

6. Research and development

The first phase of the innovation process often starts with research and development (R&D). The basic knowledge required to produce high quality and high-tech products for goods and services alike is created through this R&D. However, R&D and the commercialisation of its results do not necessarily take place within one and the same region, a fact that can also affect regional economic growth¹. Regional income from R&D investments depend on several factors such as: supplementary R&D activities with other economic activities along the value chain; the aim of R&D activities (basic research, applied research or experimental development), and the size of the regional home market and access to capital. The time factor also plays an important role since successful innovation processes often have a time horizon of several decades. A specialised R&D sector of relevant size and quality is a first step towards economic success in the modern knowledge economy.

Measured in this way, the Öresund region takes a leading role in the Nordic countries as well as in Europe (see Chapter 5 Industry). This prominence is also visible in the access to capital – and foreign capital – to finance research and development. It can also be said that the general climate for foreign investments in the Nordic countries, Denmark in particular, is one of the best in the world².

¹This fact is supported by several empirical studies. Further evidence was given in a study from 2006, where the connection between both R&D intensity as the rate of patents on the one hand and economic development (measured as GDP growth per inhabitant) on the other was compared for 240 European regions (NUTS 2 regions). The study maintains that the region which invested the most in R&D, Braunschweig in Germany, is at the same time the fourth worst region measured in economic growth. Conversely, none of the regions in the Top 10 Growth League have an R&D intensity exceeding two percent (Hanell, T & Neubauer, J: Geographies of Knowledge Production in Europe. Nordregio WP 2006: 3).

²Forbes Capital Hospitality Index 2008. The Nordic countries are in descending order (world ranking in parentheses): Denmark (1), Finland (3), Sweden (6) and Norway (15).

R&D investments

Investments in research and development are a central measure of the ability and commitment of regions to increase basic knowledge. However, this is not necessarily the same thing as commercial production of innovative R&D results. The Lisbon Strategy, which aims to make the EU the most competitive knowledge economy in the world, lists the intensity of R&D investments as one of the fourteen indicators to measure success. The target for 2010 is an investment level of at least 3 percent as a share of GDP, of which two thirds are to be financed through the business sector.

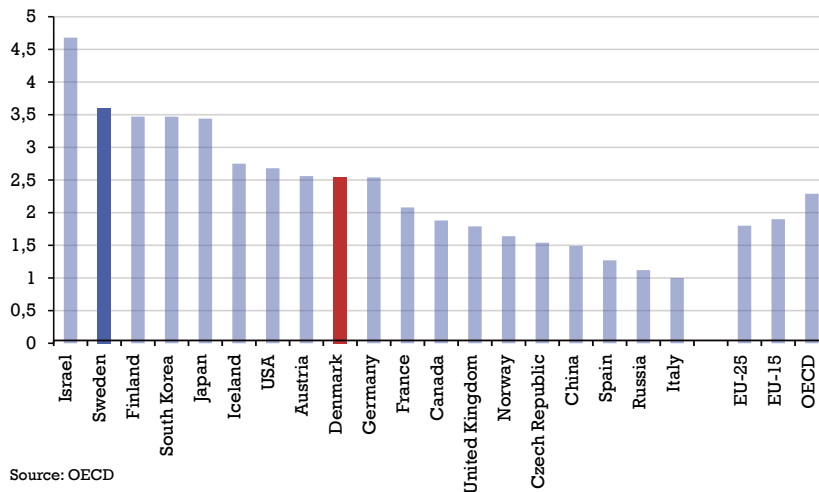
With the exception of Norway, the Nordic countries together with Japan are world leaders concerning total R&D investments. In 2007 Sweden and Finland made R&D investments above the targets of the Lisbon Strategy. Denmark and Island had lower but still considerably higher levels compared to the average for the EU and the OECD. Nearly two thirds of R&D expenses were

financed by the domestic business sectors, a high share from an international perspective. The situation is similar to the conditions in the United States, Germany and Switzerland.

