

# 3 Regional comparisons of Norwegian R&D and innovation

## Highlights

- R&D activities in Norway are geographically concentrated in the university cities and surrounding areas, as well as around some industrial clusters.

### *Human resources in the counties*

- The counties with the largest cities and the biggest educational institutions also have the highest proportion of employees with higher education.
- The highest concentration of employees with higher education was in Oslo (14.6 per cent), followed by Sør-Trøndelag (9.7 per cent) and Akershus (9.5 per cent).
- In 2009, almost one third of all R&D personnel had employment in Oslo. Of these, nearly half were employed in the higher education sector, a third in the industrial sector, and the rest in the institute sector.
- The highest share of researchers with a PhD are found in Telemark, Sogn og Fjordane, Sør-Trøndelag and Østfold.

### *Expenditure on R&D and innovation by county*

- In 2009, 45 per cent of the R&D activity was concentrated in the capital region.
- More than half of the counties account for only minimal shares of R&D expenditures (below 3 per cent of Norway's total R&D expenditures).
- Sør-Trøndelag had the highest R&D expenditure per employee in 2009, followed by Akershus and Oslo.

- In 2007, the highest R&D expenditures as a proportion of gross regional product were to be found in Sør-Trøndelag (7 per cent), followed by Troms (4 per cent) and Oslo and Akershus (3 per cent).
- From 2007 to 2009, Oslo saw the biggest growth in R&D expenditure of all the counties, followed by Akershus, Sør-Trøndelag, Troms and Telemark. In 8 counties there was a real-terms decline in R&D expenditure (Hordaland, Rogaland, Buskerud, Oppland, Østfold, Nord-Trøndelag and Hedmark).
- Svalbard, Sør-Trøndelag, Møre og Romsdal, Aust-Agder and Oslo had the largest share of enterprises with R&D in 2009.
- In the higher education sector 11 counties accounted for a total of only 5 per cent of the R&D expenditures.
- In terms of the proportion of extramural R&D in the industrial sector in 2009, Rogaland was the leading county at 40 per cent, Nordland and Vest-Agder had the lowest share.
- The percentage of enterprises with innovation activities was highest in Oslo, Akershus, Vestfold and Hordaland.

### *Characteristics of regional innovation*

- The most innovative economic regions are: the capital region, Kongsberg (Buskerud), Ørsta-Volda (Møre og Romsdal) and Alta (Finnmark).
- Some common features of the innovative regions are: specialisation in knowledge intensive industries; relatively high R&D investment in the industrial sector; and, R&D and/or higher education institutions in the surrounding area.

In Norway R&D activities are mainly concentrated around the university cities, their surrounding areas and some industrial clusters. This will be clearly illustrated by the statistics and indicators in this chapter. The chapter includes a section that analyzes variations in regional innovation in the industrial sector based on a study conducted by the Norwegian Institute for Urban and Regional Research (NIBR). Different conditions in each area mean that business-, research- and innovation policy have to be adjusted to the specific challenges and possibilities in each region. This was an important premise and argument for the creation of the Regional Research Funds (see the introduction on the Norwegian innovation system).

In the industrial sector, there are several companies whose headquarters and research centers are based in Oslo or overseas, but who have a large share of their employment in business enterprises located throughout various counties in Norway. This affects the distribution of R&D resources for this sector. The institute sector also has several units with headquarter based in one region, but scientists and R&D activities spread across several parts of the country. In these cases, the activity is distributed by county by using allocation keys for each activity. In the higher education sector, each department and branch is connected to a county number, so that this sector has detailed listings for activity on the county level.

### 3.1 Human resources in R&D by county

In Norway the central regions, the counties where the largest cities and major educational institutions are located, which have the highest proportion of highly educated people. In particular, university counties have a high proportion of employees with higher education. In 2009, Oslo was clearly on top, followed by Sør-Trøndelag, Akershus, Nordland, Hordaland and Rogaland. The rating of these counties was mainly the same in 1999 as in 2009.

An essential element for understanding the distribution of employed persons with higher education is the business structure. The proportion of highly educated employees varies significantly across industries. The Oslo area (or the capital region) is distinguished by having the highest proportion of those with post-graduate education in all industries. This region also contains nearly 13 per cent of employees with higher education. In the capital region, we find the highest proportion of those with higher education in the industries *oil and gas* and *professional, scientific and technical services*.

When you see the industries as a whole, it is mainly western Norway or mid-Norway which takes second and third place in the ranking of regions by highly educated employees. Western Norway also sees a concentration of highly educated workers within the *oil and gas*, as well as the *professional, scientific, technical services*. Central Norway has the

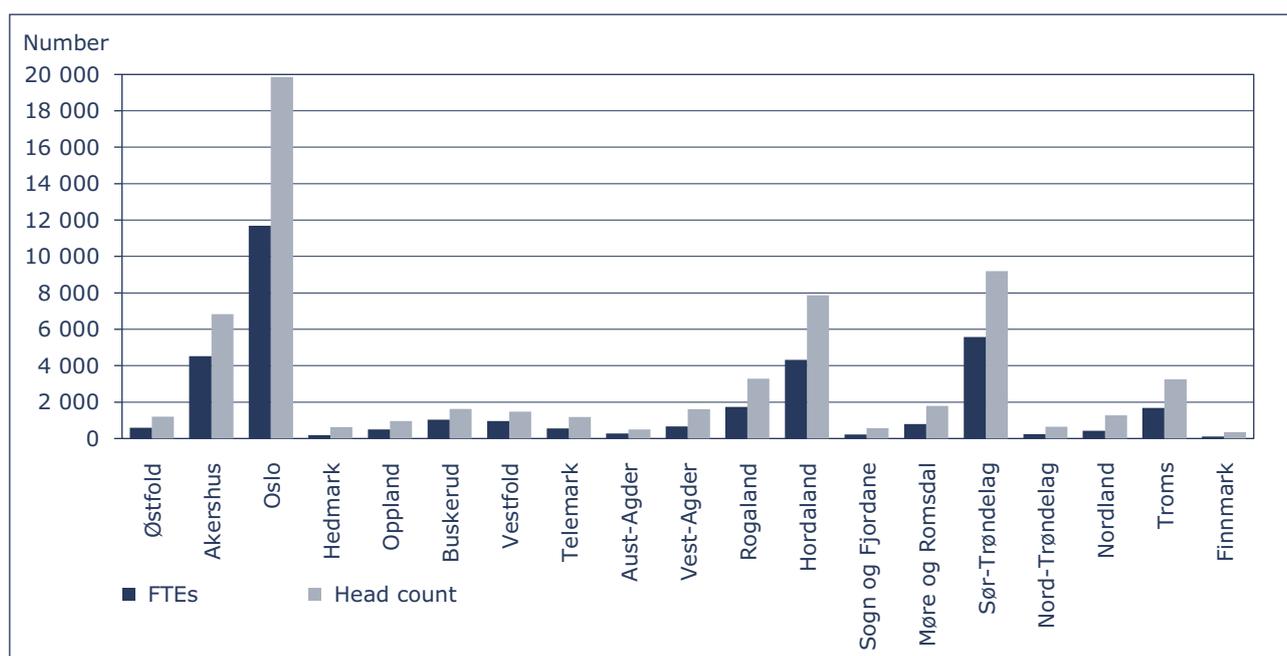
lowest percentages of those with a higher education in more industries than any of the other regions. Agder follows closely behind western and central Norway, but had the second highest proportion of jobs in the *electricity and water supply*, behind the capital region. In northern Norway, it is the *oil and gas* and *professional, scientific and technical services* sectors that have the highest proportions with higher education.

