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Measuring innovation capabilities in southern and northern Norway

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Preface

This paper has been prepared for SMEPOL, a joint research project between geographers and economists in Austria, Spain, Italy, Denmark, United Kingdom, Netherlands and Norway. SMEPOL's target is to uncover best practises for regional growth policies through innovation in small- and medium-sized enterprises.

This report gathers statistical background material on industrial structure and innovation patterns in the two studied areas of Norway; five counties in south-eastern Norway and the three northern-most counties of Norway.

The statistical material in this report has been assembled by Heidi Wiig, while Thor Egil Braadland has been responsible for writing up the report. Bjørn Asheim and Arne Isaksen are responsibles for the Norwegian part of SMEPOL, and they are also project managers for the European SMEPOL project.

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Abstract

This working paper looks at innovation capabilities in northern and southern Norway, focusing on indicators related to knowledge and technology creation and diffusion. The primary indicators used are education, R&D, product and process innovation and technology co-operation.

There are distinct differences between the two regions. The industrial structure in Southern Norway reflects in many ways the industrialisation process the region went through in the mid 1800s. The industrialisation in Southern Norway was socially and technologically similar to the industrialisation of England, with development of large factories and mechanical technology. Today, the area has evolved as a semi-urban district with several towns and large variations in industrial activities, it has the largest population of the two regions studied here, it has more people in manufacturing industries, the firms in these counties spend more often money on R&D, they are more likely to perform technology co-operation, and they have access to population with an on average higher level of education, than firms in the north.

Northern Norway, on the other hand, has - through political decision-making and an abundance of "house-hold friendly" natural resources - never been 'industrialised' in the same way as the south. In addition to infrastructural business sectors (as construction, hotels/retail and transport), Northern Norway has only one large industrial sector; fish processing. The region also has more small and medium-sized enterprises (SMEs) than the south, but at the same time more R&D institutes and colleges, more scientists, a university (in Tromsø) and more scientists per students than the south. In addition, firms from northern Norway rank higher than both the national average and southern counties in terms of performing process innovation. Although northern firms spend less on R&D, northern small firms are just as innovative as southern small firms.

This report uses statistical information from Norwegian Enterprise Register, Statistical Yearbook from Norwegian Statistical Bureau (SSB), Ministry of Church, Education and Science (KUF), Norwegian Institute on Studies on Research and Development (NIFU) in addition to innovation data from the SSB R&D survey in 1995, to construct a basis for understanding the innovation capability in these two regions.

Keywords: Regional innovation systems; competencies; industrial structure; SME, Northern Norway; Southern Norway

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Measuring innovation capabilities in southern and northern Norway

1. Innovation capability

In this paper we seek to map differences in possibilities for - and limitations to - innovation in southern and northern Norway. By innovation we mean technical changes involving some kind of new knowledge; as new or improved products or changed production processes. We also regard the establishment of new markets as innovation.

A firm's innovation capability is often regarded as based on two factors[1]; on the one hand the amount or rate of accessible knowledge and technology creation. On the other hand it is based on which eXtent the firm is involved in processes of knowledge and technology *diffusion and adoption.*

Such a division also puts emphasis on the fact that pure R&D measures are not sufficient to map regional innovation activities. Clearly, one could imagine industries (or regions) with a low R&D intensity and a high innovation rate, or vice versa. Hence, focusing on both knowledge production and knowledge assimilation will bring a more full picture of the qualities of innovation capabilities in northern and southern Norway.

New literature on innovation theory stresses that innovation rates are influenced by how well firms interact with surrounding knowledge and technology suppliers in an innovation system. An innovation system is constituted by a network of knowledge supplying agents, as research institutions, business services, educational institutions, customers, technology suppliers etc[2]. Such networks, it is argued, may work better if they are geographically agglomerated[3]. The argument is mainly that similar socio-cultural, institutional, political, technological and historical background facilitates communication and co-operation between economic agents located within one region. By investigating regional knowledge and technology production and co-operation - and comparing it to assimilation of knowledge in firms in both southern and northern Norway - we will be able to better illustrate how the respective innovation systems function in these two regions.

Innovation indicators

In this paper we will use several region-specific innovation indicators to map technology creation and diffusion in firms in two regions; respectively southern and northern Norway. As indicators for technology and knowledge creation, we will look at regional R&D eXpenditure, R&D man-years, number of researchers,

[1] Tone Haraldsen 1988; Vekstpol og utvikling

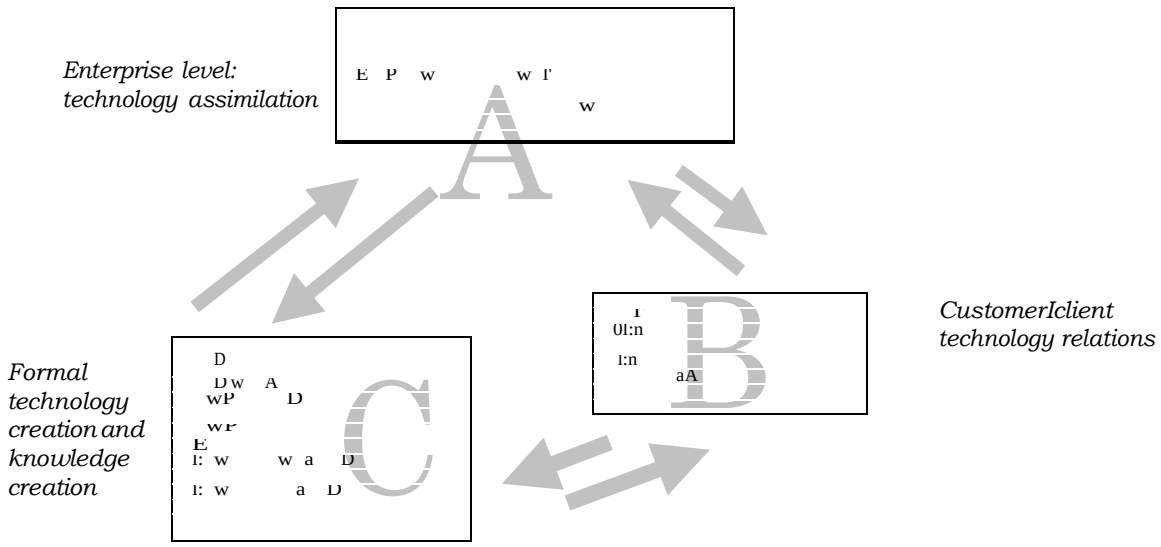
[2] For a systematic overview of dynamic system approaches, see Keith Smith 1997; System approaches to innovation: Overview and policy issues

[3] See f.eX Asheim 1998

number of institutes, colleges and universities, education level and and share of firms performing and financing R&D (boX C in Figure 1). Innovation in firms will be mapped by looking at share of firms performing product and process innovations (boX A), and share of firms reporting to have established new markets. Also, as implementation and use of information technologies often are at heart of technological change in firms, we will look at in which eXtent firms have access personell with formal IT competencies as one last way of measuring innovation activities.

Thirdly, we will look at indicators on mechanisms which binds these two activities together. We will look at indicators for technology-related inter-activity between different economic agents (boX B). These indicators are participation in public technology contracts (IFU/OFU contracts), participation in technology co-operation and participation in market co-operation.

Figure 1: Innovation capability and relevant indicators for measuring technology and knowledge creation and diffusion.



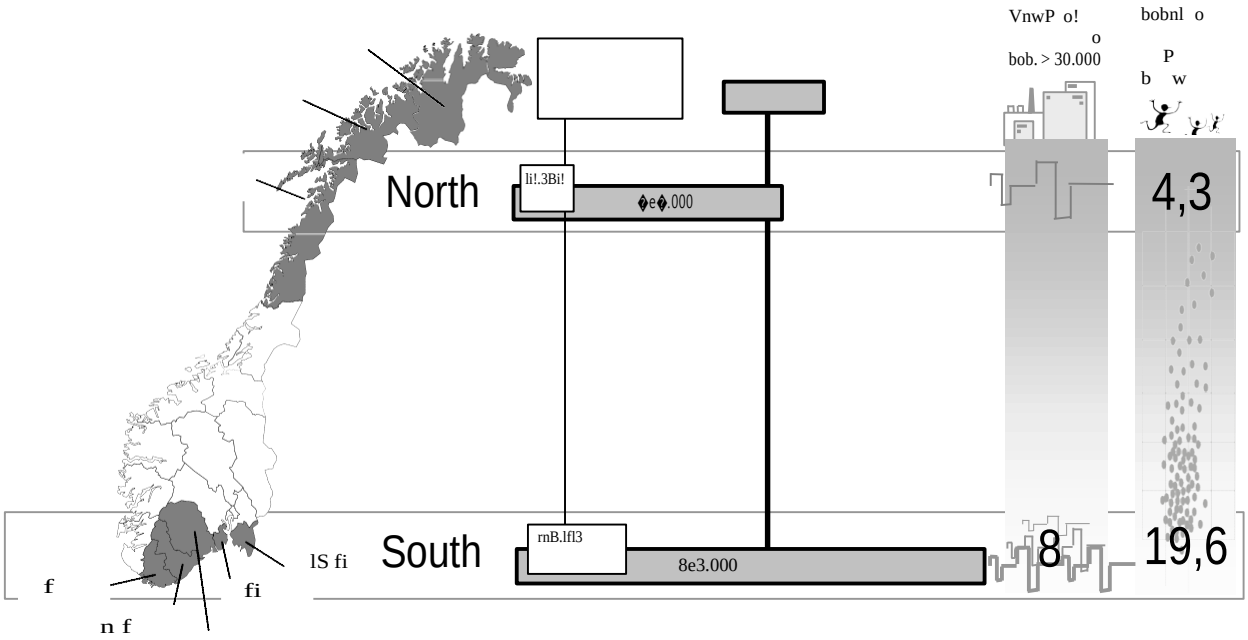
In the following chapters, we will first look at the two regions southern and northern Norway's firm structure and industrial structure. Then we turn to knowledge production indicators, as R&D eXpenditure and R&D man-years. Thirdly, we look at indicators for technology co-operation, public product development contracts and market co-operation. Finally, we look at innovation activities indicators, as product innovation, process innovation, establishment of new markets and share of population with formal IT-competencies. In the last chapter, we sum up the findings.

