes a number of measures, such as promoting research and technological development, stimulating closer collaboration and knowledge flow between local firms and with higher education institutions to strengthen regional clusters and innovation systems, and promoting academic spin-offs.

Regional innovation policy can principally be of three types (Isaksen and Onsager 2008, Jakobsen and Onsager 2008). The first type is designed and financed at the national level, for example by Innovation Norway. The policy includes the same tools irrespective of the location of the firms. SkatteFunn, which gives tax allowances for investments in innovation projects, is one example. The tool *may*, however, have different effects on specific geographical areas. Some areas may have comparatively many firms with innovation projects, and then receive more support from SkatteFunn than other regions. Thus, a national and general innovation policy tool may have some regional consequences, for example in strengthening existing regional differences with regard to innovation activity.

Another type of policy tool is also mainly designed and financed at the national level, however, the main aim is to adapt the efforts to specific regional needs and conditions. Policy tools, such as the NCE programme, have a national set of rules and resources. Regional actors are invited to apply for projects in the programme, in which the actors specify the type of activity to be carried out in their individual projects. Thus, these are national policy tools that are adapted to regional circumstances by the regional actors

themselves. As distinct from the first two types of policy tools, a third type is initiated and operated by regional actors, first of all the counties. A general trend is increasing responsibility for the counties with regard to innovation policy, exemplified by the new regional research funds from 2010.

This chapter focuses on the last two types of regional innovation policy, i.e. regionally adapted policy to stimulate the innovativeness of firms and industries. This type of policy is at the outset consistent with conventional wisdom in the literature. Scholars maintain that no one-size-fits-all policy exists (Tödtling and Trippl 2005). Rather policy should be adapted to specific needs, barriers and conditions in individual regions. The regional cases analysed in Chapter 5 of the report demonstrate, however, that the regions use more or less the same type of strategies and tools. These include strengthening regional clusters and innovations systems through networking and spin-offs, which are preferred strategies in many nationally designed programs of type 2 above. This may also demonstrates that some concepts and "recipes" become popular and used by policy-makers in many regions, regardless of the context. Grenland seems to pursue a somewhat different strategy by also attempting to recruit new external firms and brand the people and business climate of the region.

The analysis and development of regional innovation policies often build on the RIS approach. A RIS consists of two subsystems:

- the production structure comprising the companies in the region that are linked both horizontally and vertically; and
- universities and other knowledge organisations, such as technology licensing offices, innovation centres, vocational training institutions, and so on, that are involved in the creation and diffusion of knowledge and skills (cf. Chapter 2.2)

The knowledge flow between the two subsystems is promoted by informal institutions, such as mutual trust and common understanding between, for example, employees in firms and in universities and R&D institutes. A main aim of several policy tools and organisations is to promote exactly knowledge flow and interactive learning between the actors in the two subsystems.

Finally, based on theoretical literature and empirical findings, we will discuss some typical innovation challenges and possible innovation strategies in three main types of regions; large city regions, medium-sized and small city regions, and small place regions.

Large city regions

The large city regions in Table 6.1 include Oslo, Bergen, Trondheim and Stavanger. Oslo could, strictly speaking, be treated separately. Oslo is much larger then the three other city regions with regard to the number of citizens and jobs, and has a larger share of higher educated employees, and so on. A general characteristic of the large city regions, however, is the fact that they are organisationally thick, at least compared to the rest of Norway. The large city regions have comparatively many knowledge organisations, i.e. universities, university colleges, R&D institutes, and also comparatively many jobs in KIBS. The knowledge organisations as well as the KIBS sector often have a national role and reach. The large cities have a comparatively varied and knowledge intensive industry; and altogether they are seen to hold considerable innovation resources

The fact that the large cities do not perform particularly better than the rest of Norway with regard to innovation outputs (Table 4.10) has led to the impression of underperformance in these regions. Given their significant innovation recourses, the large cities are expected to perform better. The stated underperformance of large cities is often seen to reflect fragmented regional innovation systems in these regions (Tödtling and Trippl 2005). Fragmented systems refer to a lack of knowledge flow and interactive learning between the two subsystems of the RIS; i.e. between important industries and regional cluster and knowledge organisations.

The obvious innovation strategy of large cities is therefore to link the two subsystems of RISs. This may include adapting study programs and research projects in knowledge organisations to the needs of important regional industries, and to support joint R&D projects between firms and knowledge organisations. The strategy may also involve stimulating academic spin-offs, and, in general supporting cluster building activities. Through their high number of knowledge organisations and knowledge intensive firms, the

large cities may have a role as national "innovation centres", i.e. as incubators of new science-based firms and quite new industries.

These types of strategies are relevant and consistent with the empirical data material in this report. However, the comparatively low innovation performance in large cities relative to their high innovation resources should lead to the consideration of the role of higher education institutions in these cities. It may be the case that higher education institutions, in general, in the large cities focus more on being sources of spin-offs and new knowledge for firms, which may be seen in the larger rate of radical innovation activity (patents) in the large cities (Table 4.10). Higher education institutions may also play an important role in stimulating incremental innovation activity in existing firms and industries, which may contribute to realising more of the expected innovation potential of the large cities.

Small city regions

The next regional type in Table 6.1 includes city regions with more than 10,000 inhabitants. The small city regions (with 10,000 to 50,000 inhabitants) have a more specialised industrial structure than the medium-sized regions, i.e. the small cities are, in general, dependent on fewer firms and industrial sectors. The medium-sized and small city regions are somewhat over-represented in medium-high and high-tech manufacturing industries (Table 3.2). These industries often have international owners, and firms are thus integrated in global value chains and knowledge networks. The Innovation Survey (referred to in Chapter 4) and studies (e.g. Onsager et.al.2007, Isaksen 2009) demonstrate that firms in medium-sized and small city regions are also linked to the technological national innovation system, such as large universities and R&D institutes. A recent trend is also the fact that regional university colleges increasingly adapt study programs to the local industry (Chapter 5.2).

An important challenge in medium-sized and large cities is their reliance on one or very few dominant, traded industries and clusters (Porter 2003), which may cause problems of negative lock-in. This is also linked to a lack of related variety, i.e. too few industries (and firms) in individual regions that build on similar or adjacent knowledge and other input factors. Modest related variety is seen to result in little local flow of ideas and knowledge between

related industries, which may hamper entrepreneurship in new fields and radical innovations.