#### 3.1.2 R&D Personnel and R&D FTE

In 2009, a total of 64 000 people worked on R&D activities in Norway. Almost a third of these were employed by an institution or business in Oslo. The second largest county for R&D work was Sør-Trøndelag, with 14 per cent of all R&D personnel, closely followed by Hordaland and Akershus, with 12 and 11 per cent respectively. These are all university counties.

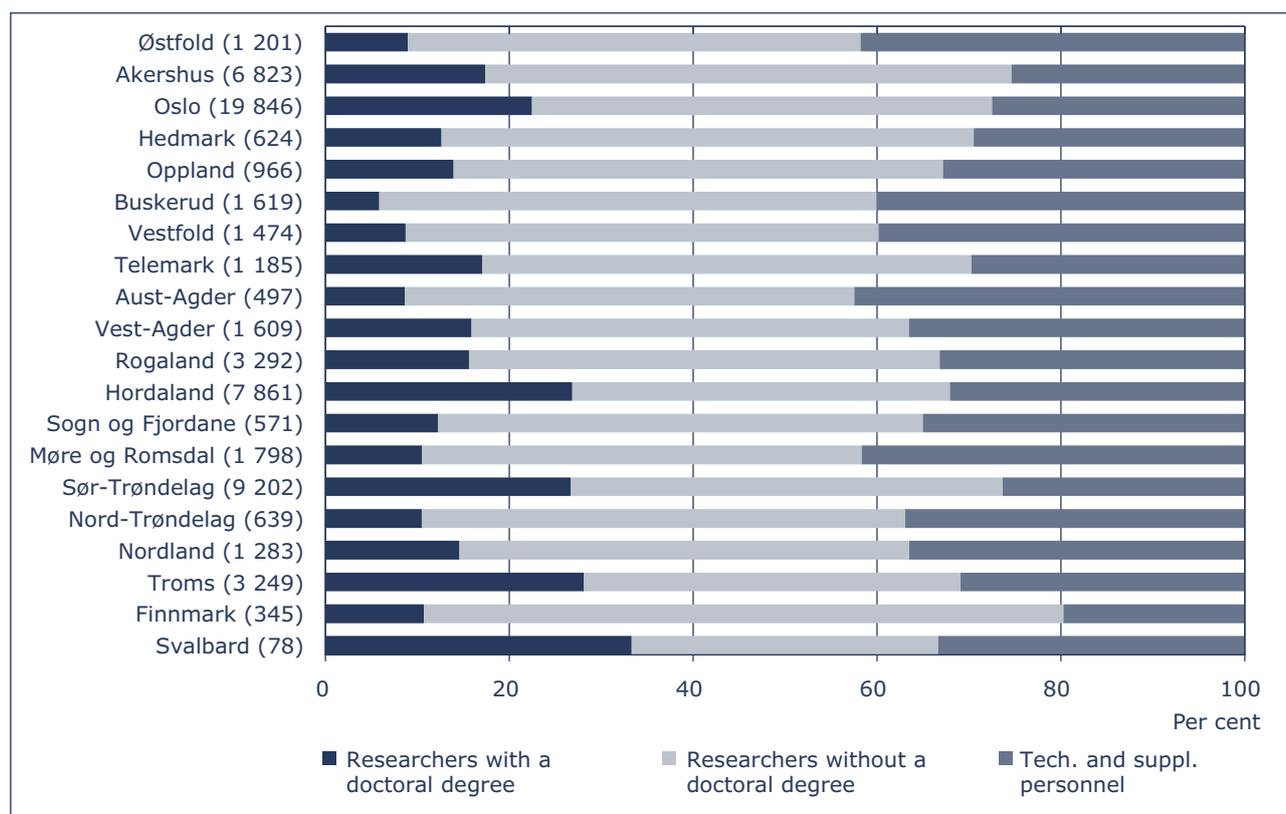
R&D personnel in Norway carried out 36 100 R&D full-time equivalents – FTEs – in 2009. In Figure 3.1 the regional distribution of Norwegian R&D personnel in 2009 is shown, by head count and FTEs. About a third of FTEs were conducted in Oslo, while Sør-Trøndelag, Akershus and Hordaland performed respectively 15, 13 and 12 per cent of total FTEs. Oslo had the highest number of R&D personnel in all research-performing sectors. Almost half of the R&D staff in Oslo were employed at an educational institution or health trust, while about a third were employed in the industrial sector. R&D personnel in the institute

Figure 3.1  
R&D personnel by county, 2009. Head count and full-time equivalents (FTEs).



Source: Statistics Norway/NIFU, Register of Research Personnel

Figure 3.2  
**R&D personnel in Norway by educational level and county, 2009. Percentages with actual number of R&D-personnel in paranthesis.**



Source: Statistics Norway/NIFU, R&D statistics

sector accounted for 19 per cent of total R&D personnel in Oslo, and about a third of all R&D personnel in the institute sector, in 2009. This emphasises the role of Oslo and the capital area, as the hub of Norway's R&D activity.

Counties with universities contained a total of 82 per cent of all R&D personnel in Norway in 2009. Nearly 80 per cent of employees with higher education were employed at an institution or business in the university counties. The higher education sector was also largest (measured in the number of R&D personnel) in the more established university counties of Oslo, Sør-Trøndelag, Hordaland and Nordland. The institute sector was also concentrated locations near the major universities. The institute sector was largest in Oslo, Sør-Trøndelag, Akershus and Hordaland, and 86 per cent of all R&D personnel in the institute sector were employed at departments in these university counties.