2. Southern and northern Norway

2.1. Population differences

Southern Norway and northern Norway are here defined as a set of counties. **Northern Norway** covers the three northern-most counties; Nordland, Troms and Finnmark. **South-eastern Norway** (in this paper shortened to *southern* Norway) covers the five south-eastern counties Vest-Agder, Aust-Agder, Telemark, Østfold and Vestfold (Figure 2).

Figure 2: Basis information about southern and northern Norway. Source: SSB Statistical Yearbook 1997.



Historical background[1]

Today, there are large differences in the industrial structure between the two regions. One the one side there is southern Norway, which has developed to be an area with multiple large industrial activities, as manufacturing of food and beverages, production of pulp and paper, chemicals, electronics and ferro and metals. On the other side, there is northern Norway, with a relatively low degree of industrialisation.

Industrialisation in Norway in the last half of the 19th century was by and large a process that took place in the Oslofjord area. The process was quite similar to the way British industrialisation evolved, as southern Norway industrialisation was in fully based on technology imports from England. The Norwegians had to this point been naval merchants, with no particular technological knowledge, insight or eXperience. When the industrial revolution evolved in England, Norwegians merchants in southern Norway saw the profit possibilities that the

[1] This section is based on Wicken 1997

British technology represented, and they started a large scale technology importation.

The industrialisation brought to town a profound change in structures and working- and life styles. It represented capital intensive mass producing factories located in the largest southern towns[2], producing 'traditional' goods, as teXtiles, iron, metals and wood products. The technological focusing point in this industrialisation process was the large-scale 'plant', a production unit with high degrees of mecanisation and division of labor. The industrialisation was labor- and capital intensive, and it rapidly created large social and economic differences between the inhabitants.

The industrialisation development in northern Norway was quite different from the process in southern Norway. The area was sheltered from modern capitalisme through political decision-making, and the inhabitants eXploited the rich abundance of natural resources to maintain the houshold economy. Before 1950, there were little manufacturing industry in the region: There were some activities based on natural resources, as mining companies and metal production. In addition, there were manufacturing of whale an fish oil and fat, and wood and wood products.

Southern and northern Norway today

Today, there are large differences in population and industry structure between the two regions. In terms of urbanisation, there are more towns - and a larger share of people living in towns - in the south than in the north. In southern Norway there are eight towns[e] with more than 30.000 inhabitants[···], while there are only two in northern Norway[E]. The three largest towns in the south are populated by about 160.000 persons, while about 100.000 persons[a] inhabit the three largest towns in the north. 21 percent of the population in the northern counties lives in towns with more than 30.000 persons, while in southern Norway 37 percent of the population live in such towns.

This difference in urbanisation is underlined by the difference in number of persons living in each region. The northern counties cover three times as much land as the southern counties, with only half of the southern population. The northern counties cover an area of 107.000 square km's, with a population similar to the one in Oslo; about 465.000 persons.[JQ] The average population density in the North is 4,3 persons per square km.

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[2] Mainly in Østfold (see fig. 2) and the inner Oslofjord counties Buskerud, Akershus and Oslo

[e] Town is here defined as population clusters where distance between houses does not eXceed 50 meters. Population in these clusters are counted with no regard to administrative limitations.

[···] Kristiansand (VA) 57.263, Fredrikstad (Ø) 51.472, Tønsberg (V) 40.843, Sarpsborg (Ø) 39.662, Porsgrunn (T) 35.705, Sandefjord (V) 33.987, Skien (T) 30.411, Moss (Ø) 30.101. Source: SSB Statistical Yearbook 1997.

[E] Tromsø (T) 47.103, Bodø (N) 33.017. Source: SSB Statistical Yearbook 1997.

[a] Includes Harstad with 18.886 inhabitants

[JQ] Figures for 1997. Nordland 240.255 persons, Troms 151.242 persons and Finnmark 75.575 persons. Source: SSB statistical yearbook, 1997, Table 35

The five southern counties cover an area 1/3 the size of the North, 35.000 square km's, while the population is almost twice as large; 863.000 persons[JJ]. The average population density in the southern counties is 24,7 persons per square km.

According to the Norwegian Enterprise Register[J:)], 75.395 persons - 16,2 percent of all citizens - were employed in northern private sector industries in 1995. Private employment in northern Norway represents 8,14 percent of the national private sector employment. For the southern Norway, 169.473 persons - 19,6 percent of the population - were engaged in private sector industries in 1995. This represents 18,81 percent of the national employment in such industries.

2.2. Firm size and employment

Figure 3: Share of employment with respect to different firm sizes in Norway, northern Norway and southern Norway, 1995. Source: Norwegian Enterprise Register.

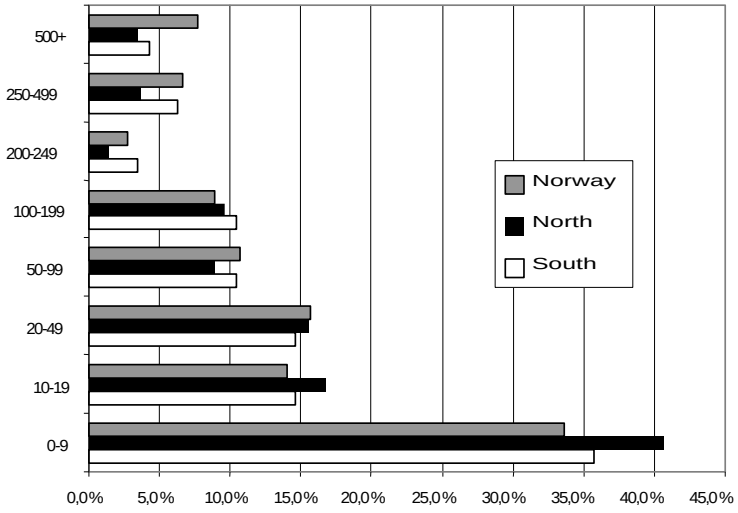


Figure 3 shows an overview on how employment in the different regions are distributed with respect to different entreprise sizes. The figure reveals that both southern and northern Norway are regions with a higher share of employment in enterprises with less than 20 employees than the national average. In northern Norway, as much as 40 percent of all employees work in enterprises with less than 10 employees, while national average is 33 percent.

There eXist few significant differences between the two regions and the national average on share of employment in enterprises with 20-199 employees. The over-representation of employment in small firms goes together with a lower share of employment in the largest enterprises (200+). When we look at figures for the largest enterprises, we see that the share of employment in these categories in both regions (in the northern region in particular) is generally lower than the national average. On national level, approXimately seven percent of employment in private sector industries work in enterprises with more than 500 employees. In northern Norway, the share is about half of national average.

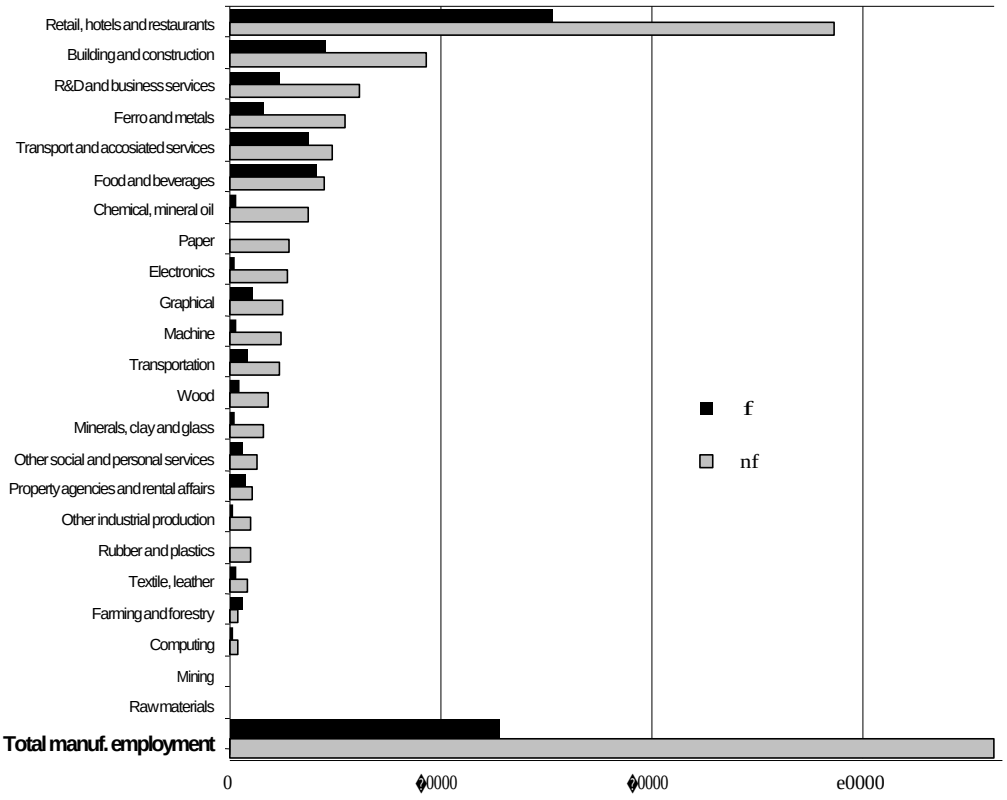
[JJ] Vest-Agder 151.580 persons, Aust-Agder 100.582, Telemark 163.449, Vestfold 206.119 and Østfold 241.151 persons. Source: SSB 1997, Table 35

[J:)] Bedrifts- og Foretaksregisteret

2.3. Industries, employment and firms

The employment in private sector industries in the northern region is, relative to population, 20 percent lower than in the southern region (16,2 percent to 19,6 percent). How does these employment differences vary by industry?