Table 6.1 *Main elements of current regional innovation strategies and proposed supplementary strategies.*

Regional types	**Typical innovation challenge**	**Current innovation strategy**	**Proposed supplementary strategy**
Large city regions	Under-performance	Improve RIS, and promote spin-offs from knowledge organisations.	Increase incremental innovations in existing firms
Smaller city regions	Danger of negative lock-ins	Improve RIS and over-local linkages, promote external investments	Strengthen diversification of industrial milieus and local labour markets. Enhance the attractivness of work and place.

Based on this understanding, an important innovation strategy in medium-sized and small city regions is to bring in external investments, companies and organisations to compensate for the lack of local variety. A correlated strategy is to help firms build links to relevant external knowledge organisations. Boschma and Frenken (2010) maintain that the extra-regional knowledge most effectively supports regional industrial growth if it is related and close to existing regional knowledge bases, but not quite similar to these. These strategies include strengthening regional innovation systems both through making use of external investments and networks, but also by supporting local collaboration. Regarding the last point, strengthening of local labour markets, by adapted study programs and courses at universities, is highly relevant. A specialised local labour market with unique knowledge is one of the few genuine local assets to embed firms in regional clusters.

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Appendix 1

Figure V.1 *Regional avarages in the numbers of "organisations and players" in innovation, R&D and knowledge intensive industries (Datasource:Statistics Norway)*

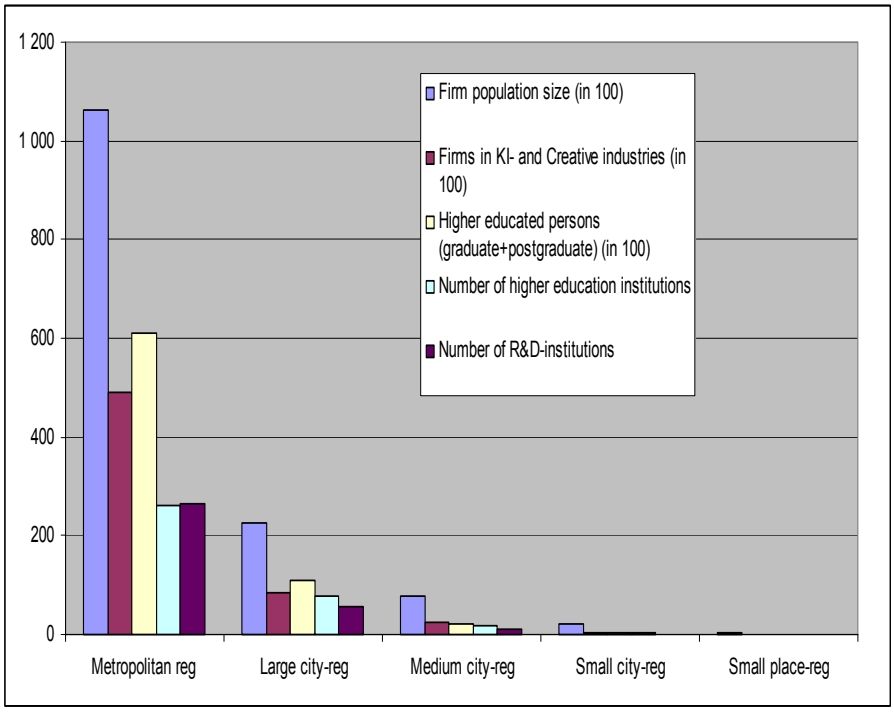

Table V.2 *Employment (in numbers) in industries and sectors in different region types 31.12. 2008 (Datasource:Statistics Norway).*

		Metropol reg	Large city-reg	Medium city-reg	Small city-reg	Small place reg	Country
1	*All sectors*	683 466	480 999	627 610	482 993	164 224	2 439 292
2	*Primary industries*	5 309	10 367	16 169	24 294	15 845	71 984
	Agriculture, Forestry	5 225	9 536	14 418	20 594	11 130	60 904
	Fisheries	22	326	1 351	2 230	2 781	6 710
	Aqua-culture	61	505	400	1 470	1 934	4 370
3	*Low R&D-intensive manufacturing*	24 672	19 557	34 180	26 453	12 374	117 236
7	Food, pulp/paper, etc.	10 661	12 818	23 147	19 533	8 831	74 992
8	Publishing, printing, tanning, furniture	14 010	6 738	11 033	6 920	3 543	42 244
4	*Medium R&D-intensive manufacturing*	14 838	48 075	52 334	36 751	10 517	162 515
	Oil, Gas	1 763	18 278	2 349	2 006	937	25 334
	Maritime	2 236	11 993	8 532	9 388	1 643	33 791
	Plastic, metallic, mineral product etc.	4 582	9 061	20 219	15 237	4 796	53 896
	Automotive, machines, chemicals etc.	6 256	8 743	21 234	10 120	3 142	49 494
5	*R&D-intensive manufacturing*	6 179	4 041	4 663	4 304	170	19 357
	ICT	3 156	2 416	3 589	2 352	156	11 669
	Pharmacy, instruments, aircraft/space	3 023	1 625	1 073	1 952	14	7 688
6	*Knowledge intensive services*	99 411	48 429	45 170	25 676	5 671	224 357
	Telecom and ICT-consulting	31 659	10 516	7 934	4 318	602	55 029
	Consulting Others	67 752	37 913	37 236	21 357	5 070	169 328
7	*Creative services*	16 662	5 426	5 542	2 723	762	31 115
	Architectural, design, advertising etc.	7 678	2 546	2 793	1 193	230	14 440
	Cultural activities	8 984	2 880	2 748	1 530	533	16 676
8	*Finance & estate*	33 845	17 868	17 486	11 285	3 227	83 710
	Finance and Insurance	21 974	10 828	9 281	5 599	1 651	49 334
	Estate Agents	11 871	7 040	8 204	5 686	1 576	34 376
9	*R&D*	5 932	4 676	1 201	715	274	12 798
10	*Universities/colleges*	20 132	19 566	16 629	14 037	3 608	73 973
11	*Lesser knowlede intensive privat servic*	267 471	165 714	229 825	168 157	52 239	883 408
	Hotels and Restaurants	26 135	17 466	19 433	15 849	5 344	84 226
	Wholesale and retailing	116 404	64 874	96 333	62 946	16 860	357 417
	Construction, energy/water supply	44 411	36 718	55 205	43 017	15 806	195 157
	Transport services	50 524	29 072	36 826	29 732	8 985	155 139
	Other private services	29 998	17 584	22 028	16 614	5 244	91 469
12	*Public dominated services*	189 015	137 281	204 410	168 598	59 535	758 839
	Public Administration	39 138	20 096	31 858	27 220	10 776	129 088
	Health care& social work	115 963	91 115	137 998	108 259	35 969	489 303
	Other Education	24 838	22 769	32 765	28 518	11 440	120 331
	Defence	9 076	3 300	1 789	4 601	1 350	20 117