Only Japan and Luxembourg exhibit larger financial contributions from the business sector. The remaining investments are mostly from public sources within the countries. In

Denmark and Sweden nearly one-tenth of R&D investments come from abroad. The share of foreign R&D investments from abroad is even a bit larger in Iceland.

R&D expenses as a share of GDP within the OECD in 2007



Source: OECD

Looking at the R&D commitment from the business sector in relation to total investments, there is a clear connection between these investments. That is to say, the higher the investments from the business sector, the higher the level of general investments in the country³. This connection is equally clear in most of the Nordic regions. The Öresund region is among the leading European regions when it comes to R&D expenses as a share of GRP.

Even though the Öresund region cannot be considered as a functionally united region today, we see that a considerable amount of total R&D investments in Denmark and Sweden are concentrated in the Öresund region. Of the total R&D investments in

³Hanell, Neubauer 2006

R&D expenditure as a share of regional GRP, leading regions in the EU in 2005 (current prices in EUR).

Rank	Country	Region	R&D as share of GRP
1	Germany	Braunschweig (2005)	5.83
2	Sweden	Western Sweden (2005)	5.40
3	Germany	Stuttgart (2005)	5.37
4	Finland	Pohjois-Suomi (2006)	4.79
5	Germany	Oberbayern (2005)	4.71
6	Sweden	Stockholm (2005)	4.29
7	France	Midi-Pyrénées (2004)	4.15
8	Sweden	East central Sweden (2005)	3.99
9	Germany	Tübingen (2005)	3.94
10	Germany	Karlsruhe (2005)	3.92
11	Denmark/Sweden	Öresund region (2007)	3.90
12	Germany	Berlin (2005)	3.82
13	Finland	Länsi-Suomi (2006)	3.70
14	Germany	Dresden (2005)	3.55
15	Austria	Vienna (2006)	3.54
16	Finland	Etelä-Suomi (2006)	3.54
17	Austria	Steiermark (2006)	3.47
18	France	île de France (2004)	3.15
19	Netherlands	Noord-Brabant (2005)	3.07
20	Germany	Darmstadt (2005)	2.99

Calculations by Region Skåne.

Footnote: The Öresund region is not included in Eurostat's NUTS classification but is calculated as a model based on statistics from the national statistical agencies in Denmark and Sweden.

Denmark and Sweden in 2005, 32 percent were allocated to the Öresund region. The region has also increased its share over time. In 1997 the Öresund region accounted for 25 percent of total R&D investments from the business sector in Sweden and Denmark, showing an increase of 7 percentage points in 2005.

It is a consistent pattern that most of R&D investments occur in metropolitan areas. Investments from industry in Denmark are largely concentrated to Öresund DK and to the Capital Region of Denmark in particular. About 74 percent of Danish R&D investments from the business sector were for Öresund DK: 71 percent for the Capital Region of Denmark and 3.1 percent for Region Zealand. In Sweden, most of these investments are in Stockholm, followed by Västra Götaland county and Öresund SE.

Even in Sweden, considerable parts of industry's R&D investments occur in the capital city region, but Stockholm's role is not as

dominant in Sweden as Copenhagen is in Denmark. About 33 percent of industry's R&D investments are made in Stockholm county, followed by 27 percent in the Västra Götaland region and 18 percent in Öresund SE (figures from 2007).

However, when measuring R&D spending as a share of gross regional product the picture looks different. Among the Nordic regions, western Sweden (Gothenburg) is highest with 5.40 percent. Stockholm and east central Sweden are farther down on the list at 4.29 and 3.99 percent respectively. However, the total Öresund region is farther down on the list at 3.90 percent.

An important explanation as to why several German and Swedish regions are ranked high on the list of R&D investment is that much of these investments are concentrated in the automotive industry that is highly concentrated to places like Braunschweig and western Sweden.