Figure 4: Number of employees in privat sector industries in northern and southern Norway, and in manufacturing industries, 1995. Source: Norwegian Enterprise Register.

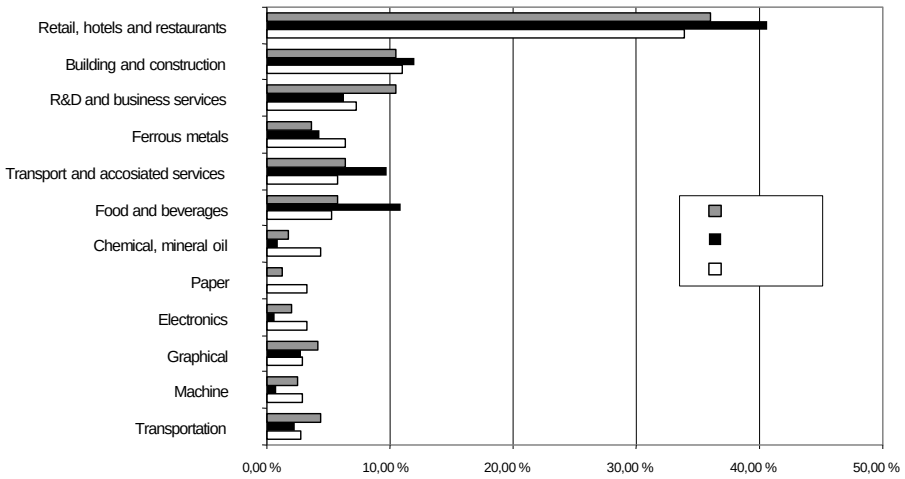


Both in the northern and the southern region, 'retail, hotels and restaurants' is the largest sector, measured in number of employees (Figure 4). In the north, more than 30.000 persons work in this industry. In the south, about 57.000 people are employed in this industry. For both regions, 'building and construction' is the second largest industry, with respectively 9.000 and 18.000 employees.

The third and fourth largest industries in the north is 'food and beverages' and 'transport and associated services'. In the south, 'R&D and business services' and 'Ferrous metals' constitute the third and fourth largest industries.

The two lower floaters in Figure 4 add up employment in all manufacturing industries in the two regions. The figure shows that there are almost three times as many persons employed in manufacturing industries in the south than in the north (relation for population is approXimately 1:2; see Figure 2). Figures for manufacturing industries include employment in raw materials, mining, teXtile/leather, rubber/plastics, other industrial production, minerals/clay/glass, machine, graphical, electronics, paper, chemical/mineral oil, food/beverages, ferro/metals and building/construction.

Figure 5: Twelve of the largest industries in Norway, northern Norway and southern Norway, ranged after industry's employment share of total employment in each region, 1995. Source: Norwegian Enterprise Register.



If we look at industry-specific employment as share of total employment (Figure 5), we get a closer look at regional specialisation patterns. (We have also included figures for the national average, so that the figure gives us a possibility to weighten the regions against each other and against the national average).

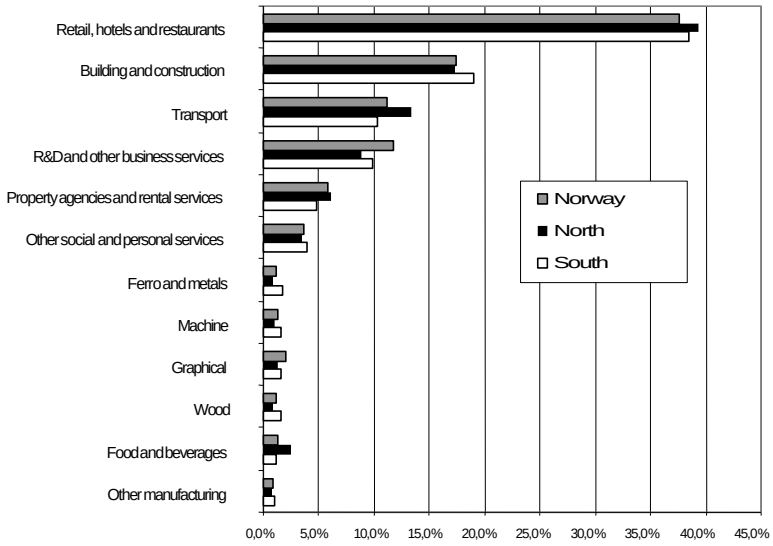
The figure shows that there are four industries in the North which have a relativly larger share of employment than the country as a whole; 'retail, hotels and restaurants', 'building and construction', 'transport an associated services' and 'food and beverages'. In addition, the northern relative employment in 'ferrous metals' is higher than the Norwegian average.

Of particular interest is the category '(production of) food and beverages', which is primarily constituted by the fish processing industries in the north. As the figure shows, the share of employment in this industry in the north doubles both the national and the southern average.

An interesting aspect is that the four industries playing a relative large role (compared to the south) in the northern Norwegian economy are industries that employ large quantities of people. All industries that count for more than 10 percent of the employment employ more than 7.000 employers each. As we shall see, the situation for the south is quite the opposite, as small industries (measured in number of employees) play more important roles in terms of industry's share of employment relative to the national average. In other words, while the northern industry structure is marked by a few large industries, the southern industry structure is more diversified.

In 'chemical and mineral oil products', 'paper' and 'electronics', the share of total employment in the south is almost twice as high as the national average and much higher than in the northern economy. Still, these industries do not account for more than 4-5 percent each of total employment. It is 'ferro and metals' that is the largest industry in the south (about 7 percent of total employment) relative to both the national and Northern average share of employment.

Figure 6: Twelve of the largest industries in Norway, northern Norway and southern Norway, ranged by number of firm in indystry as share of total number of firms in each region, 1995. Source: Norwegian Enterprise Register.



In Figure 6, we compare the relative number of firms in each industry (number of firms in industry divided by all firms in region). We find that share of firms in each three areas is quite similar. Northern Norway has a somewhat higher share of firms in 'retail, hotels and restaurants', 'transport', 'property agencies and rental services' and 'food and beverages'. The south has a relative higher share of firms in 'building and construction', 'other personal services' and 'wood'.

3. Knowledge capital

3.1. Education levels

The globalisation process increasingly stresses labour skills and competencies as a central mean to maintain local competitiveness[J3]. Such competencies may be divided into informal competencies and formal competencies. By the first category we think of skills obtained through for eXample private eXperience, through technical curiosity or in learning-by-doing working situations. By the second category we mean publicly approved education.

In this section we use the latter category to map skills in the northern and southern Norway. We chose this variable for two reasons. Firstly because there eXist easily accessible and quite accurate statistical material on this topic. Secondly, in spite of the clear weaknesses implied with this indicator - it contains no information about informal trained persons - level of formal competencies still represent the best indicator on the overall regional skill level. It is clear that by eXcluding informal competencies we run the risk that some core, regionally embedded tacit knowledges are left out. Such weaknesses of the data should be born in mind during the following presentation.

[J3] See for eX. Bjørn Asheim 1994, 1995 and Bjørn Asheim / Arne Isaksen 1996 (STEP reports 18/94, 3/95 and 13/96), or OECD 1996; The Knowledge-based Economy

Figure 7: Share of persons 16 yrs+, categorised by highest completed education, for Norway, northern Norway and southern Norway. Source: SSB statistical yearbook, 1997.

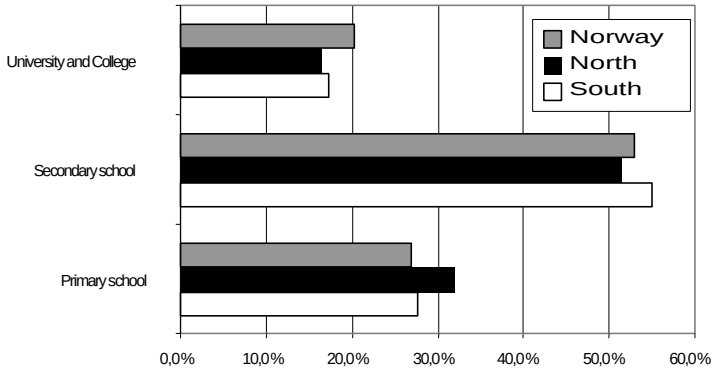


Figure 7 gives an overview of how share of the population (16 years +) varies with respect to education length, in Norway, northern Norway and southern Norway. The figure shows the relative share of population with respect to highest completed education, where education level is divided into three; primary school (1-9 years), secondary school (10-12 years) and university / college (13-18 years).

In northern Norway, the share of persons with only primary school is five-siX percent points higher than both the national average and the share in the southern counties. Almost 32 percent of the population has primary school as highest education, while the national average is below 27 percent. The share of people in the south with secondary school is higher than the share in both northern Norway and the country as a whole.