Table V.3 *Development in industries and sectors in different region type s (procent changes in employment) 1998-2008. (Datasource:Statistics Norway)*

		Metropol reg	Large city-reg	Medium city-reg	Small city-reg	Small place reg	Country
1	*All sectors*	*25,1*	*35,4*	*22,9*	*19,8*	*9,6*	*24,1*
2	*Primary industries*	*-10,5*	*-21,1*	*-21,6*	*-24,2*	*-27,8*	*-23,2*
	Agriculture, Forestry	-10,3	-20,5	-18,8	-22,8	-29,1	-21,9
	Fisheries	-66,9	-37,1	-43,1	-41,8	-39,7	-41,1
	Aqua-culture	60,9	-20,5	-17,4	-4,3	17,7	0,8
3	*Low R&D-intensive manufacturing*	*-6,5*	*1,3*	*-14,4*	*-16,0*	*-20,1*	*-11,6*
7	Food, pulp/paper, etc.	-4,8	3,9	-12,1	-14,1	-19,3	-10,2
8	Publishing, printing, tanning, furniture	-7,8	-3,4	-18,9	-21,0	-22,2	-13,9
4	*Medium R&D-intensive manufacturing*	*1,8*	*26,1*	*-1,9*	*-1,8*	*-7,3*	*5,0*
	Oil, Gas	120,5	65,2	33,2	14,1	2,5	55,4
	Maritime	354,6	24,2	6,8	-15,4	-8,8	8,9
	Plastic, metallic, mineral product etc.	-10,8	4,6	-3,8	-1,0	-5,9	-2,5
	Automotive, machines, chemicals etc.	-23,2	0,2	-5,9	10,2	-11,2	-5,1
5	*R&D-intensive manufacturing*	*-15,7*	*24,8*	*-14,1*	*41,7*	*2,8*	*0,8*
	ICT	-21,0	17,0	-18,9	58,4	22,5	-3,5
	Pharmacy, instruments, aircraft/space	-9,5	38,4	7,4	25,7	-62,9	8,2
6	*Knowledge intensive services*	*54,6*	*82,6*	*70,3*	*57,2*	*44,7*	*63,1*
	Telecom and ICT-consulting	112,7	148,1	129,1	53,3	185,2	114,9
	Consulting Others	37,1	70,2	61,5	57,9	36,8	51,2
7	*Creative services*	*46,1*	*76,3*	*40,9*	*31,7*	*37,5*	*47,9*
	Architectural, design, advertising etc.	29,6	72,3	22,3	31,8	22,5	34,0
	Cultural activities	64,1	80,0	66,7	31,7	45,1	62,6
8	*Finance & estate*	*45,2*	*83,5*	*40,3*	*33,4*	*10,6*	*47,2*
	Finance and Insurance	28,1	58,5	1,8	-5,4	-14,3	20,5
	Estate Agents	92,9	142,4	145,3	124,0	58,9	115,8
9	*R&D*	*41,7*	*10,4*	*2,4*	*5,9*	*104,2*	*23,0*
10	*Universities/colleges*	*25,2*	*17,5*	*19,3*	*14,9*	*0,8*	*18,4*
11	*Lesser knowlede intensive privat servic*	*15,1*	*21,2*	*17,0*	*16,0*	*8,3*	*16,4*
	Hotels and Restaurants	27,2	18,6	14,6	-5,6	-13,7	12,0
	Wholesale and retailing	8,9	15,3	12,1	11,2	6,0	11,1
	Construction, energy/water supply	31,8	40,3	33,9	31,3	23,9	33,1
	Transport services	10,8	9,8	4,4	14,7	-0,8	9,0
	O.Other private services (23+26)	16,7	34,8	29,9	29,0	21,2	25,5
12	*Public dominated services*	*34,7*	*62,6*	*49,4*	*47,4*	*43,1*	*46,6*
	Public Administration	10,0	15,3	18,9	8,6	-3,4	11,3
	Health care& social work	39,0	69,8	62,0	54,9	55,5	55,2
	Other Education	36,2	76,5	58,3	71,9	59,4	59,2
	Defence	202,5	584,3	-56,7	60,8	788,1	89,3

Table V.4 *Development in industries and sectors in different region type s (absolute changes in employment) 1998-2008. (Datasource:Statistics Norway)*