The structure of investments is nearly identical on both sides of the sound. Significant and market-oriented R&D investments from the business sector (three fourths) are combined with more moderate investments from universities and government agencies. (However, the picture in Region Zealand looks a little different with more activity from government agencies). Stockholm is characterised by the same pattern. In western Sweden (Gothenburg) and in Etelä-Suomi (Helsinki) however, industry and government agencies are stronger R&D actors than in the Öresund area.

Regional R&D investment among the neighbours of the Öresund region is generally moderate bordering on weak. St. Petersburg and Berlin are the main areas investing more intensively in research and development, but Hamburg is also another area investing in R&D. In Berlin, R&D investments from industry account for only half of the investments, while investments from government agencies are more than

three times larger than in the Öresund area. In Warsaw, government is nearly as strong a player as industry is in the Capital Region of Denmark. Like Helsinki, Hamburg and Tallinn have a weaker emphasis from industry in their investment portfolio while government investment is larger. In line with this, research and development in the eastern European metropolitan areas in the Baltic Sea area are generally less market-oriented than in the Nordic countries.

In the academic area, the Öresund region has two world-class universities and three top European universities, giving the region a strong position within the Nordic countries and among its closest neighbours in northern Europe. Only Stockholm has an equally strong ranking (See section later in this chapter and chapter 3 Education).

If the investments are compared internationally in nominal amounts such as above in euros, it is not certain that a similarly large sum can finance as much research and devel-

opment in different countries and regions. This is of course due to differences in the structure of industry, direction of research and different cost structures. Another part of the explanation are the salary differences among countries and regions, and also among industries.

Differences in purchasing power for investment/expenditure are normally adjusted with different price indices. However, this is not possible in the R&D sector. As in so many other service industries, research and development requires sufficient staff. Thus, the main part of R&D investments go to salaries, which roughly account for two thirds of the costs in the case of the Öresund

¹⁴No statistics exist in Denmark and Sweden on the R&D investments of the sectors by type of expense. However, in Germany these questions exist in R&D surveys. In the German surveys, it is shown that about two-thirds of R&D expenses go to financing salaries for most industries, especially in the R&D sector. (Stifterverband für die Deutsche Wissenschaft: FuF-Datenreport 2007. Tabellen und Daten, s. 38 Tabelle 14).

region¹⁴. Even if it is currently not possible to analyse the effects of these conditions in detail, it is reasonable to assume that R&D investments on the Danish side of the sound probably have lower purchasing power and thus finance less R&D than their counterparts in Sweden. This fact is even more significant when making the same comparison between the regions of western and eastern Europe. The differences in purchasing power may significantly affect the pattern of R&D investment in Europe in the longer term.

Innovation

The ability of companies to transform research, other knowledge and ideas to new commercial products and processes is vital for increasing the ability of global competition for the region. However, this ability is difficult to measure, partly because the concept is difficult to define and partly because of a considerable lack of regional data.

The EU-supported survey “Regional Innovation Scoreboard” makes an attempt to

measure the ability of regions to innovate. According to the survey, the regions in Sweden and Denmark are among the most innovative in Europe. The survey is based on an index that is a weighted total of 17 different indicators broken down into three main groups: *Background facts that promote innovation* (public R&D, higher education, access to broadband etc), *innovation activities in companies* (R&D expenses, patents etc.) and *performance factors* (employees in the high-tech sector, sales of products that are new to the market, new innovation companies etc.). The latest survey was published in December of 2009 and refers to data for 2006. Unfortunately, the statistics from Denmark are not broken down regionally but refer to the entire country. Denmark as a country belongs to the regions judged to have the greatest ability to innovate, while Öresund SE belongs to the second highest group.

Leading universities

The Öresund region plays a leading role in the Nordic countries and in Europe regard-

ing academics, with contributions from the Danish as well as Swedish sides. The region is also globally well positioned.