Summing up, the northern share of people with only primary school is higher than the national average, while the share of people with secondary school is close to the national average. Southern Norway, on the contrary, has a relatively higher share of people with secondary school, and close to a national average in share of population with primary school. Hence, both north and south have a lower share of persons with university or college education than the national average. In south, the share of persons with primary school is equivalent to the national share, and share of persons with secondary school is slightly higher than national average (55 percent compared to 52,9 percent). In northern Norway, 46.670 persons (10,03 percent of the population) had completed one year or more on university or college (1996). In the southern counties, the number of persons was 85.046 persons (9,85 percent)[J'f]

[J'f] Source: SSB employment/employer register, 1996

Figure 8: Registered students in universities and colleges in southern and northern Norway, 1996 (only state owned Colleges). Source: KUF: St. prp. nr 1 (1997-1998)

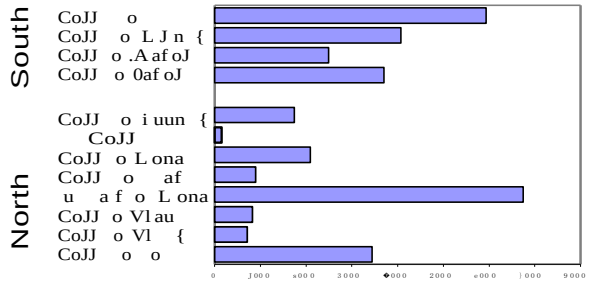


Figure 8 gives an overview of the number of students attending colleges and universities in southern and northern Norway in 1996. There are four colleges in south; one in each county - eXcept for Aust-Agder and Vest-Agder where the college is shared. College of Agder is largest, with about 6.000 students. College of Vestfold is the smallest, with 2.500 students. All southern counties together, 16.199 persons are registered as students, representing an average of about 4.000 students per college.

In the northern counties there are seven colleges and one university. University of Tromsø is the largest institution of them all, with 6.750 students. The largest college is College of Bodø, with 3.450 students. Lapp College is the smallest, with 152 students. The total number of students registered in all these institutions was in 1996 16.323 persons. This gives an average of 2040 students. Keeping University of Tromsø aside (41 percent of all students in the north), the average number of students on colleges in northern Norway is 1367.

Formal IT competencies

In Norway, as for most of the western economy, employees with high and formal education in IT are in demand. Almost all economic sectors are more or less in a situation of transition, where IT tools are adopted, implemented and assimilated in order to propel production and service efficiency. Implementation of IT tools are in other words a central means to innovation for almost all sectors and regions. Hence, it is also a key element in measuring potential for innovative activitites in different regions.

In this section we look how southern and northern Norway manage to attract and keep persons with higher education in IT. Table 1 shows that number of employees with education in IT-related subjects are 2,6 times as high in the southern counties as northern counties. Even though the population in the five southern counties is almost twice the population in the northern counties (863.000 to 465.000), the relative difference in IT employment is 38 percent (0,438 percent / 0,317 percent). As share of national pool of IT-skilled employees, 16,1 percent work in southern counties, while 6,1 percent work in northern counties.

Table 1: Share of persons in southern and northern Norway with IT education from university or college (source: SSB employment register)

Region	Number of employed IT skilled persons	**Share of regional population**	**Share of national IT skilled workforce**
North	1.476	**0,317%**	**6,3%**
South	3.780	**0,438%**	**16,1%**
Norway	23.487	**0,573%**	**100%**

3.2. R&D

In this section we map research and development activities in southern and northern Norway. Research and development activities are most often performed within knowledge intensive institutions like universities, colleges and private institutes. These institutions have direct and indirect linkages to the regional economy in which they are located; through student training, informal links to industries, movement of people, through performance of applied research, through publications and so on.

Figure 9: Number of scientific personnel at universities and colleges in southern and northern Norway, 1995. Source: NIFU, Instituttsektoren, katalog over forskningsenhetene, rapport 5/95.

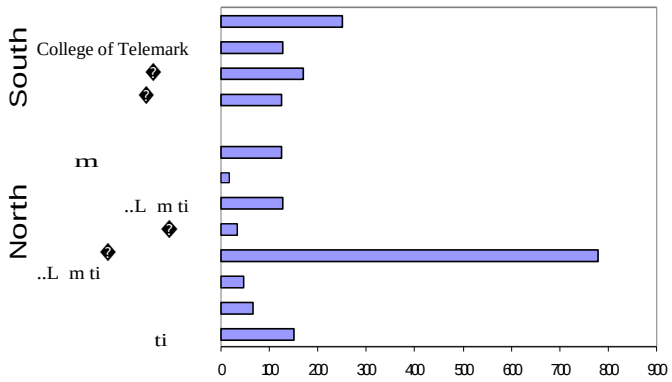


Figure 9 brings an overview of number of scientific personnel at the different colleges and universities in the two regions. In southern Norway, there are approximately 700 college researchers. The average number of researcher per institution is 174, with College of Agder as the institution with most researchers (330). In north, there are fairly 600 researcher within universities or colleges. The average number of scientists is 74. College of Bodø is the largest college, with 151 scientists. Lapp College is the smallest has 18. University of Tromsø has 778 researcher, and is clearly the largest institution with respect to R&D and higher education.

Figure 10: Number of students per scientist in colleges and universities in northern and southern Norway (Source: KUF ibid. and NIFU ibid.).

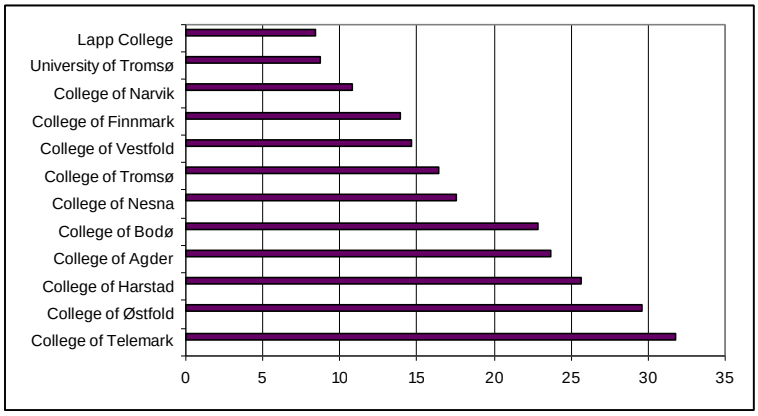


Figure 10 brings an overview of number of students per each scientist at the different colleges and universities. The overview shows that University of Tromsø together with Lapp College has fewest scientists per student, approximately eight.

Table 2: Research institutes in southern and northern parts of Norway, research direction and number of employees, 1995. Source: NIFU ibid.

Region	**Name of institute**	Category	**Employees**[JQ]
South	Telemark teknisk industrielle utviklingssenter	Technology	32
	Telemarksforskning Notodden	Social science	20
	Telemarksforskning Bø	Social science	30
	Agderforskning	All areas	43
	Institutt for energiteknikk	Technology	-[Je]
	Stiftelsen Østfoldforskning	Social science	55
			180
North	Nordlandsforskning	Social science	55
	EISCAT, Ramfjordmoen forskningsstasjon	Science	-
	Norsk institutt for fiskeri- og havbruksforskning	Science	114
	NORUT-Teknologi A/S	Technology	12
	NORUT-Informasjonsteknologi A/S	Technology	35
	NORUT-Samfunnsforskning A/S	Social science	24
	Finnmarksforskning	All areas	23
	Nordisk samisk institutt	Social science	16
	Reindriftsadministrasjonen	Science	42
			321

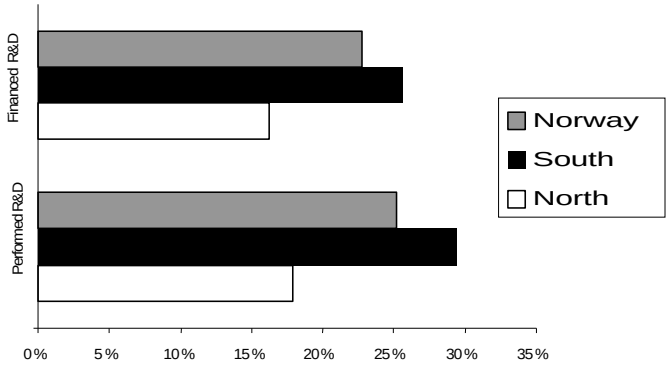
[J2] 1995

[Je] Figures not available

Three of the four colleges in southern Norway is among the four colleges with most students per scientist, 23+.Table 2 brings a complete overview of research institutions in the two regions. In south, there are siX institutes, with about 180 employees (IFE not included). Three of the southern institutes are related to social science, two are technologic and one is covering all areas.

In northern Norway, there are nine research institutes with 321 employees (EISCAT not included). Three of them perform studies related to science, as biology or physics. Three of them are social science institutes. Two institutes relates to studies in technology, while one covers all areas.

Figure 11: Percentage of firms in Norway, South and North confirming they have performed R&D (upper floaters) or financed R&D (lower floaters). Source: SSB, R&D statistics 1995.



Enterprises in southern parts of Norway tend to spend money on R&D more often than both Norway in general and in northern Norway in particular. A study from SSB in 1995 show that 26 percent of all firms with more than 50 employees in the southern counties had spent money on R&D the last three years (Figure 11). For Norway as a whole, the same result was 23 percent, for the northern counties the rate was 16 percent.

The same pattern erupts if we look at firms performing R&D activities. 29 percent of the large and medium-sized firms from the southern counties have performed R&D activities, while the national average was 25 percent. In the north, the average was 18 percent.

Table 3: R&D expenditure (1.000 NOK) in northern Norway, southern Norway and the whole country. Source: SSB R&D statistics 1995.