			Metropol reg	Large city-reg	Medium city-reg	Small city-reg	Small place reg	Country
1	*All sectors*		*137268*	*125820*	*117079*	*79852*	*14321*	*474340*
2	*Primary industries*		*-625*	*-2780*	*-4451*	*-7754*	*-6101*	*-21710*
		Agriculture, Forestry	-603	-2457	-3344	-6087	-4564	-17055
		Fisheries	-45	-192	-1023	-1601	-1828	-4689
		Aqua-culture	23	-131	-84	-65	291	34
3	*Low R&D-intensive manufacturing*		*-1726*	*245*	*-5741*	*-5046*	*-3118*	*-15386*
	7	Food, pulp/paper, etc.	-534	481	-3177	-3203	-2107	-8539
	8	Publishing, printing, tanning, furniture	-1192	-236	-2564	-1844	-1011	-6847
4	*Medium R&D-intensive manufacturing*		*259*	*9961*	*-998*	*-681*	*-830*	*7709*
		Oil, Gas	964	7211	586	247	23	9031
		Maritime	1744	2336	543	-1714	-159	2751
		Plastic, metallic, mineral product etc.	-556	395	-799	-150	-299	-1408
		Automotive, machines, chemicals etc	-1893	19	-1329	935	-396	-2664
5	*R&D-intensive manufacturing*		*-1155*	*802*	*-765*	*1266*	*5*	*153*
		ICT	-837	352	-839	867	29	-429
		Pharmacy, instruments, aircraft/spac	-317	451	74	399	-24	582
6	*Knowledge intensive services*		*35114*	*21912*	*18651*	*9338*	*1753*	*86769*
		Telecom and ICT-consulting	16776	6277	4471	1502	391	29417
		Consulting Others	18339	15635	14181	7836	1362	57352
7	*Creative services*		*5261*	*2347*	*1609*	*656*	*208*	*10081*
		Architectural, design, advertising etc.	1753	1068	510	288	42	3661
		Cultural activities	3508	1279	1099	368	166	6421
8	*Finance & estate*		*10536*	*8132*	*5022*	*2827*	*309*	*26826*
		Finance and Insurance	4818	3996	163	-321	-274	8382
		Estate Agents	5718	4136	4859	3148	584	18444
9	*R&D*		*1747*	*442*	*28*	*40*	*140*	*2396*
10	*Universities/colleges*		*4050*	*2908*	*2696*	*1825*	*29*	*11508*
11	*Lesser knowlede intensive privat service*		*35068*	*29018*	*33445*	*23199*	*4000*	*124729*
		Hotels and Restaurants	5592	2734	2468	-940	-849	9005
		Wholesale and retailing	9550	8604	10386	6329	955	35823
		Construction, energy/water supply	10710	10542	13968	10265	3045	48530
		Transport services	4918	2595	1553	3815	-68	12813
		O.Other private services (23+26)	4300	4542	5070	3730	917	18558
12	*Public dominated services*		*48737*	*52832*	*67583*	*54184*	*17926*	*241263*
		Public Administration	3551	2674	5056	2162	-378	13065
		Health care& social work	32515	37470	52796	38351	12841	173972
		Other Education	6596	9871	12072	11931	4264	44734
		Defence	6076	2818	-2340	1740	1198	9492

Table V.5 *The regional shares of the total national growth (1998-2008) in employment in different industries and sector (Datasource:Statistics Norway).*

			Metropol reg	Large city-reg	Medium city-reg	Small city-reg	Small place reg	Country
1	*All sectors*		28,9	26,5	24,7	16,8	3,0	100,0
2	*Primary industries*		-0,1	-0,6	-0,9	-1,6	-1,3	-4,6
		Agriculture, Forestry	-0,1	-0,5	-0,7	-1,3	-1,0	-3,6
		Fisheries	0,0	0,0	-0,2	-0,3	-0,4	-1,0
		Aqua-culture	0,0	0,0	0,0	0,0	0,1	0,0
3	*Low R&D-intensive manufacturing*		-0,4	0,1	-1,2	-1,1	-0,7	-3,2
	7	Food, pulp/paper, etc.	-0,1	0,1	-0,7	-0,7	-0,4	-1,8
	8	Publishing, printing, tanning, fu	-0,3	0,0	-0,5	-0,4	-0,2	-1,4
4	*Medium R&D-intensive manufacturing*		0,1	2,1	-0,2	-0,1	-0,2	1,6
		Oil, Gas	0,2	1,5	0,1	0,1	0,0	1,9
		Maritime	0,4	0,5	0,1	-0,4	0,0	0,6
		Plastic, metallic, mineral produ	-0,1	0,1	-0,2	0,0	-0,1	-0,3
		Automotive, machines, chemical	-0,4	0,0	-0,3	0,2	-0,1	-0,6
5	*R&D-intensive manufacturing*		-0,2	0,2	-0,2	0,3	0,0	0,0
		ICT	-0,2	0,1	-0,2	0,2	0,0	-0,1
		Pharmacy, instruments, aircraft	-0,1	0,1	0,0	0,1	0,0	0,1
6	*Knowledge intensive services*		7,4	4,6	3,9	2,0	0,4	18,3
		Telecom and ICT-consulting	3,5	1,3	0,9	0,3	0,1	6,2
		Consulting Others	3,9	3,3	3,0	1,7	0,3	12,1
7	*Creative services*		1,1	0,5	0,3	0,1	0,0	2,1
		Architectural, design, advertisin	0,4	0,2	0,1	0,1	0,0	0,8
		Cultural activities	0,7	0,3	0,2	0,1	0,0	1,4
8	*Finance & estate*		2,2	1,7	1,1	0,6	0,1	5,7
		Finance and Insurance	1,0	0,8	0,0	-0,1	-0,1	1,8
		Estate Agents	1,2	0,9	1,0	0,7	0,1	3,9
9	*R&D*		0,4	0,1	0,0	0,0	0,0	0,5
10	*Universities/colleges*		0,9	0,6	0,6	0,4	0,0	2,4
11	*Lesser knowlede intensive privat service*		7,4	6,1	7,1	4,9	0,8	26,3
		Hotels and Restaurants	1,2	0,6	0,5	-0,2	-0,2	1,9
		Wholesale and retailing	2,0	1,8	2,2	1,3	0,2	7,6
		Construction, energy/water sup	2,3	2,2	2,9	2,2	0,6	10,2
		Transport services	1,0	0,5	0,3	0,8	0,0	2,7
		O.Other private services (23+26	0,9	1,0	1,1	0,8	0,2	3,9
12	*Public dominated services*		10,3	11,1	14,2	11,4	3,8	50,9
		Public Administration	0,7	0,6	1,1	0,5	-0,1	2,8
		Health care& social work	6,9	7,9	11,1	8,1	2,7	36,7
		Other Education	1,4	2,1	2,5	2,5	0,9	9,4
		Defence	1,3	0,6	-0,5	0,4	0,3	2,0

Table V.6 *R&D and innovation intensities in different industries (N=26595 firms). (Datasource: Statistics Norway Innovation survey 2006)*