Buskerud had the highest concentration of R&D personnel outside the university counties. Among the counties without a university, the industrial sector was largest in Buskerud, Møre og Romsdal and Vestfold. The higher education sector was the largest sector in

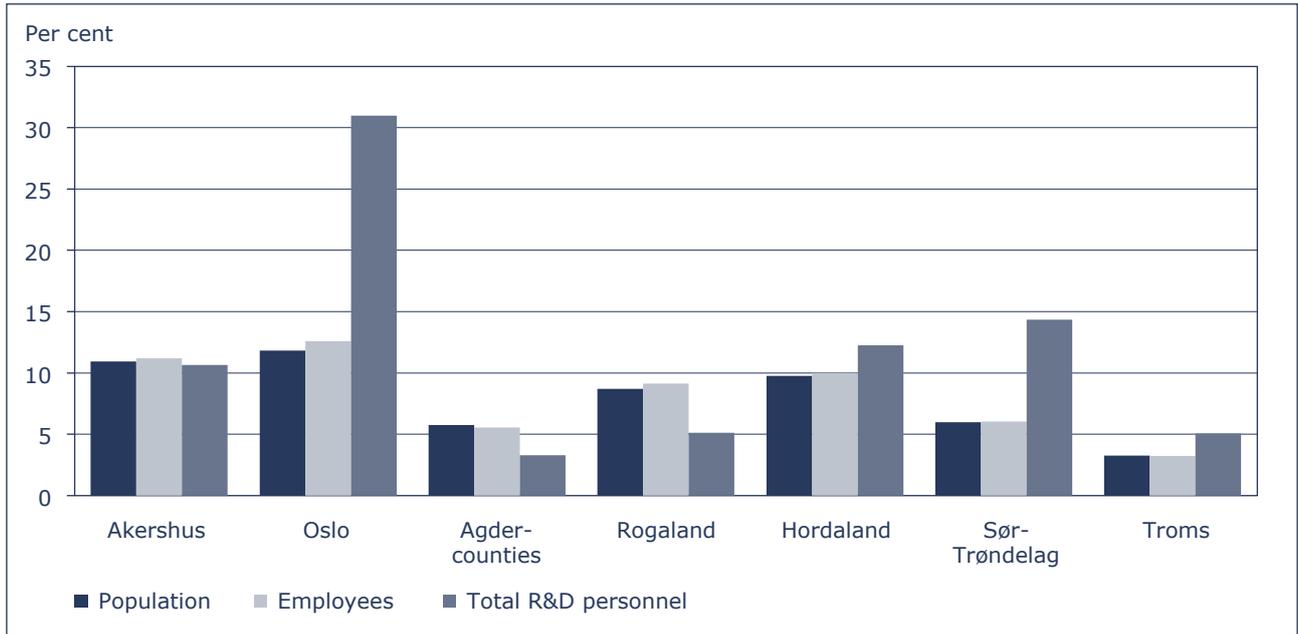
Nordland, Møre og Romsdal and Telemark, and institute sector was highest in Østfold, Møre og Romsdal and Nordland. The country's fifth largest university college in 2009, Bodø University College, received university status in 2010 under the name University of Nordland.

Another indicator related to human resources is the distribution of formal competences (Figure 3.2). The statistics show that counties with a small business sector have the highest proportion of researchers among the R&D personnel.

The overall proportion of R&D personnel with a PhD was almost 30 per cent at universities, colleges and research institutes, while the industrial sector had a share of just under seven per cent.

More than half of the Norwegian population, (56 per cent) were living in one of the eight university counties, and 58 per cent of the workforce were employed within these counties. Furthermore, 82 per cent of all R&D personnel work within one of the university counties. Indeed, Oslo's share of R&D personnel is three times as high as its share of the overall population. The proportion of R&D personnel was also high compared with the overall proportion of em-

Figure 3.3  
**Comparison of the university counties' share of inhabitants, employees and R&D personnel (of national totals), 2009.**

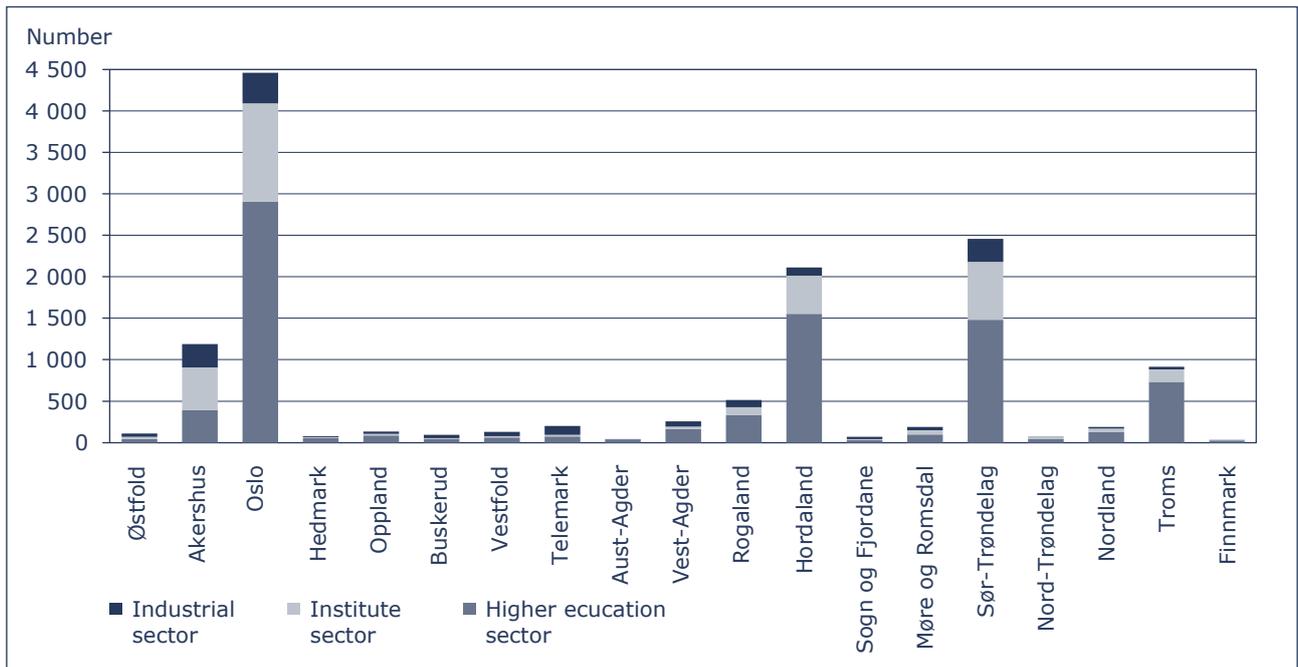


Source: Statistics Norway/NIFU, Register of Research Personnel

employees/citizens in Sør-Trøndelag, as shown in Figure 3.3. Oslo, Akershus, Rogaland and Hordaland County account for a higher proportion of employment than might be expected from their overall share