	R&D expenditures	**Share of nation**	**Share of manuf. empl.**
Northern Norway	72.559	0,80 %	8,14 %
Southern Norway	1.618.984	17,70 %	18,81%
Norway	9.163.417	100,00 %	100,00%

The figures from Figure 11 are underpinned by the regional differences in R&D eXpenditures (Table 3). The table shows that while R&D eXpenditures in southern Norway represent 17,7 percent of all R&D eXpenditure in Norway, R&D eX-

penditures in northern Norway accounts for only 0,8 percent of the national spending on R&D. In absolute values enterprises in the southern counties spend 1,6 billion NOK on R&D, while enterprises in the northern region spend 72.5 million NOK.

If we compare the R&D shares of national R&D eXpenditures with the regions share of national manufacturing employment, we find that the R&D share is lower than the employment share in both regions. Northern Norway is worst off, with an employment share more than ten times as high as the R&D share. In southern Norway, the difference is about siX percent, or a little more than one percent point.

Table 4: R&D man-years in northern Norway, southern Norway and the whole country. Source: SSB R&D statistics 1995.

	R&D man-year	**Share of nation**	**Share of manuf. empl.**
Northern Norway	63,4	0,80 %	8,14 %
Southern Norway	1796,4	23,30 %	18,81%
Norway	7696,3	100,00 %	100,00%

Table 4 shows an overview of R&D man-years performed in the two regions, and it further outlines the difference in R&D activity between northern and southern Norway. While the southern part of Norway performed 23,3 percent of all R&D man-years, northern Norway only represented 0,8 percent of this type of activity.

Compared to the two regions share of employment in manufacturing industries, we for northern Norway a contrast between the share of employees and the share of research man-years. As with R&D eXpenditures, the difference here is about ten times, or more than seven percent points. Interestingly, southern Norway's share of R&D man-years is higher than the regions share of employment in manufacturing industries. The R&D share is 24 percent higher than the employment share, representing about 4,5 percent points.

How does these regional figures distribute on different industries? In Table 5 we bring statistics on R&D eXpenditures for the two regions broken down on different NACE industries.

Table 5: R&D expenditure by industry in northern and southern Norway (three most intensive sectors in both regions highlighted). Source: SSB, R&D survey, 1995

		IllOK)		SHARE OF REGIONAL SPENDING	
Industry	G	Northern Norway	Southern Norway	Northern Norway	Southern Norway
	2J	O	JO OO	3,	O,e
A	o++				
	3 +3		eOJ		O,
	o+ J				
EI G G	30+3J+3+33		O		O
G I G fl G	2+	OOO			
A	3+		3 e		J,e
	2		Je3 O		J,O
fl I	+	e	3 OQ	J3,	3
	o -Jo+J -J	Q Q	300		0,0
CP G I I I	3+		3		
	o++		JJeOe	J,3	O,
		O	O	,	,
	J2+J	3 Q			J,
	J		3 J		,O
	JJ		J OO	0,0	J,J
,		3O	e 3	,	J,e
,	J +J +J	OOO	OO	,	0,0
A	o+ J+ + 3		O		O,J
	3 +32		J eO		O,
	o		J 3	J,3	O,J
,	20+2 +22	JOO	3	O,J	0,0
			JeJ	JOO,O	JOO,O

The table illustrates strong industrial differences between the two regions. In northern Norway, the three industries which spend most money on R&D is 'Financial services and insurance' (NACE 65 + 66), 'Food and beverages' (NACE 15+16) and 'Farming and forestry' (NACE 27+28). These three industries account for more than 60 percent of all R&D eXpenditure in this region. In the table, there are 14 of 25 industries which don't have R&D eXpenditures at all. Among these industries are 'Post and telecommunication', 'Graphical', 'Rubber and plastics', 'Electronics' and 'Computing'[J...].

[J...] These figures are not transferrable to the figures in Figure 4, because of different categories.

The southern industries which spend most on R&D show an even stronger 'hegemonic' trend than in the north. 'Electronics' (NACE 30+31+32+33) account for 47 percent of all R&D spending in these counties, while 'Chemicals and mineral oil' accounts for 28,6 percent. Including 'Ferrous metals' (NACE 27+28), the three most R&D intensive industries in southern Norway accounts for about 85 percent of all R&D in these counties. Still, in contradiction to the northern counties there are fewer industries which have R&D eXpenditures at all. In the south, 9 of 25 industries do not have R&D eXpenditures, while as many as eleven industries accounts for 0,1-2,0 percent of the regions overall R&D eXpenditure.

4. Technology co-operation

How does firms in northern and southern Norway vary with respect to technology co-operation with eXternal partners? We will try to answer this question by turning to regional statistics on to which eXtent firms have established market co-operation with other actors, whether they have established technology co-operation or not with others, and to which eXtent firms have established public product development contracts. The four variables are:

- establishment of market co-operation,
- participation in technology co-operation,
- industrial technology contracts (IFU contracts), and
- public procurement technology contracts (OFU contracts).

In the first section, we look at firms with more than 50 employees (medium-sized and large firms). In the neXt section we look at firms with 10-50 employees (small firms).

4.1. Firms with more than 50 employees

In this section, we look at firms with more than 50 employees. We will find that northern firms have a higher rate than national average on market co-operation, while the share on the other variables are similar or less the national average. For the southern firms, they have a higher rate than national average in technology co-operation and some public technology development contracts.

Table 6: Medium-sized and large firms (>50 employees) in northern Norway, southern Norway and Norway reporting they have established market co-operation. Source: SSB R&D survey, 1995.

Region	**Total number of firms asked**	**Firms with market co-operation**		**Firms with no market co-operation**	
North	117	**41**	**35,0%**	76	65%
South	351	**109**	**31,1%**	242	68,9%
Norway	1910	**600**	**31,4%**	1310	68,6%

Table 6 brings an overview on how firms report whether they have established market co-operation or not. As the table shows, northern enterprises are more likely to develop market co-operation than other firms, both compared to southern firms and to the national average. 35 percent of 117 northern firms report they have developed market co-operation the last three years, almost four percent points more than both the southern and the national average.

Table 7: Medium-sized and large firms (>50 employees) in northern Norway, southern Norway and Norway reporting they participate in technology co-operation. Source: SSB R&D survey, 1995.

Region	**Total number of firms asked**	**Firms with technology co-operation**		**Firms with no technology co-operation**	
North	120	**28**	**23,3%**	92	76,7%
South	353	**113**	**32,0%**	240	68,0%
Norway	1968	**572**	**29,1%**	1396	70,9%

Table 7 brings an overview on how firms in the two regions differ with respect to technology co-operation. The table shows that the share of southern companies performing technology co-operation comes out much higher than in the northern counties. While 32 percent of the southern companies answered that they performed technology co-operation, only 23,3 percent of the firms in the northern region answered the same. The national average was 29,1 percent.

Table 8: Medium-sized and large firms (>50 employees) in northern Norway, southern Norway and Norway with IFU-contracts. Source: SSB R&D survey, 1995.

Region	**Total number of firms asked**	**Firms with IFU contracts**		**Firms with no IFU contracts**	
North	118	**6**	**5,1%**	112	94,9%
South	358	**27**	**7,5%**	331	92,5%
Norway	1980	**134**	**6,8%**	1836	93,2%

The southern companies do also tend to participate in IFU[JE] contracts more often than northern firms (Table 8). While 7,5 percent of the southern companies (27 of 358) had got IFU contracts in 1995, the same share for northern firms was 5,1 percent (6 of 118). The national average was 6,8 percent, or 134 of 1980 firms.

[JE] Industrial R&D contracts; publicly sponsored technology development contracts between large enterprises and SME, aimed at increasing technological flows from large to smaller enterprises (see Hauknes, STEP-report 14/94 pp 46.

Table 9: Medium-sized and large firms (>50 employees) in northern Norway, southern Norway and Norway with OFU contracts. Source: SSB R&D survey, 1995.

Region	Total number of firms asked	Firms with OFU contracts		Firms with no OFU contracts	
North	118	**7**	**5,9%**	111	94,1%
South	356	**20**	**5,6%**	336	94,4%
Norway	1968	**133**	**6,8%**	1835	93,2%

Figures for firms with OFU[Ja] contracts shows that northern enterprises have a slightly stronger tendency to participate than with IFU contracts (Table 9). However, the differences are small; in south and north, respectively 5,6 percent and 5,9 percent of the firms had OFU contracts in 1995. Both areas was below the national average, which was 6,8 percent.

4.2. Firms with 10-50 employees

This sections look at firms with 10-50 employees. We will find that northern firms have a higher share than national average in market co-operation and OFU contracts. The southern firms have a higher rate than national average in IFU and OFU contracts.

Table 10: Small firms (10-50 employees) in northern Norway, southern Norway and Norway with market co-operation. Source: SSB R&D survey, 1995.

Region	Total number of firms asked	Firms with market co-operation		Firms with no market co-operation	
North	197	**49**	**24,9%**	148	75,1%
South	391	**91**	**23,3%**	300	76,7%
Norway	2116	**517**	**24,4%**	1599	75,6%

The share of firms having market co-operation is slightly higher in the northern counties than in the southern (Table 10). 49 of 197 firms (24,9 percent) in Nordland, Troms and Finnmark participates in such co-operation, while 91 of 391 southern firms (23,3 percent) do the same. The national average is 24,4 percent.

[Ja] Public R&D contracts; cases where public procurement agreements demand new technical solutions from the supplying firm.

Table 11: Small firms (10-50 employees) in northern Norway, southern Norway and in Norway participating in technology co-operation. Source: SSB R&D survey, 1995.