			R&D-intensity:	Innovation intensity:							
				Firms (%) with :						Employment (%) in firms with :	
			Tot. R&D-expend. per employed (thousand	All types of innovations	1.Market innovation	2.Product innovation	3.Process innovation	4.Organizational innovation	5.Radical innovations (patent)	All types of innovation	Product- and/or process
0	All sectors		*3 056*	*38*	25	*20*	*16*	13	*5*	*52*	*40*
1	Primary (only aquaculture)		*12 916*	*48*	21	*21*	*37*	17	*2*	*59*	*47*
2	Low-tech manufacturing		*1 249*	*44*	33	*20*	*18*	10	*5*	*60*	*44*
		Food, wood processing	1 505	45	31	25	22	13	6	64	51
		Publishing, printing, reproduction	817	43	35	15	14	6	5	52	34
3	Medium-high-tech manufacturing		*4 837*	*42*	24	*25*	*19*	13	*11*	*55*	*46*
		Oil/gas	9 515	40	23	18	15	13	15	32	18
		Maritime industries	2 188	40	19	23	17	14	10	67	53
		Metall products, plastic products etc.	1 908	37	21	21	18	11	6	49	42
		Machines etc.	7 480	51	30	36	23	16	18	67	59
4	High-tech manufacturing		*16 747*	*63*	43	*47*	*31*	25	*24*	*78*	*73*
		ICT-products	17 520	78	53	57	39	36	29	87	80
		Pharmaceutical products, advanced i	15 606	44	31	34	20	12	17	66	62
5	Knowl.intensive services		*8 096*	*57*	40	*41*	*27*	16	*7*	*68*	*59*
		ICT-services	9 355	65	48	48	31	17	5	72	61
		Consulting others	5 942	44	27	31	20	15	9	62	55
6	Creative services		*649*	*26*	18	*9*	*13*	3	*0*	*25*	*16*
7	Finance and Insurance		*3 775*	*42*	31	*23*	*18*	24	*1*	*65*	*53*
8	R&D		*34 541*	*68*	53	*55*	*45*	25	*45*	*58*	*49*
9	Less knowl.int.private services		*506*	*28*	16	*11*	*11*	11	*3*	*39*	*25*
		Retailing	1 153	42	27	21	14	14	8	45	32
		Construction, Energy Supply, Transpo	280	22	12	7	9	10	2	37	23

Table V.7 *R&D and innovation intensities in different region and industries (N=26595 firms). (Datasource: Statistics Norway Innovation survey 2006) .*

		R&D-intensity:	Innovation intensity:								The survey sample (numb. of firms)
			Firms (%) with :						Employment (%) in firms with :		
		Tot. R&D-expend. per employed	All types of inno-vations (1-5)	1.Market inno-vation	2.Produc t inno-vation	3.Process inno-vation	4.Organi-zational inno-vation	5.Radical inno-vation (patent)	All types of inno-vation (1-5)	Product- and/or process	
	Metropolitan region (Oslo)										
1	*All sectors*	*4 385*	*40*	*29*	*21*	*16*	*13*	*7*	*56*	*44*	6 497
2	Primary (aquaculture)	0	0	0	0	0	0	0	0	0	0
3	Low-tech manufacturin	1 793	40	34	15	16	6	6	63	44	1045
4	Medium-high-tech man	6 874	45	28	27	19	13	13	57	48	564
5	High-tech manufacturin	25 479	68	47	48	34	36	25	77	68	116
6	Knowl.intensive service	9 250	57	40	42	26	14	7	70	61	1070
7	Creative services	1 319	40	25	13	22	8	1	40	24	89
8	Finance and Insurance	7 140	44	32	22	18	22	3	72	60	474
9	R&D	58 865	59	41	47	29	12	35	72	69	16
10	Less knowl.int private s	899	32	22	14	10	12	5	44	33	3121
	Large city regions others (Stavanger, Bergen, Trondheim)										
1	*All sectors*	*3 616*	*37*	*23*	*21*	*16*	*13*	*7*	*50*	*37*	4901
2	Primary (aquaculture)	42 626	71	33	38	58	33	17	76	71	23
3	Low-tech manufacturin	1 470	38	32	17	11	9	5	61	46	786
4	Medium-high-tech man	6 388	41	22	27	17	13	17	46	34	901
5	High-tech manufacturin	13 033	46	37	41	25	14	25	56	54	76
6	Knowl.intensive service	8 087	56	36	40	27	19	7	69	59	608
7	Creative services	129	20	14	10	6	0	0	14	12	66
8	Finance and Insurance	1 295	43	34	24	23	20	1	63	56	305
9	R&D	41 421	62	46	38	46	15	54	45	40	12
10	Less knowl.int private s	243	28	14	13	12	13	4	40	25	2124
	Medium-sized city regions										
1	*All sectors*	*2 056*	*38*	*25*	*20*	*18*	*13*	*5*	*51*	*39*	7466
2	Primary (aquaculture)	3 327	73	22	26	39	20	0	82	71	19
3	Low-tech manufacturin	1 046	46	34	24	22	11	6	59	44	1483
4	Medium-high-tech man	3 729	41	21	24	20	13	10	60	52	1388
5	High-tech manufacturin	12 848	65	49	45	32	20	21	91	86	105
6	Knowl.intensive service	5 730	58	43	43	30	15	5	60	54	644
7	Creative services	0	15	10	2	11	2	0	10	9	50
8	Finance and Insurance	528	48	38	31	23	30	0	65	52	356
9	R&D	12 413	77	71	71	59	47	59	50	40	16
10	Less knowl.int private s	379	28	17	9	12	11	3	37	22	3404
	Small city regions										
1	*All sectors*	*2 240*	*36*	*22*	*18*	*15*	*13*	*4*	*51*	*39*	5486
2	Primary (aquaculture)	13 877	39	26	21	24	10	0	45	24	87
3	Low-tech manufacturin	842	47	33	21	18	13	5	58	45	1151
4	Medium-high-tech man	4 404	40	25	24	19	12	7	62	53	936
5	High-tech manufacturin	11 385	59	41	41	31	32	32	85	80	43
6	Knowl.intensive service	5 683	58	42	40	24	17	7	67	56	426
7	Creative services	482	20	20	8	8	0	0	16	7	40
8	Finance and Insurance	147	32	22	18	10	23	0	41	27	278
9	R&D	43 366	80	60	80	60	0	20	82	82	5
10	Less knowl.int private s	286	26	13	10	11	11	2	35	21	2518
	Small place regions										
1	*All sectors*	*1 272*	*34*	*19*	*15*	*17*	*10*	*2*	*41*	*31*	2247
2	Primary (aquaculture)	5 506	45	14	16	42	20	0	58	51	108
3	Low-tech manufacturin	1 316	47	31	24	24	8	4	54	43	691
4	Medium-high-tech man	2 008	45	26	27	22	13	7	50	41	323
5	High-tech manufacturin	7 333	94	12	88	18	18	6	97	97	16
6	Knowl.intensive service	5 727	58	43	47	32	12	2	54	49	39
7	Creative services	0	0	0	0	0	0	0	0	0	2
8	Finance and Insurance	0	39	19	20	12	28	0	44	20	109
9	R&D	3 283	100	0	0	0	100	0	100	0	1
10	Less knowl.int private s	62	17	9	3	7	7	0	20	11	957