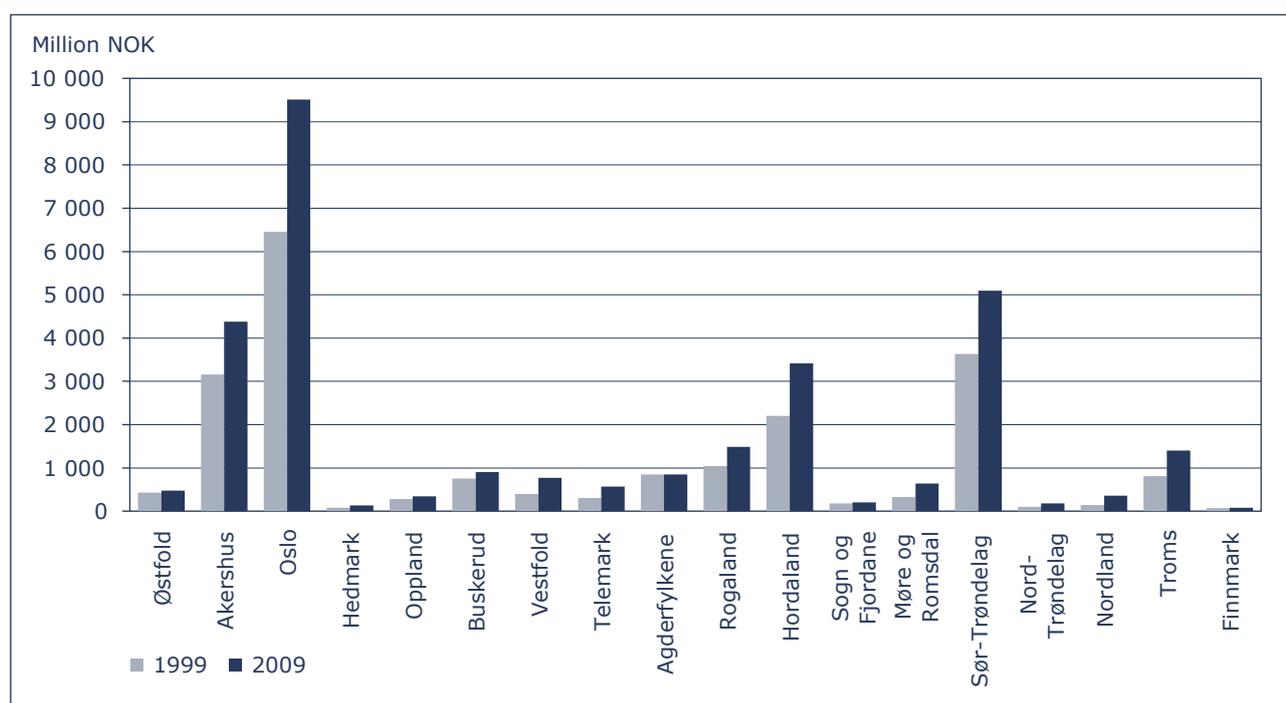
of the population. This may indicate that these areas experience labour migration, but it may also be related to demographic factors, such as a greater proportion of the population being of working age.

Figure 3.4  
**Number of doctoral degrees by county and sector of performance, 2009.**



Source: NIFU, Register of Doctoral Degrees

Figure 3.5  
**Total Norwegian R&D expenditure by county, 1999 and 2009. Million NOK. Fixed 2000-prices.**



Source: Statistics Norway/NIFU, R&D statistics

A total of 13 232 researchers with a PhD participated in R&D activities in Norway in 2009. The industrial sector accounted for 12 per cent all all researchers with a doctoral degree, the higher education sector for 63 per cent, and the institute sector for 25 per cent respectively. Naturally, those counties with large educational institutions and research institutes had the highest shares of researchers with a PhD (Figure 3.4).

Despite the fact that there has been a sharp rise in the number of those with a doctoral degrees in Norway, the proportion employed in the business community has only increased modestly. In Norway, as in the rest of Europe, many of those with a doctoral degree working in enterprises are based in the larger cities. But the proportion of researchers with a PhD in the Norwegian business sector is low when compared to many countries in Europe, at just 10 per cent. Taking 2007, as an example, there were three times as many doctoral degrees among those in the business enterprise sector in the Copenhagen region compared to Norway's Capital Region, even when adjusting for the population size (source: Statistics Denmark and Statistics Norway).

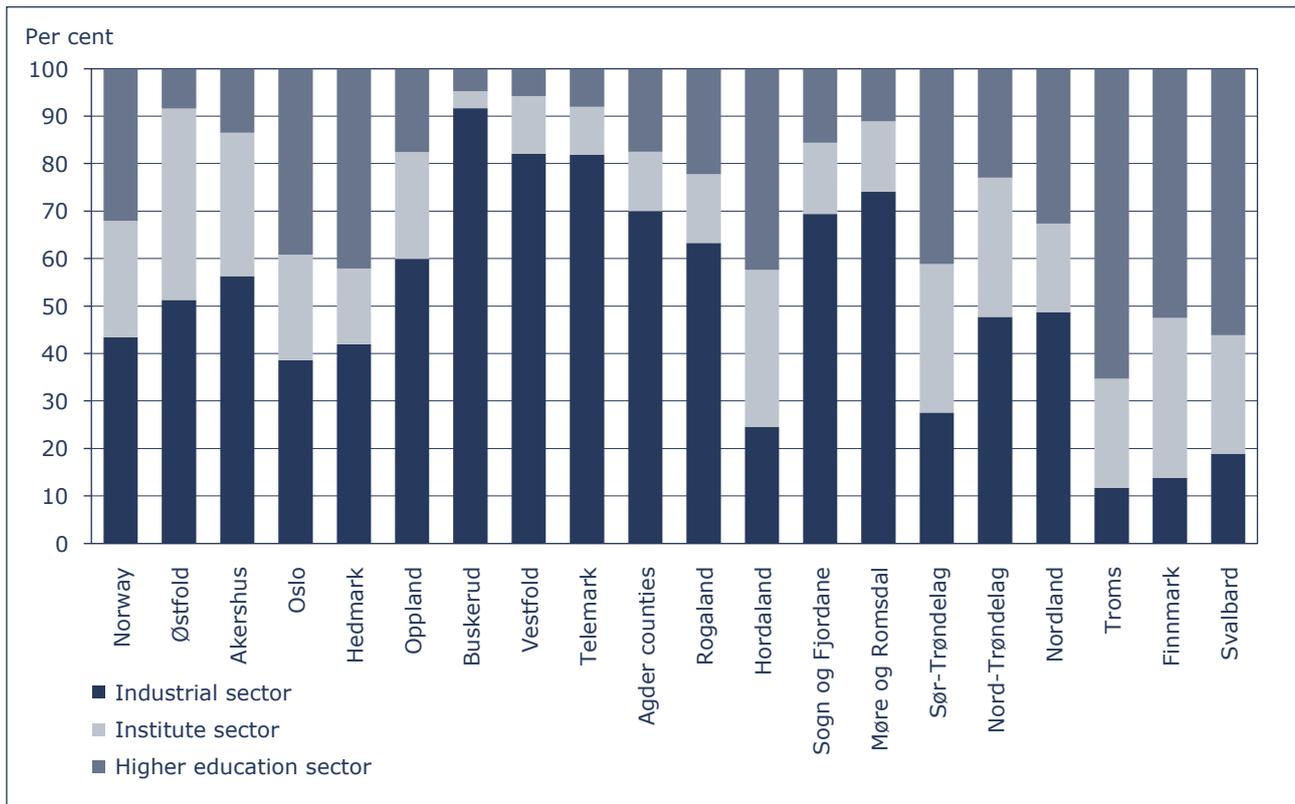
## 3.2 R&D and innovation expenditure by county

As shown earlier in this chapter a characteristic of Norwegian R&D is that it is centred in and around the major university towns. This relates first and foremost to activity in the higher education sector, but also to research institutes, as most of the major research institutes are located in close proximity to a university. R&D activity in the business sector is, however, distributed somewhat differently and related largely to so-called business clusters which are found around the country. It is perhaps in this sector where we find the most interesting findings and changes, and where R&D activities vary most from one year to the next.