Region	Total number of firms asked	Firms with technology co-operation		Firms with no technology co-operation	
North	203	**22**	**10,8%**	181	89,2%
South	407	**49**	**12,0%**	358	88,0%
Norway	2192	**286**	**13,0%**	1906	87,0%

Table 11 looks at share of SMEs participating in technology co-operation. While the national average is 13 percent, 10,8 percent of the northern firms (22 of 203) report they participate in such co-operation. In south, 12 percent (49 of 407) report the same.

Table 12: Small firms (10-50 employees) in northern Norway, southern Norway and Norway with IFU contracts. Source: SSB R&D survey, 1995.

Region	Total number of firms asked	Firms with IFU contracts		Firms with no IFU contracts	
North	198	**6**	**3,0%**	192	97,0%
South	409	**19**	**4,6%**	390	95,4%
Norway	2203	**86**	**3,9%**	2117	96,1%

Table 12 looks at share of firms with IFU contracts. The southern firms have a higher share than both the northern firms and the national average; 4,6 percent, or 19 of 409 firms, have such contracts. The share of northern firms with such contracts is 3 percent (6 of 198 firms), while the national average is 3,9 percent.

Table 13: Small firms (10-50 employees) in northern Norway, southern Norway and Norway with OFU contracts. Source: SSB R&D survey, 1995.

Region	Total number of firms asked	Firms with OFU contracts		Firms with no OFU contracts	
North	198	**7**	**3,5%**	191	96,5%
South	408	**16**	**3,9%**	392	96,1%
Norway	2191	**74**	**3,4%**	2117	96,6%

As for IFU contracts, the figures for OFU contracts are very much the same. Southern firms have a share on 3,9 percent (16 of 408 firms) which is slightly higher than nation average on 3,4 percent. The northern firms have a share almost similar to the national average (7 of 198 firms).

5. Innovation activities

We have looked at two broad ways of measuring innovation activities: a) R&D and education activitites, as research man-years, number and direction of knowledge and private research institutions etc., and b) technology co-operation, as participation in OFU or IFU contracts, or participation in technology and marked co-operation.

How do these two forms of activities correlate with measureable innovation activities in these two regions? In the following, we shall look at four indicators aimed at measuring innovation activities in northern and southern Norway. These indicators are:

- product innovation activities,
- process innovation activities,
- establishment of new markets and

In the first section, we look at the three first indicators and firms with more than 50 employees (medium-sized and large firms). In the neXt section we look at the same indicators for firms with 10-50 employees (small firms). Finally, we look at share of population with formal IT-competencies.

5.1. Innovation in firms with more than 50 employees

In this section, we look at firms with more than 50 employees. We will find that northern firms have a higher rate than national average in process innovation activities while the share on the other variables are similar or less the national average. For the southern firms, they have a higher rate than national average in product innovation, process innovation and new markets.

Table 14: Medium-sized and large firms (>50 employees) in northern Norway, southern Norway and Norway with product innovations. Source: SSB R&D survey, 1995.

Region	Total number OF FIRMS ASKED	Product innovations		No product innovation	
North	120	**29**	**24,2%**	91	75,8%
South	362	**127**	**35,1%**	235	64,9%
Norway	1996	**660**	**33,1%**	1336	66,9%

In a SSB survey, 29 of 120 enterprises (24,2 percent) in the northern counties responded they had introduced new or improved products to the market during the last three years (Table 14). This is nine percent points less than national average, 33,1 percent.

For southern Norway, the share of firms with product innovation was slightly higher; 127 of 362 firms reported product innovations (35,1 percent). This result is slightly higher than the national average.

Table 15: Medium-sized and large firms (>50 employees) in northern Norway, southern Norway and Norway with process innovations. Source: SSB R&D survey, 1995.

Region	Total number of firms asked	Process innovations		No process innovation	
North	116	**33**	**28,4 %**	83	71,6%
South	358	**100**	**27,9 %**	258	72,1%
Norway	1945	**461**	**23,7 %**	1484	76,3%

Table 15 shows how enterprises in the different regions answered to a question on whether they had performed process innovation or not. In opposition to the results that derived from the product innovation survey, both southern and northern Norway came out with a share of enterprises saying they had performed process innovation higher than the national average. 33 of 116 firms in the northern counties (28,4 percent) responded that they had performed process innovations, while 27,9 percent of the southern firms reported the same. The national average was 23,7 percent.

Table 16: Medium-sized and large firms (>50 employees) in northern Norway, southern Norway and Norway reporting they have established new markets. Source: SSB R&D survey, 1995.

Region	Total number of firm asked	Firms with new market		Firms with no new market	
North	117	**31**	**26,5 %**	86	73,5%
South	352	**129**	**36,6 %**	223	63,4%
Norway	1925	**608**	**31,6 %**	1317	68,4%

Innovation in terms of establishing new markets is more likely to take place in southern enterprises. Table 16 shows that more than a third of 352 southern firms answer that they have established new markets the three last years. Hence, southern companies eXceed the national average on 31,6 percent. The share of northern firms answering yes to this question is a bit more than one fourth of 117 firms - 17 percent below the national average.

5.2. Innovation in firms with 10-50 employees

This sections look at firms with 10-50 employees. We will among other things find that northern small firms have a lower share than national average in most indicators, while southern firms have a higher rate in than national average in establishing new markets.

Table 17: Small firms (10-50 employees) in northern Norway, southern Norway and Norway with product innovations. Source: SSB, R&D survey 1995.

Region	**Total number of firms asked**	**Firms with product innovation**		**Firms with no product innovation**	
North	205	**52**	**25,4%**	153	74,6%
South	415	**103**	**24,8%**	312	75,2%
Norway	2237	**616**	**27,5%**	1621	72,5%

Table 17 shows that small firms in northern and southern Norway are quite similar with respect to introducing new products; in both regions, approXimately 25 percent of the firms (52 of 205 / 102 of 415 firms) have had product innovation. This is about 2 percent points below national average for small firms.

Table 18: Small firms (10-50 employees) in northern Norway, southern Norway and Norway with process innovations. Source SSB R&D survey, 1995.

Region	**Total number of firms asked**	**Firms with process innovation**		**Firms with no process innovation**	
North	191	**27**	**14,1%**	164	85,9%
South	406	**59**	**14,5%**	347	85,5%
Norway	2150	**324**	**15,1%**	1826	84,9%

As with product innovation, the figures for process innovation show that small firms in northern and southern Norway have a similar share, although slightly lower than the national average (Table 18). In northern Norway, 14,1 percent of the firms (27 of 191) performed process innovation, in southern Norway the share was 14,5 59 of 406). The national average was 15,1.

Table 19: Small firms (10-50 employees) in northern Norway, southern Norway and Norway reporting they have established new markets. Source: SSB R&D survey, 1995.

Region	**Total number of firms asked**	**Firms with new markets**		**Firms with no new markets**	
North	199	**44**	**22,1%**	155	77,9%
South	403	**100**	**24,8%**	303	75,2%
Norway	2170	**529**	**24,4%**	1641	75,6%

Table 19 brings data on share of firms having established new markets. On this indicator we find that northern firms have a slightly lower rate (22,1 percent) than the southern firms (24,8 percent), but the difference is not significant. 44 of 199 northern firms answered that they had established new markets, while 100 of 403 southern firms answered the same.

6. Analysis

6.1. Innovation and technology co-operation differences between small and large firms

We have looked at four indicators for market and technology co-operation, and we have looked at three indicators on innovation activities (eXcluding regional share of employment with formal IT competencies). For these seven technology indicators we have presented figures for both medium-sized and large firms (more than 50 employees) and small firms (firms with 10-50 employees). Hence, in the following, we would give a summary of regional differences with respect to these seven indicators on the firm size levels.

Counting the seven forms of technology co-operation and innovation in both firm size classes, we have seen that in four of fourteen cases, the northern firms have a higher rate than the national average. Southern firms have scored higher than national average in eight of fourteen times. This is mainly so because of the large southern firms, which in five of seven cases had a higher share than national average.

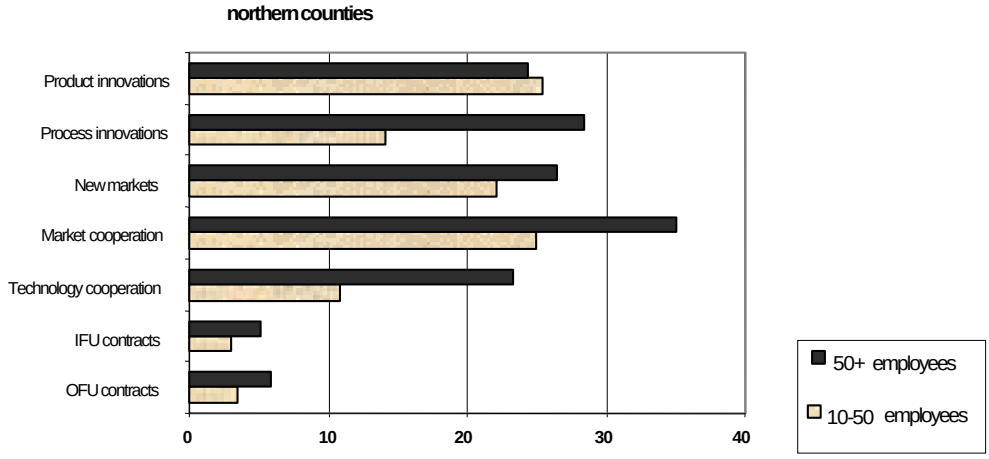
Southern share on innovation indicators was in nine of fourteen times higher than the northern share. The largest differences between northern and southern companies (southern share divided by northern share) was found three times on two indicators, all in favour of southern firms: New products (medium-sized / large firms only) and IFU contracts (both size categories). In all three cases, southern firms had almost 50 % higher share than the northern counties. In the case of market co-operation indicator, the northern medium sized / large firms had the highest share relative to the southern companies, with a difference on approXimately thirteen percent.