Table V.8 *The important innovation partners in different industries and regions (N=5 012 firms with innovation partners). (Datasource: Statistics Norway Innovation survey 2006).*

		Share (%) of firms with cooperation	Important innovation cooperation partners (% partner cooperations of all types) :								Important innovation cooperation areas (% cooperation areas of all types) :						
			Suppliers	Clients/customers Internal of company	Consulents Universities and collages	R&D-institutes Private labs. and R&D	Competitors	Total	Locale/regional	Rest of country	Norden others	EU/EFTA (excl.Nord	USA	Globaly others	Total
	Metropolitan region (Oslo)														
0	*All sectors*	17	19	17	15	12	12	10	8	7	100	32	26	17	15	7	4	100
1	Primary (aquaculture)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	Low-tech manufacturing	15	20	13	11	11	10	11	12	11	100	39	28	18	8	1	6	100
3	Medium-high-tech manufactur	27	20	13	15	11	13	13	9	5	100	29	29	17	19	7	0	100
4	High-tech manufacturing	49	16	20	10	10	17	12	10	5	100	18	29	15	25	8	5	100
5	Knowl.intensive services	27	20	22	13	13	9	9	6	7	100	32	25	15	15	9	4	100
6	Creative services	7	11	11	11	11	0	43	11	0	100	31	69	0	0	0	0	100
7	Finance and Insurance	65	14	18	26	19	9	4	1	10	100	30	23	37	10	0	0	100
8	R&D	17	9	16	11	4	25	14	14	7	100	29	20	20	27	4	2	100
9	Less knowl.int.private services	11	20	16	19	11	12	8	8	6	100	34	22	14	13	11	5	100
	Large city regions others (Stav, Berg, Trond)																	
0	*All sectors*	18	19	19	12	11	12	10	9	8	100	30	33	12	15	7	3	100
1	Primary (aquaculture)	75	17	19	10	8	11	13	12	12	100	53	38	2	4	3	0	100
2	Low-tech manufacturing	13	19	19	12	8	10	12	8	12	100	25	37	18	14	5	1	100
3	Medium-high-tech manufactur	24	21	19	12	11	13	9	9	7	100	26	25	13	22	9	4	100
4	High-tech manufacturing	32	17	22	15	10	11	6	13	4	100	16	35	14	25	10	0	100
5	Knowl.intensive services	29	18	24	10	10	13	10	8	6	100	31	31	10	15	10	3	100
6	Creative services	6	0	33	0	33	0	0	0	33	100	67	0	33	0	0	0	100
7	Finance and Insurance	77	19	17	15	24	14	3	0	9	100	30	40	24	7	0	0	100
8	R&D	23	18	18	6	12	21	12	12	3	100	59	9	6	21	6	0	100
9	Less knowl.int.private services	12	20	15	12	14	10	11	12	7	100	38	41	7	6	4	3	100
	Medium-sized city regions																	
0	*All sectors*	19	20	18	12	12	11	10	9	8	100	32	35	15	12	4	2	100
1	Primary (aquaculture)	32	14	13	10	9	19	13	13	10	100	38	61	2	0	0	0	100
2	Low-tech manufacturing	20	19	14	11	12	11	13	10	10	100	27	41	17	10	4	2	100
3	Medium-high-tech manufactur	26	19	18	11	10	12	11	9	10	100	27	29	17	20	7	0	100
4	High-tech manufacturing	49	17	25	11	10	11	9	10	8	100	31	29	12	20	9	0	100
5	Knowl.intensive services	36	19	28	12	12	10	7	6	7	100	41	33	8	9	5	3	100
6	Creative services	7	43	16	16	0	8	8	8	0	100	38	41	0	21	0	0	100
7	Finance and Insurance	94	20	17	16	19	10	4	11	2	100	32	39	22	7	0	0	100
8	R&D	30	17	12	18	9	18	13	3	10	100	15	37	19	18	12	0	100
9	Less knowl.int.private services	11	23	16	14	13	10	9	8	7	100	38	34	14	7	1	6	100
	Small city regions																	
0	*All sectors*	21	21	17	13	13	12	10	6	8	100	32	36	14	11	4	2	100
1	Primary (aquaculture)	34	16	16	11	11	10	18	8	12	100	41	43	7	10	0	0	100
2	Low-tech manufacturing	25	24	17	15	11	9	8	7	10	100	26	33	21	16	4	1	100
3	Medium-high-tech manufactur	24	21	17	9	9	14	12	7	10	100	29	33	14	16	8	1	100
4	High-tech manufacturing	39	12	18	13	13	17	14	3	11	100	30	22	12	25	12	0	100
5	Knowl.intensive services	31	19	24	14	11	12	9	4	7	100	25	33	15	11	4	12	100
6	Creative services	16	50	0	0	33	17	0	0	0	100	33	50	0	0	0	17	100
7	Finance and Insurance	100	20	12	19	21	15	8	2	4	100	33	50	14	3	0	0	100
8	R&D	21	16	16	21	5	11	11	5	16	100	32	53	5	11	0	0	100
9	Less knowl.int.private services	16	21	13	15	15	10	11	7	7	100	42	41	12	3	2	0	100
	Small place regions																	
0	*All sectors*	20	19	16	11	14	11	11	10	8	100	40	37	8	8	4	2	100
1	Primary (aquaculture)	38	20	11	5	13	16	9	17	8	100	50	42	1	3	3	1	100
2	Low-tech manufacturing	25	19	20	11	14	9	8	10	9	100	45	36	8	6	3	2	100
3	Medium-high-tech manufactur	28	21	18	9	11	12	12	9	7	100	26	31	17	19	6	1	100
4	High-tech manufacturing	37	20	24	18	6	10	15	6	2	100	13	44	12	23	8	0	100
5	Knowl.intensive services	20	20	17	9	16	16	8	9	5	100	27	35	14	13	8	3	100
6	Creative services	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	Finance and Insurance	50	18	12	18	20	12	12	6	4	100	43	57	0	0	0	0	100
8	R&D	26	13	38	13	0	13	13	13	0	100	0	38	0	13	0	50	100
9	Less knowl.int.private services	11	18	13	13	15	10	13	8	10	100	46	34	6	6	6	2	100