### 3.2.1 R&D and innovation expenditures by county

There are large variations between counties in terms of how much R&D is performed, as measured by expenditure. R&D expenditure in Norway is geographically concentrated in the capital region, where 45 per cent of the country's total R&D expenditure was spent in 2009. This corresponds to almost 19 billion NOK of the 42 billion NOK total R&D expenditures for Norway that year. Moreover, 85 per cent of all Norwegian R&D expenditures were spent in counties

Figure 3.6  
**Norwegian R&D expenditure by county and sector of performance, 2009.**



Source: Statistics Norway/NIFU, R&D statistics

that have a university. In the established university counties, spending on research in the higher education sector and the institute sector dominates the industrial sector, with the exception of Akershus, where industry accounts for over half of R&D expenditure. In Troms business R&D accounts for only 12 per cent of all R&D in the county. In counties without established universities the industrial sector is usually the heaviest R&D performer.

Oslo had the highest total R&D expenditures in both 1999 and 2009, followed by Sør-Trøndelag, Akershus and Hordaland (Figure 3.5). The counties with the lowest R&D efforts in 1999 were Finnmark, Hedmark, Nord-Trøndelag and Nordland. In 2009, Finnmark, Hedmark and Nord-Trøndelag were still at the bottom of the scale, while Nordland had the highest annual real growth of all counties during this period.

From 1999 to 2009, Oslo saw real growth in R&D expenditure of 4 per cent per a year on average. This was the same rate as real growth for Norway as a whole, while Sør-Trøndelag and Akershus both had an annual average real growth of just over 3 per cent in this ten year period.

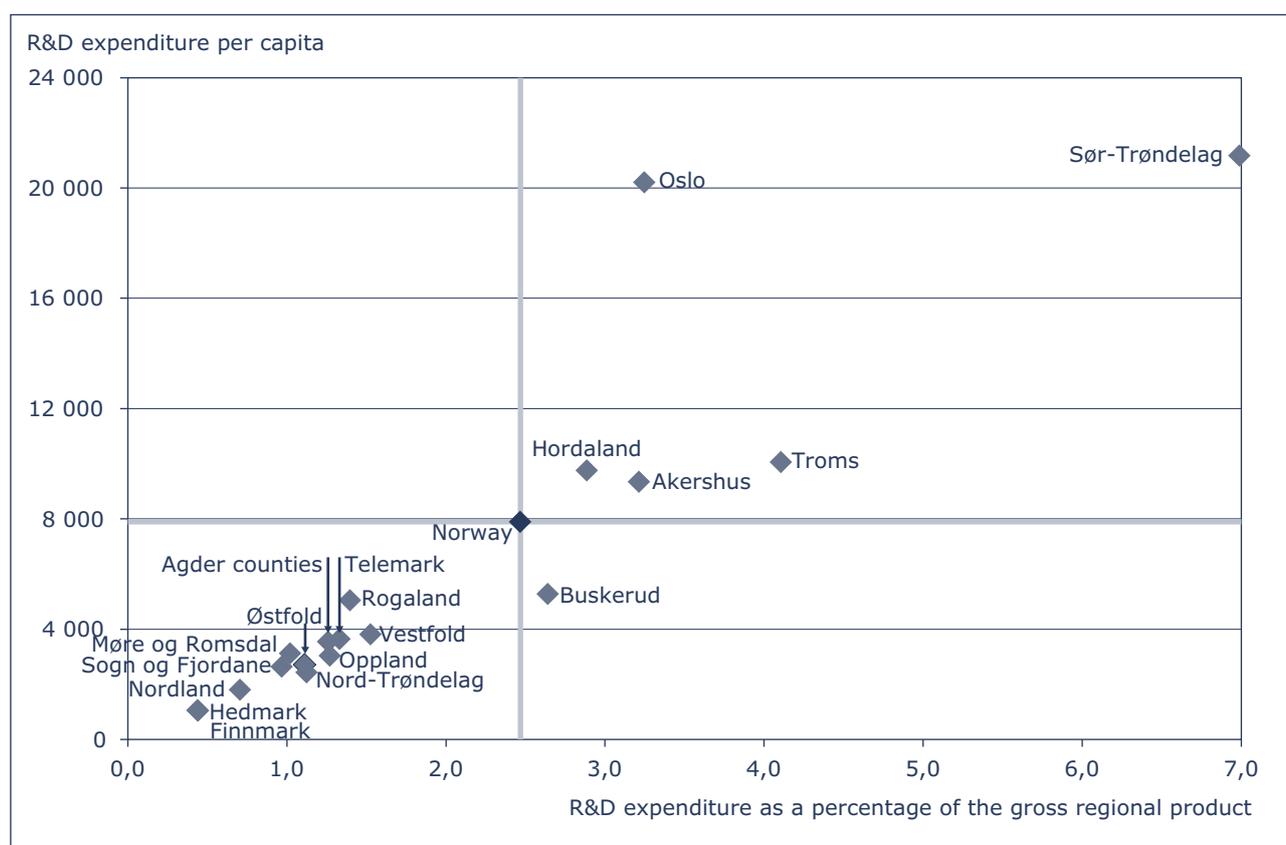
Nationwide, more than 43 per cent of R&D was performed in the industrial sector, representing 18 bil-

lion of Norway’s nearly 42 billion NOK of R&D expenditure in 2009. R&D expenditure in the institute sector accounted for about 25 per cent of the total, while 32 per cent was performed in the higher education sector. There are considerable variations between counties in the distribution of activity across these sectors.

Figure 3.6 shows the research and development activity by sector of performance in each county. In Oslo, the distribution of activity across sectors is quite similar to the national average, which is to be expected as so much R&D activity takes place here. Buskerud county stands out with a very high proportion (92 per cent) of its research activity taking place in the industrial sector. Other counties that had a high proportion of R&D within the industrial sector were Vestfold, Telemark and Møre and Romsdal, but these are all small counties in terms of their absolute R&D spending. In the two northernmost counties, Troms and Finnmark, a low share of R&D is performed in the industrial sector; in these regions it is the higher education sector where the greatest activity takes place, with 65 and 53 per cent respectively.

A key indicator to describe a country’s R&D activities is R&D expenditures relative to GDP, as shown in Chapter 1. In spite of the stress on this indicator be-

Figure 3.7  
**R&D expenditure by gross regional product<sup>1</sup> and R&D expenditure per capita by county, 2007.**



<sup>1</sup> Only mainland Norway (excl. oil and gas exploration on the continental shelf).

Source: Statistics Norway/NIFU, R&D statistics

ing reduced, in the last White paper to the Norwegian Parliament (Stortinget), this remains a very important indicator for Norwegian research policy. Comparisons between countries are also often based on this indicator. Regional comparisons using this kind of indicator are also informative.