Having looked at the regional differences, one central issue remains; how does these indicators vary with respect to firm size? In the following we shall sum up the results from Table 6 - Table 19 with respect to regional differences between different firm categories.

Innovation and firm size in northern counties

How does innovation patterns vary between different firm sizes located within the southern region? Figure 12 shows an overview of seven different indicators for both medium sized and large firms in northern Norway.

Figure 12: Innovation and co-operation indicators for medium-sized / large firms and small firms in northern Norway (in percentages of firms).

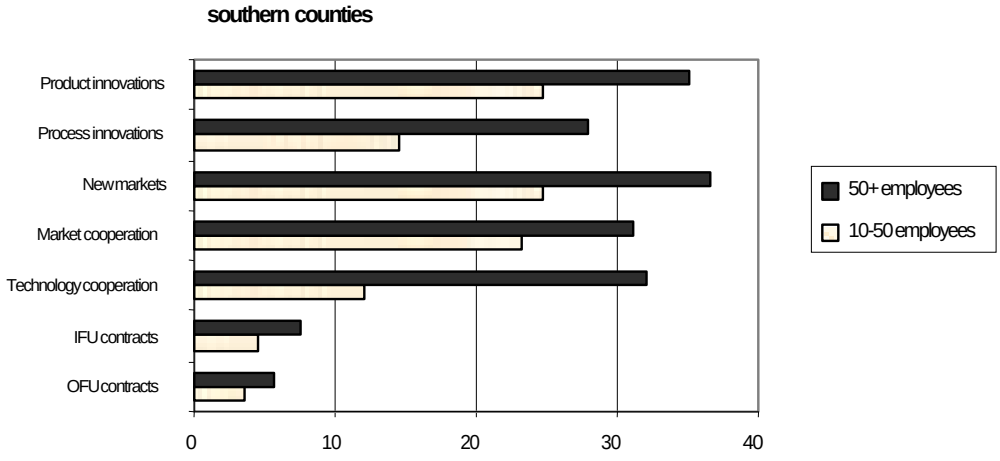


The figure illustrates the difference in innovation activities between small and large firms, as medium-sized and large firms have a higher share on siX of the seven indicators. The difference is particularly big in areas as process innovation, market co-operation and technology co-operation. The only area where small firms have a higher rate than medium-sized and large firms are in product innovation, where the share is 26 percent (vs. 25 percent).

Innovation and firm size in southern counties

Figure 13 looks at difference in innovation-related activites in southern firms, with respect to firm size.

Figure 13: Innovation and co-operation indicators for medium-sized / large firms and small firms in southern Norway (in percentage of firms).



The figure shows that in this region the difference between small and medium-sized/large firms is even larger than in the northern counties. This difference is illustrated in two ways, both by the fact that medium-sized and large firms rates higher than small firms on all seven indicators. The figure also shows that the difference between small and larger firms are generelly larger in the south than in the northern counties. In almost all indicators, the medium-sized / large firms

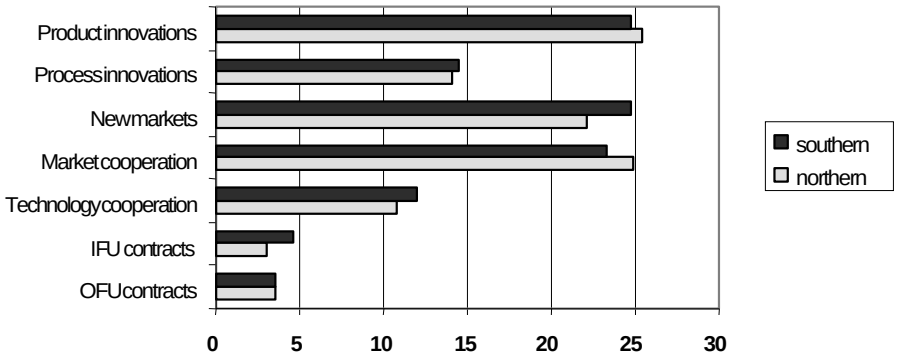
rates more than 50 percent higher than what small firms do. The difference is particularly large in areas like technology cooperation, process innovation and new markets.

Innovation activities in small southern and northern firms

The last question we want to answer in this section, is if we can trace any differences in innovation capabilities between small firms in northern and southern Norway. In Figure 14, we turn once again to the seven technology co-operation and innovation indicators from the previous sections, but now arranged as an comparison on innovation patterns between small firms in northern and southern Norway.

The figure shows that southern firms have a slightly higher share in four of these seven indicators. While the share of northern firms are slightly larger in product innovation and market co-operation, the southern firms show a bit larger share in process innovation, new markets, technology co-operation and IFU contracts. For OFU contracts, the share is the same.

Figure 14: Innovation and co-operation indicators for small firms (10-50 employees) in southern and northern Norway (in percentages of firms).



However, the overall picture is that there are no significant differences in innovation patterns between small firms in northern and southern firms. This is an interesting observation, given the differences between northern and southern Norway with respect to R&D eXpenditures and R&D man-years. Although firms in southern Norway have shown to be much more R&D intensive, the innovation pattern for small firms is almost the same in these two regions. As we have seen (Figure 12 and Figure 13), there are in fact greater difference between small and medium-sized/large firms within the same region than between small firms in respectively northern and southern Norway.

If we look at these result in on the background of the enormous differences in R&D between the two regions, there are clear conclusions to be drawn. The similarity in innovation patterns between small firms in southern and northern Norway shows that R&D eXpenditures as a means to propel innovation are of much lower significance for small firms than for large firms. In spite of the southern region spending much more money on R&D than northern firms, southern small firms do not vary from northern firms with respect to innovation patterns at all. The data therefore suggest that the high southern share of na-

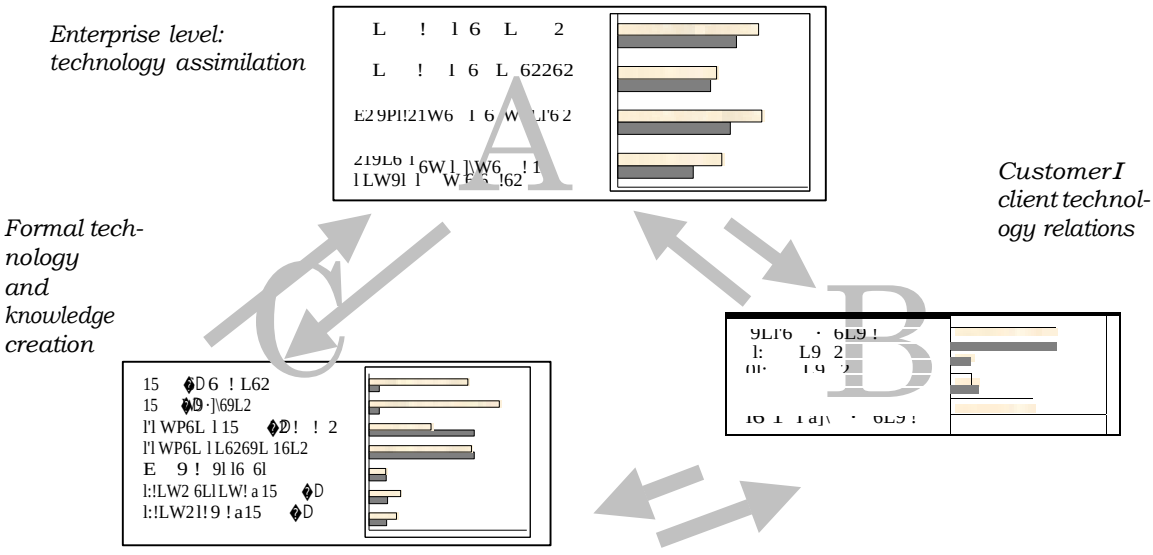
tional R&D eXpenses are mostly due to activities performed by large firms (50+ employees) in southern Norway. It is possible that this finding may eXplain the large difference in innovation patterns demonstrated in Figure 13.

However, as an eXplanation to variances in R&D patterns, me must also bear in mind that there are significant industrial differences between the north and the south. There are slightly more smaller firms in northern Norway than in southern Norway, and the industrial structure in the south are more diversified than the one in the north. The share of employment in northern Norway is larger than the national average in a few large sectors; retail, hotels and restaurants, transport and associated sectors and food and beverages. In the south, the industries which employs more people than national average are industries which are counted for as more R&D intensive; electronics, paper, chemical industries and ferrous metals (Table 5).

6.2. Innovation capabilities in northern and southern Norway

This eXamination of statistical data on southern and northern Norway has pointed to interesting regional differences, both with respect to knowledge and technology creation, knowledge and technology co-operation and technology and innovation activities.

Figure 15: Indicators for innovation capability in southern (bright floaters) and northern (dark floaters) Norway. All single indicators for each region are only relative to same indicator for other region.



In Figure 15 we have gathered the results from the indicators presented above. The floaters give an indication on how the two different regions perform in different areas, relative to the other region[:)9].