Table V.9 *The changes in the firm populations of different industries and region types 31.12.1999–31.12. 2008. All rates are in % per year of the avarage firm population per year (1999-2008). (Datasource:Statistics Norway).*

		Number of firms 31.12 2008	Net-changes in number of firms per year	Net-growth-rates of firms per year	New firm rates per year	Closed firm rates per year	Brutto-dynamism per year
	Country	**477 399**	**5 830**	**1,3**	**12,1**	**10,8**	**22,8**
1	Primary	72 878	-2 622	-3,1	3,5	6,6	10,1
2	Low-tech manufacturing	12 274	-310	-2,2	9,4	11,6	21,0
3	Medium-high-tech manufacturing	11 168	-89	-0,8	8,9	9,7	18,6
4	High-tech manufacturing	1 008	-10	-1,0	8,4	9,4	17,9
5	Knowl.intensive services	57 428	2 459	5,1	23,3	18,3	41,6
6	Creative services	22 489	1 077	6,6	26,1	19,5	45,5
7	Finance and Insurance	56 403	3 266	8,4	18,6	10,1	28,7
8	R&D	661	26	5,3	14,6	9,3	23,9
9	Less knowl.int.private services	182 794	-71	0,0	10,9	11,0	21,9
10	Public dominated services	60 296	2 104	4,2	11,9	7,6	19,5
	Metropolitan region (Oslo)	**120 617**	**2 673**	**2,5**	**16,3**	**13,8**	**30,1**
1	Primary	5 082	-195	-3,2	3,8	7,0	10,9
2	Low-tech manufacturing	2 918	-73	-2,2	11,8	14,0	25,8
3	Medium-high-tech manufacturing	1 667	-29	-1,7	9,3	11,0	20,3
4	High-tech manufacturing	325	-5	-1,5	9,1	10,6	19,6
5	Knowl.intensive services	22 836	1 000	5,1	24,9	19,8	44,7
6	Creative services	10 689	516	6,7	26,7	20,0	46,7
7	Finance and Insurance	15 308	811	7,5	20,2	12,8	33,0
8	R&D	266	10	5,0	15,5	10,4	25,9
9	Less knowl.int.private services	46 874	33	0,1	12,6	12,5	25,1
10	Public dominated services	14 652	607	5,3	15,6	10,3	25,9
	Large city regions others (Stav, Berg.	**77 031**	**1 849**	**2,7**	**13,9**	**11,2**	**25,1**
1	Primary	8 019	-236	-2,6	3,4	6,0	9,5
2	Low-tech manufacturing	1 809	-29	-1,5	10,4	11,9	22,2
3	Medium-high-tech manufacturing	2 104	1	0,0	10,1	10,0	20,1
4	High-tech manufacturing	201	-2	-0,9	8,6	9,5	18,1
5	Knowl.intensive services	10 467	514	6,0	24,1	18,1	42,2
6	Creative services	4 071	236	8,3	28,3	20,0	48,3
7	Finance and Insurance	10 729	714	10,1	19,9	9,8	29,6
8	R&D	169	7	5,3	14,4	9,1	23,4
9	Less knowl.int.private services	29 585	232	0,8	11,9	11,1	23,1
10	Public dominated services	9 877	412	5,3	13,6	8,3	21,9
	Medium-sized city regions	**122 087**	**1 481**	**1,3**	**11,8**	**10,5**	**22,4**
1	Primary	16 272	-629	-3,2	3,6	6,8	10,4
2	Low-tech manufacturing	3 273	-83	-2,3	8,8	11,1	19,9
3	Medium-high-tech manufacturing	3 661	-38	-1,0	8,4	9,4	17,8
4	High-tech manufacturing	293	-3	-1,0	7,9	8,9	16,9
5	Knowl.intensive services	13 541	557	4,9	22,5	17,6	40,1
6	Creative services	4 496	203	6,1	25,0	18,9	43,9
7	Finance and Insurance	14 953	907	9,0	18,5	9,5	27,9
8	R&D	124	5	6,0	14,5	8,5	23,1
9	Less knowl.int.private services	50 115	34	0,1	10,9	10,9	21,8
10	Public dominated services	15 359	528	4,2	11,8	7,6	19,3
	Small city regions	*109 052*	*183*	*0,2*	*9,1*	*8,9*	*18,0*
1	Primary	27 432	-942	-2,9	3,4	6,3	9,7
2	Low-tech manufacturing	2 740	-75	-2,4	7,9	10,4	18,3
3	Medium-high-tech manufacturing	2 655	-14	-0,5	8,7	9,3	18,0
4	High-tech manufacturing	165	0	0,3	7,0	6,7	13,8
5	Knowl.intensive services	8 185	306	4,3	20,6	16,2	36,8
6	Creative services	2 477	93	5,0	23,3	18,3	41,6
7	Finance and Insurance	11 470	635	8,0	16,6	8,6	25,2
8	R&D	81	3	5,1	12,3	7,2	19,6
9	Less knowl.int.private services	40 052	-232	-0,6	9,4	9,9	19,3
10	Public dominated services	13 796	403	3,4	9,5	6,1	15,6
	Small place regions	**48 611**	**-356**	**-0,7**	**7,4**	**8,1**	**15,4**
1	Primary	16 073	-620	-3,3	3,5	6,8	10,3
2	Low-tech manufacturing	1 534	-50	-2,9	7,2	10,0	17,2
3	Medium-high-tech manufacturing	1 081	-9	-0,8	8,0	8,8	16,8
4	High-tech manufacturing	24	-1	-3,5	13,9	17,4	31,4
5	Knowl.intensive services	2 399	83	4,0	18,8	14,9	33,7
6	Creative services	756	24	4,0	21,6	17,6	39,2
7	Finance and Insurance	3 943	198	7,0	14,8	7,8	22,6
8	R&D	21	1	4,0	14,8	10,8	25,6
9	Less knowl.int.private services	16 168	-138	-0,8	8,5	9,3	17,8
10	Public dominated services	6 612	155	2,6	7,3	4,7	12,0
	***All rates** are in % per year (1999-2008) of the avarage firm population per year (1999-2008)*						