Figure 3.7 shows R&D expenditure as a share of gross regional product<sup>1</sup> per county for 2007, (the latest year these data are available) mapped against county R&D expenditure per capita. There are some counties that clearly stand out. Sør-Trøndelag had the highest R&D expenditure per capita and R&D expenditure amounted to as much as 7 per cent of the gross regional product. Oslo spent almost as much as Sør-Trøndelag in terms of R&D per capita and just over 3 per cent of its gross regional product on research and development. Troms uses just over 4 per cent, but has a much lower level per capita on R&D. On average, 2.5 per cent of regional gross product is spent on

R&D in Norway. This must not be confused with R&D as a percentage of national GDP, where *oil and gas exploration* on the continental shelf is included in the calculation.

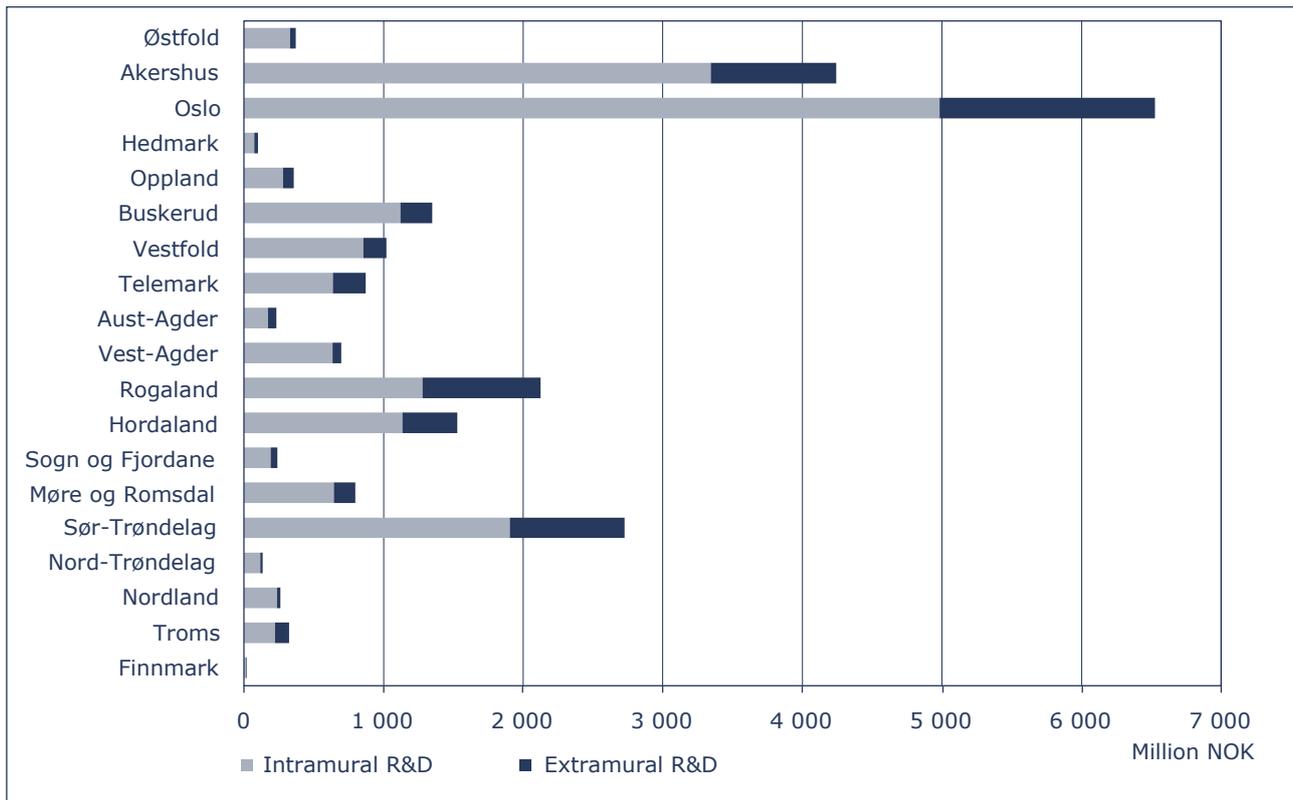
For Norway as a whole, public sources provided 46 per cent of total R&D expenditure in 2009, making them the main funding source for research. The industrial sector accounted for 42 per cent of national funding, while funding from other sources and abroad accounted for 4 and 8 per cent respectively.

At the county level relatively higher shares of public funding were found in Finnmark, Troms, Hordaland, Svalbard and Hedmark. The lowest shares of public funding were in Buskerud, Vestfold, Østfold, Telemark og Romsdal. Oslo had a 53 per cent share of public funding, which was a higher share than the national average, while Akershus with a 33 per cent was relatively low.

Naturally a high proportion of private sector funding is found in counties where a high percentage of R&D takes place within the industrial sector, such as Buskerud, Telemark and Møre og Romsdal. In contrast, Troms, Finnmark and Hordaland had the lowest

<sup>1</sup> For the country as a whole we operate with gross domestic product, while we at the county level must use the gross regional product that only covers mainland Norway, ie oil and gas exploration on the continental shelf are excluded.

Figure 3.8  
**Intramural and extramural R&D expenditure in the industrial sector by county,<sup>1</sup> 2009.**



<sup>1</sup> These regional figures are calculated using a differently weighted data, so that the values of individual variables (calculated with national weighting) will differ slightly from the sum of the counties shown here.

Source: Statistics Norway/NIFU, R&D statistics

proportion of funding from industry. Oslo and Akershus received 37 and 48 per cent of their R&D funding from industry.

When it comes to funding from abroad, five counties had a higher share than the national average: Østfold, Akershus, Vestfold, Oppland and Sør-Trøndelag all received relatively high levels of international funding for R&D.

### 3.2.2 R&D and innovation expenditures in the industrial sector

Intramural R&D expenditure in the Norwegian industrial sector accounted for just over 18 billion NOK in 2009. An alternative measure of R&D spending in each county can be provided by looking at R&D expenditure per employee. On average, business R&D expenditures per employee amounted to 27 100 NOK in 2009. Enterprises in Sør-Trøndelag had the highest share of R&D expenditures per employee at 50 300 NOK. Sør-Trøndelag is closely followed at Akershus and Oslo, with 46 500 and 37 000 NOK per employee respectively. As shown in Figure 3.8, the lowest R&D

effort per employee is found in Finnmark and Hedmark.

From 2008 to 2009, Norwegian R&D expenditures in the industrial sector saw a real decrease of nearly 5 per cent, and most counties saw a similar or greater decline in this period. Among the counties where the industrial sector had R&D expenditures in excess of 300 million NOK in 2009, Troms and Akershus had the largest growth of spending from 2008.

In the decade 1999–2009, business R&D expenditures almost doubled, with an increase in nominell prices from 9.5 to 18.2 billion NOK. Oslo and Akershus had the largest growth in absolute spending, of 2.4 and 1.6 billion NOK respectively. Overall it was a real increase in business R&D expenditure of 36 per cent in this period. Oslo and Akershus were close to the average for Norway. The highest percentage changes in R&D expenditures were found in Nordland, Møre og Romsdal, Telemark and Vest-Agder, all of which saw 100 per cent real growth in the period. These are all small counties when it comes to resources for research. Vest-Agder and Telemark spend most.