[:)9] All indicators show level in one region *relative to the other region*. Hence, one indicator level are not comparable to other indicator levels. Indicators for new products, new processes or new markets (boX A) show share of firms (all sizes) performing innovation activity. R&D eXpenditure and R&D man years is measured as region's share of national

The figure shows that firms in northern Norway have a slightly lower innovation rate than southern Norway. This goes for all innovation indicators; product development, process development, establishment of new markets and IT employment. Firms in southern Norway also have a higher tendency than northern firms to perform or finance R&D activities. Southern firms do also have a higher ratio in most co-operation indicators (technology co-operation, IFU and OFU contracts). In addition, there is a profound difference in R&D eXpenditure relative to number of employees, with southern firms raging 10-15 times as high as northern firms.

There are also a set of similarities between the two regions. Number of researchers and average educational level (percentage of persons with background from university or college) is quite the same in both regions. Share of firms with OFU contracts is also almost similar in these two regions.

There are two indicators in which northern Norway is ranked higher than southern Norway. Northern Norway has more R&D institutions than southern Norway, and northern firms also tend to establish market co-operation more often than southern firms.

Conclusion - Northern Norway

On the one hand this investigation has pointed to several indications on northern Norway having a lower innovation capacity than the south. The region is marked by large industrial sectors which traditionally are described as 'low-tech'[:)J], with food processing, transport and hotels/restaurants and retail as the largest sectors (both measured in number of employees and as share of work force). The homogenous industry structure stands in relief to the southern counties, which have a relative specialisation[:):)] in areas as ferrous metals, chemicals, paper and electronics. Firms in northern Norway perform very little R&D, and share of persons with formal IT education is much lower than southern and in particular national share.

Northern Norway is also marked by a high share of small firms, which - according to our statistical data - are performing less innovation activities than both national average and large firms in the same region. This result goes well together with the fact that northern firms have less access to a skilled labour force than the firms in the south, and that northern firms rarely perform R&D activities. However, we have pointed to the fact that innovation patterns in small firms do not vary substantially from innovation patterns in southern small firms.

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activity, relative to share of manufacturing employment. Number of R&D institutions and number of researchers are in real figures. Educational level is share of persons with university or college education. Firms performing or financing R&D are as share of firms. Technology co-operation indicators (boX c) include both firm size classes (10-50 and 50+), and show share of firms performing that type of technology co-operation.

[:)J] Accoring to OECD's definition. This definition does however not tell anything about the industry's knowledge intensivity; see Dietrichs (1995) for a different approach to categorisation of industries by mapping knowledge bases of the industry's activities.

[:):)] Share of employees in industry larger than national share

On the other hand, the rate of knowledge and technology creation is large in northern Norway. Compared to population size, there are much more students and researchers in the north than in the south, and more private and public institutions for higher education and research[03]. These interesting facts lead us to several seemingly contradictory issues. First, there is a contradiction between number of researchers (high) and number of R&D man-years (low). Secondly, we have the discrepancy between educational level (low) and number of students (high). Last, we have the difference between number of R&D institutions (high) and industrial innovation activity (low).

Ultimately, these findings indicate that northern Norway is a region with a substantial technology or knowledge creation, manifested as high, formal competencies, but with a low ability to use or transform such qualities into economic practice. The high number of researcher and the low rate of enterprise R&D eXpenditure suggest that most of northern R&D is performed in public institutions, with few links to economic activity. It therefor seems that northern firms have proved little use of the local knowledge suppliers that are located within these counties.

The difference in institutional infrastructure in the two regions eXplains the difference in number of students. In northern Norway there are twice as many educational institutions than in the south (eight / four). In addition, as we have seen, one of the most important factors eXplaining the high number of students in northern Norway is University of Tromsø, with 7.000 students. The low number of students in southern Norway (compared to population) may come from the fact that there are no university located in the southern region. It is likely to assume that most southern students attending university are enregistered in universities in Bergen, Trondheim or Oslo, all universities located outside the area we have defined as southern Norway.

Conclusion - southern Norway

Southern Norway has a more diversified economy than the northern counties, with higher share of employment than national average in areas as ferrous metals, chemicals, paper and electronics. R&D and business services also constitute a large sector, measured in number of employees. This mirrors the fact that southern counties have in average a higher of persons with IT education than northern counties.

As for northern Norway, there are relatively many small firms in this region. Though the southern SMEs seems to be as innovative as the northern SMEs, they are all much less innovative than larger firms in the same area. It is also clear that even though the share of people with higher education is higher than the northern counties, the southern share of people with higher education still is less than national average.

An interesting observation is that even though there are fewer R&D institutions and fewer researchers than in the north, the southern firms are above both northern and national average in terms of purchasing R&D services. This may very well go together with the fact that it is the largest firms in southern Nor-

[03] One eXplanation for this is that many R&D institutions - and one university - are located in the closely localised capital area of Oslo.

way which stands for most of the innovation activity in this region. Of seven innovation indicators, large firms scored higher than SMEs in all. A central aspect eXplaining this pattern is that many firms also buy scientific knowledge outside their region. Central suppliers to industries in this region are first and foremost public and private research institutions in Oslo and Akershus, two urban counties located geographically close to what we here have termed Southern Norway.

To summarise, southern Norway is marked by higher industrial differentiation and higher R&D efforts than the north, and with SMEs representing little of the innovation activities in this region.

In Table 20, we have summed up some of the findings in this paper.

Table 20: Summing up the results

	Northern Norway	**Southern Norway**
demography/ geography		
industrial structure		
firm size structure		
education		
R&D and higher education		
technology co-operation		
innovation activities		

6.3. Methodological remarks

Use of statistical indicators always brings forth questions on data relevancy. In this paper we have presented several indicators on innovation activities, in order to illustrate innovation capabilities in northern and southern Norway. Innovation capability is a compleX and abstract term, as it includes both technology and knowledge creation and diffusion between firms and between a firms and

their socio-institutional surroundings. There is a general agreement[)'f] among policy-makers working on innovation-studies that there is a long way ahead in developing relevant indicators for innovation-related economics. In this paper, we have used eXisting data on indicators spanning from product development, formal skills, R&D activities to market and technology co-operation. These are useful indicators in the way that they are directly concerned with economic innovation and development. We have directly been able to describe how firm perform technology co-operation, how often they perform product and process innovation and so on, core features in the approach we have chosen for this paper. The width and variations of these indicators also suggest that we have been successful in demonstrating multiple sides of the dynamic economics of these two areas.

At the same time, in order to fully describe innovation capabilities, there are central indicators missing. We have not been able to illustrate in which degree the technology co-operation is taking place with regional partners, nor have we illuminated how such a technology collaboration is actually taking place. In order to strengthen the systemic aspect of this investigation, we could have looked at figures for personnel mobility, in order to illustrate formal knowledge flows and technology borders between different industries. Neither have we been able to bring up figures for informal skill creation. A presentation of figures from these indicators could have improved the picture of innovation capabilities in the northern and southern Norway.

All in all, however, it is the authors opinion that this report gives a good indication on which elements that constitute the innovation capability in the two regions. It is however important to be aware of the premises and limitations of this survey.

Data sources

The data used in this presentation stem from several sources. Below, we present an overview of information related to these datasources.

[)'f] See for eXample OECD 1996; The knowledge-based economy

Table 21: Datasources

Dataset	Source	Comment
Norwegian Enterprise Register	Norwegian Bureau of Statistics (SSB)	Data are collected on a yearly basis, and information about employment and industries account for given year. The database is supposed to cover all firms located in Norway, but about 10-20 percent of enterprises misses out each year.
University and college R&D	Norwegian Institute for Studies on Research and Education	Information gathered biannually through questionnaires to R&D-performing institutions (universities, colleges and R&D institutes)
R&D survey	Norwegian Bureau of Statistics (SSB)	Information gathered biannually through questionnaire. Data cover activities for *all* firms with 50+ employees (in 1995: 2.557 firms) and *randomly picked* 2.820 firms with less than 50 employees.
Employment register	Norwegian Bureau of Statistics (SSB)	Database covering all firms located in Norway (location, size, industry) and their employees (seX, age, highest education, personal income). Based on data from employer-register (Rikstrygdeverket), person statistics (SSB), Norwegian VAT register (momsregisteret) and taX register (Skattedirektoratet). Updated yearly. Some misleading information involved; firms and persons missing, firms obviously given wrong NACE codes, invalide organisation numbers etc.

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STEP gruppen

STEP-gruppen ble etablert i 1991 for å forsyne beslutningstakere med forskning knyttet til alle sider ved innovasjon og teknologisk endring, med særlig vekt på forholdet mellom innovasjon, økonomisk vekst og de samfunnsmessige omgivelser. Basis for gruppens arbeid er erkjennelsen av at utviklingen innen vitenskap og teknologi er fundamental for økonomisk vekst. Det gjenstår likevel mange uløste problemer omkring hvordan prosessen med vitenskapelig og teknologisk endring forløper, og hvordan denne prosessen får samfunnsmessige og økonomiske konsekvenser. Forståelse av denne prosessen er av stor betydning for utformingen og iverksettelsen av forsknings-, teknologi- og innovasjonspolitikken. Forskningen i STEP-gruppen er derfor sentrert omkring historiske, økonomiske, sosiologiske og organisatoriske spørsmål som er relevante for de brede feltene innovasjonspolitikk og økonomisk vekst.

The STEP-group was established in 1991 to support policy-makers with research on all aspects of innovation and technological change, with particular emphasis on the relationships between innovation, economic growth and the social context. The basis of the group's work is the recognition that science, technology and innovation are fundamental to economic growth; yet there remain many unresolved problems about how the processes of scientific and technological change actually occur, and about how they have social and economic impacts. Resolving such problems is central to the formation and implementation of science, technology and innovation policy. The research of the STEP group centres on historical, economic, social and organisational issues relevant for broad fields of innovation policy and economic growth.