Table V.10 *Hampering factors for innovation in different industries and regions. (Datasource: Statistics Norway Innovation survey 2006)*

		Share (%) of firms with different innovation barrieres									
		1.To high innovation costs	2.Problems with keeping and recruiting qualified persons	3.Lack of internal funding	4.Demand insecurity	5.Lack of external funding	6.Other firms' marked dominance	7.Problems with finding innovation partners	8.Lack of marked information	9.Lack of technological information	Average of firms with barrieres
	The country										
0	*All sectors*	28	24	22	22	18	18	15	13	12	19
1	Primary (aquaculture)	48	29	32	21	46	17	26	21	28	30
2	Low-tech manufacturing	36	25	29	30	23	25	20	19	16	25
3	Medium-high-tech manufacturing	33	32	27	25	22	19	17	16	17	23
4	High-tech manufacturing	48	47	38	35	32	25	23	22	18	32
5	Knowl.intensive services	45	37	38	30	33	24	22	19	11	29
6	Creative services	28	14	26	23	18	16	17	6	7	17
7	Finance and Insurance	22	18	17	19	7	17	6	8	6	13
8	R&D	61	48	44	42	39	25	12	12	10	33
9	Less knowl.int.private services	19	17	14	15	12	14	10	9	9	13
	Metropolitan region (Oslo)										
0	*All sectors*	25	21	22	18	16	15	12	10	9	17
1	Primary (aquaculture)	.	.	.	.	.	.	.	.	.	0
2	Low-tech manufacturing	33	19	29	28	18	21	15	15	13	21
3	Medium-high-tech manufacturing	24	21	22	18	19	11	12	13	13	17
4	High-tech manufacturing	38	48	34	25	26	21	12	11	16	26
5	Knowl.intensive services	41	35	39	25	30	22	18	15	9	26
6	Creative services	32	15	32	24	23	11	20	7	12	19
7	Finance and Insurance	17	17	14	18	5	12	5	7	5	11
8	R&D	63	29	41	29	44	24	0	6	6	27
9	Less knowl.int.private services	16	17	14	12	11	12	10	7	8	12
	Large city regions others (Stavanger, Bergen, Trondheim)										
0	*All sectors*	25	23	19	21	16	17	13	12	10	17
1	Primary (aquaculture)	42	29	29	33	50	21	46	12	17	31
2	Low-tech manufacturing	27	24	17	24	19	23	17	16	14	20
3	Medium-high-tech manufacturing	36	35	29	26	22	20	19	19	18	25
4	High-tech manufacturing	35	40	36	19	29	21	25	14	12	26
5	Knowl.intensive services	42	39	35	36	29	23	23	21	12	29
6	Creative services	18	0	14	14	8	14	10	6	4	10
7	Finance and Insurance	16	15	15	23	9	17	7	11	6	13
8	R&D	46	38	54	31	31	38	15	8	15	31
9	Less knowl.int.private services	16	15	11	13	9	12	6	5	6	10
	Medium-sized city regions										
0	*All sectors*	29	23	22	22	19	18	14	14	13	19
1	Primary (aquaculture)	48	33	48	36	49	21	26	16	21	33
2	Low-tech manufacturing	35	23	27	30	20	25	19	19	16	24
3	Medium-high-tech manufacturing	31	31	25	24	22	16	15	14	16	21
4	High-tech manufacturing	60	46	45	45	26	25	33	33	23	37
5	Knowl.intensive services	52	39	39	33	39	25	28	24	15	33
6	Creative services	18	7	12	25	5	12	12	5	5	11
7	Finance and Insurance	31	25	22	24	8	24	6	10	10	18
8	R&D	69	81	31	75	31	12	12	19	6	37
9	Less knowl.int.private services	21	16	15	15	13	14	9	9	9	14
	Small city regions										
0	*All sectors*	32	26	24	23	21	21	17	14	14	21
1	Primary (aquaculture)	54	28	38	21	54	14	19	25	31	31
2	Low-tech manufacturing	38	26	32	26	25	26	20	21	16	26
3	Medium-high-tech manufacturing	37	36	30	27	21	22	17	16	18	25
4	High-tech manufacturing	57	65	57	54	51	21	35	22	29	43
5	Knowl.intensive services	46	40	35	32	33	27	25	17	13	30
6	Creative services	46	45	50	31	46	31	34	5	5	33
7	Finance and Insurance	23	8	14	11	4	12	3	2	0	9
8	R&D	75	25	50	25	50	50	50	25	25	42
9	Less knowl.int.private services	23	20	16	19	16	18	16	11	13	17
	Small community regions										
0	*All sectors*	32	25	26	27	23	23	18	18	16	23
1	Primary (aquaculture)	46	29	27	17	42	18	25	22	30	28
2	Low-tech manufacturing	45	32	36	42	35	30	27	26	22	33
3	Medium-high-tech manufacturing	41	39	34	31	24	28	24	18	21	29
4	High-tech manufacturing	65	43	10	63	73	69	4	60	18	45
5	Knowl.intensive services	52	34	45	24	50	22	22	19	10	31
6	Creative services	100	100	100	100	0	100	0	0	0	56
7	Finance and Insurance	27	20	18	9	5	20	8	8	8	14
8	R&D	50	50	100	0	100	0	0	0	0	33
9	Less knowl.int.private services	20	16	16	19	14	16	12	12	11	15