Figure 3.8 shows shares for R&D conducted by the industrial sector itself (intramural R&D) and the share of R&D they bought in from other corporations, research institutes or universities and colleges (extramural R&D). When extramural R&D is included, the industrial sector conducted or purchased R&D worth a total of 23.8 billion in 2009, which represents a slight decrease from 2008. On this measure, enterprises in Oslo and Akershus had the highest R&D activity in 2009, with 6.3 and 4.4 billion NOK respectively.

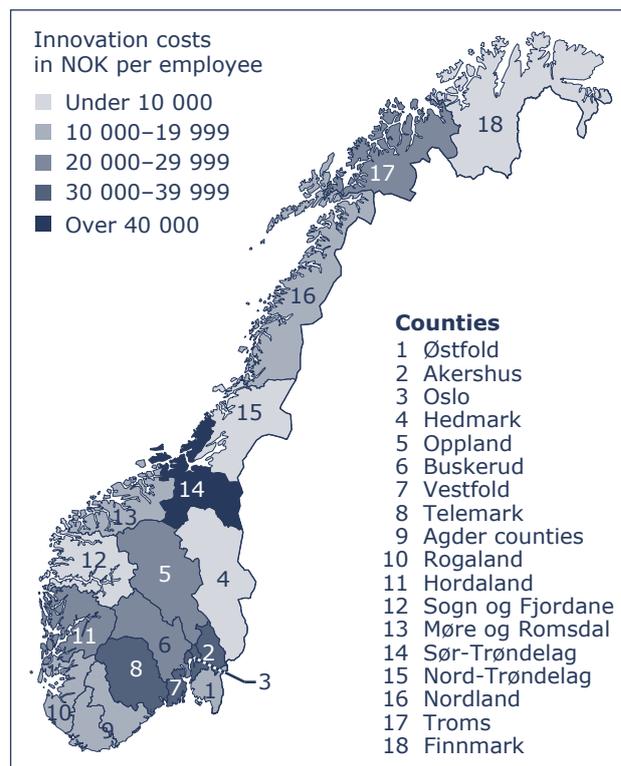
Extramural R&D accounted for almost 24 per cent of total R&D expenditure in 2009. If the relative scale of intramural R&D spending is compared, the business community in Rogaland buys in the most extramural R&D, accounting for nearly 40 per cent of total expenditure, followed by Troms and Sør-Trøndelag where extramural R&D accounted for 32 and 30 per cent respectively. The private sector in Nordland and Vest-Agder buy least extramural R&D relative to total R&D expenditure. Much of the national research and acquisition is related to the oil and gas sector and this may explain why the business community in Rogaland, where a number of oil and gas organisations are based, buys in so much research.

When it comes to innovation costs, these are concentrated in the central areas of the country. In particular, the capital region of Oslo and Akershus stands out from the other counties. This is a pattern we have seen for R&D expenditures alone in the past year, and the innovation survey also makes it clear that innovation costs are dominated by R&D costs. Nearly 42 per cent of total innovation costs in the industrial sector were based within these two counties in 2008. Oslo and Akershus are also among the five counties with the highest innovation costs per employee, as shown in Figure 3.9. Sør-Trøndelag stands out with a significantly higher proportion than any other county. It may be partly due to the presence of some large enterprises, which have headquarters in other parts of the country, but with major R&D sites based around Trondheim.

### 3.2.3 Characteristics of regional innovation

The creation, use and diffusion of knowledge is essential for economic growth and development. Successful innovation policy should not only be developed on the national level, but also adapted to different regional conditions and opportunities. The knowledge base required for such flexible policy will, among other things, need to build on regional analyses of relevant surveys, such as the R&D and innovation

Figure 3.9  
Innovation costs in the industrial sector per employee and by county, 2008.



Source: Statistics Norway, Innovation survey 2008

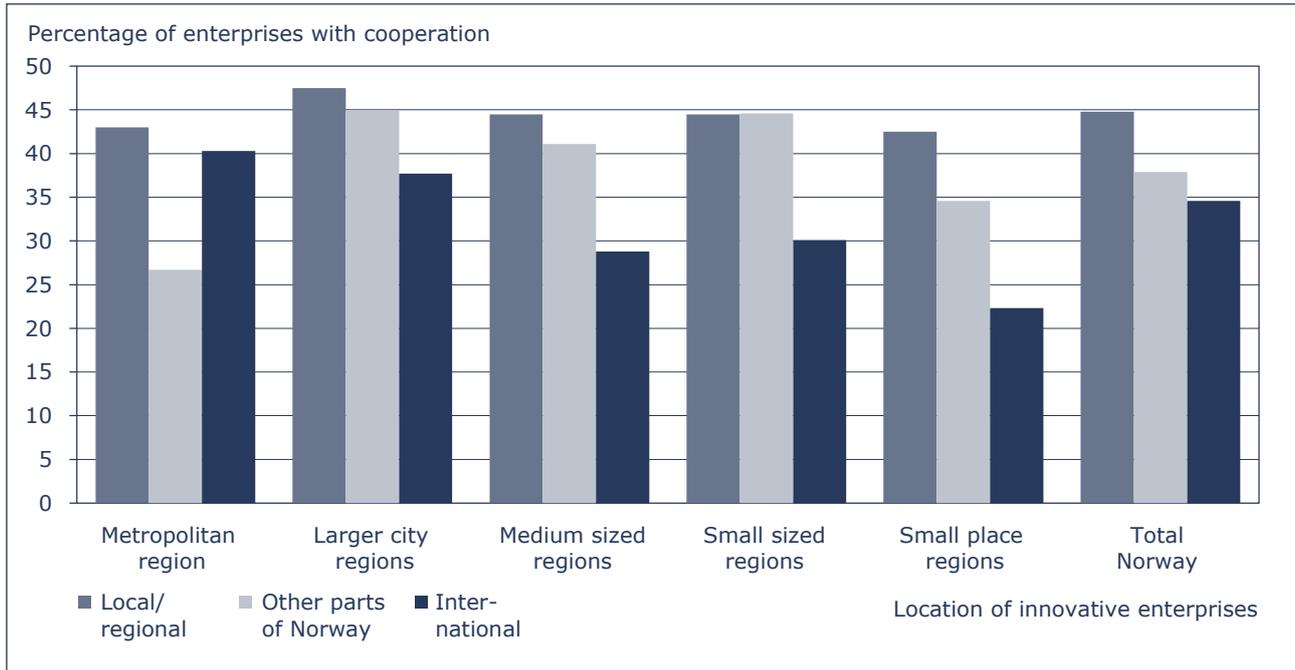
survey carried out by Statistics Norway. Data from these surveys were used to analyse regional variations in innovation, in a study published by the Norwegian Institute for Urban and Regional Research (NIBR).<sup>2</sup> The report considers the characteristics and causes of regional innovation patterns in Norway.

When the regions are considered under five groups, of similar sized regions (see Figure 3.10 for an example of these groupings) a systematic pattern of differentiation appears, regarding their resource base and innovation inputs, geographical patterns of cooperation, barriers to innovation and results. As region size increases, the following factors become more prominent: variety in its industrial and knowledge base; a larger proportion of knowledge-intensive industries and R&D institutions; higher R&D investments; and more use of higher educated personal. These regional profiles and patterns in these structures and resources imply that, for some innovation types, the potential for renewal might be higher in more central and larger regions.

In contrast, a region's size does not appear to be very important for cooperation between innovative

<sup>2</sup> Gundersen and Onsager 2011.

Figure 3.10  
**Enterprises with innovation cooperation as a share of all enterprises with innovation by region,<sup>1</sup> 2008.**



<sup>1</sup> Metropolitan region (>500 000 inhabitants, ie only Oslo ). Larger city regions (50 000–500 000 inhabitants – eg. Stavanger, Bergen, Trondheim, Drammen, Kristiansand, Nedre Glomma). Medium sized regions (25 000–50 000 – eg. Tromsø, Hamar, Arendal, Haugesund, Molde, Ålesund). Small sized regions (5 000–25 000 – eg. Halden, Kongsberg, Ulsteinvik, Lillehammer, Steinkjer, Bodø, Harstad). Small place regions (<5 000 – eg. Risør, Trysil, Oppdal, Røros, Lærdal, Stryn, Andøy).

Source: Statistics Norway/NIBR

partners. Innovative enterprises in every type of region work consistently with customers, suppliers and knowledge institutions in their innovation activities. International cooperation is more important for innovative enterprises in urban areas than in rural areas, while the opposite pattern applies for national cooperation (see Figure 3.10). The international orientation of the enterprise increases with the centrality of the region, primarily because these firms tend to be larger and have large corporate headquarters and R&D-intensive enterprises. However, the regional neighborhood is the most important area for innovation cooperation, regardless of the size of the region where a enterprise is based. Geographical proximity between parties is still very important for innovation, regardless of the size of the regional environment and their industry specialization.

The data also show that the most innovative companies have complex relationships, cooperating with many different partners (suppliers, customers, knowledge institutions) and across a range of geographical areas/locations (regional, national, international) simultaneously.

A number of factors are anticipated to act to inhibit innovation, in particular a lack of information about

technologies, potential markets, past innovations and or a lack of partners. These factors have been found to apply broadly, to innovative enterprises in all types of regions, except for those in small sized towns. Enterprises in small sized towns often report more significant inhibiting factors linked to problems recruiting and retaining qualified employees, and tend to rely more on previous innovations.

There are large and systematic differences in the regions' resource base, which are again related to their size and centrality. Differences are apparent in access to R&D resources, the share of employees with higher education and types of business expertise. There are also significant differences in the regions' results in terms of innovation rates, new ventures and growth rates in employment in innovative sectors; all of these vary by the same regional pattern. However, there are even greater differences in the regions' use of formal innovation resources (R&D investments, employees with higher education in business enterprises) than in innovation rates (excluding patents). This seems to be because a large proportion of the enterprises mostly perform incremental innovation, based on experience-based knowledge, where formal R&D and having employees with a higher education is less important.

Several of these types of enterprises are located in smaller, less central towns and rural areas.

The study looked more closely at the country's most and least innovative regions and highlighted some similarities and differences between them. The sample for this comparison was based on ranking the nation's *labour market regions* by an innovation indicator.<sup>3</sup> This revealed a fairly large spread of innovativeness across the regions. The Oslo metropolitan area was shown to be by far the most innovative region, followed by the five small sized towns Halden, Kongsberg, Ulsteinvik, Ørsta-Volda and Alta. Five factors distinguish this group of most innovative small sized towns, when compared with the five least innovative regions:

- Stronger industrial specialization.
- A more R&D-intensive industrial base, with a higher share of R&D expenditure financed by the government.
- More innovation cooperations with different partners and in different geographical areas, and a higher proportion of cooperation with customers and knowledge institutions.
- Lower barriers to innovation among innovative companies.
- Higher rates of innovation, new venture rates and growth rates of innovative firms.

More innovative regions tend to have a higher degree of specialisation in knowledge-intensive industries (such as manufacturing or services), higher levels of R&D investment in the industrial sector, R&D and/or higher education institutions located in the area, richer innovation networks, lower innovation barriers and higher rates of growth.

Innovative companies and business environments appear to have a greater potential for growth (measured in growth rates of employment) when they are based in the most innovative regions, compared with the least innovative regions and the country as a whole. This indicates a relationship at the regional level between having a high percentage of innovative firms and high growth rates in employment in innovative companies and possibly even within the industrial environment as a whole. However, the innovative regions are also different from one another when it comes to their: size and centrality, type of industry specialization and expertise, funding profile (public vs. private funding of R&D in the industrial sector) and the importance of international innovation coop-

eration. This illustrates that there are several ways to target high innovation capacity.

Public financing of R&D expenditures (particularly that from ministries, directorates and counties) appears to be higher in the most innovative small sized towns when compared with the least innovative small sized towns and the Oslo metropolitan area. Business communities in innovative small sized towns thus benefit from good access to both private and public R&D funding. This is caused by a combination of intentional regional and district policy, and the unintended regional effects of national business-oriented R&D programs (especially those under the auspices of ministries/directorates and the Research Council of Norway).

Norway shows some similarities with other countries in terms of its regional innovation pattern: as in many other countries there appears to be a innovative central core, with less innovative peripheral areas around it. At the same time, the regional differences involved in the Norwegian 'centre and periphery' are not as great as those often found in international studies. One reason for this is that the many of the most innovative companies and milieus in Norway are scattered across the country in small sized towns and rural areas. These business communities developed through historical processes, rooted in particular, local resource industries and their related technology industries. Over time, these business environments have become strongly integrated into national and global knowledge and innovation networks. Additionally, Norway has developed an extensive institutional apparatus as a part of its knowledge, innovation and regional policy, that helps to support decentralised innovation (see introduction on the Norwegian innovation system).

Large regional variations in the resource base, innovation patterns and barriers to innovation in Norway again emphasize the importance of having a nationally led, but regionally differentiated, innovation policy that can be adapted to very different regions in light of their advantages, barriers and opportunities. The analysis shows that overall development strategies to strengthen regional, national and international cooperation on R&D and innovation, and the flow of information and expertise, should act reasonably well as measures to strengthen the innovation and development capability in all types of regions. A major challenge will be to ensure the recruitment of qualified personnel to innovative companies and institutions located in small sized towns and rural areas. Policies to strengthen the attractiveness of these areas will therefore be an important part of an overall regional innovation and development policy.

<sup>3</sup> This innovation indicator is based on the average for the share of innovative enterprises and the share of employees in innovative enterprises of the total sample. Being innovative, means that the firm had product and/or process innovation between 2006 and 2008.