To compare universities internationally is not easy. This is especially true with regard to their quality of instruction in complicated areas such as education and research. One of the most well established international comparisons of the quality of instruction among universities in both these areas is published annually by the Institute for Higher Education at Shanghai's Jiao Tong University. Over 2 000 universities from all over the world are included in the comparison, where they are ranked according to a quality evaluation in the following six fields (weights stated in parentheses):

- Persons who are employed by the university and have won a Nobel Prize or another distinguished award in their area of research (10 percent)
- Persons who have studied or conducted research at the university and won a No-

bel Prize or another distinguished award in their area of research outside the university (20 percent)

- The most often cited researchers in 21 broad subject categories (20 percent)
- Articles published in Nature and Science (20 percent)

- Articles in citation databases such as Science Citation Index Expanded, Social Science Citation Index and Arts and Humanities Citation Index (20 percent)
- Academic performance with regard to the size of the university (10 percent)

Nordic universities in JTU's 2009 World class Top 100

Universities	Global position	European position	National position
University of Copenhagen	43	8	1
Karolinska Institute	50	10	1
University of Oslo	65	18	1
Uppsala University	76	23	2
Stockholm University	88	28	3
University of Aarhus	97	31	2
Technical University of Denmark	152-200	59-79	3
Lund University	101-151	33-58	4
University of Southern Denmark	303-401	126-170	4
Royal Institute of Technology	201-302	80-125	5-7
Umea University	201-302	80-125	5-7
University of Gothenburg	201-302	80-125	5-7
Chalmers University of Technology	303-401	126-170	8-9
Swedish University of Agricultural Sciences	303-401	126-170	8-9
Linkoping University	402-501	171-208	10-11
Stockholm School of Economics	402-501	171-208	10-11

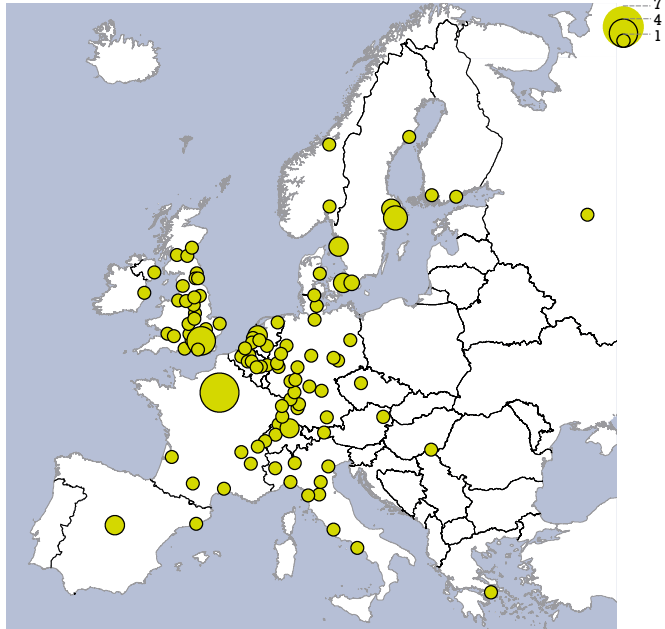
Source: www.arwu.org

Copenhagen University is the leading academic environment of the Nordic countries today and has in recent years risen in the ranks to surpass Karolinska Institute in Stockholm. The two universities are now respectively in eighth and tenth place in Europe. Of the universities with higher academic standards on the top ten list in Europe are four from the U.K (Cambridge University, Oxford University, Imperial College London and University College London), one in Switzerland (Swiss Federal Institute of Technology) one in France (University of Paris) and one in the Netherlands (University of Utrecht). Lund also takes a forward position in Europe. Lund is also one of the two Nordic universities outside the capital cities ranking among the hundred highest quality universities in the world.

However, from a broader European perspective, Stockholm clearly has more high-performance universities than the Öresund region (compare with the map of Number of top 100 universities in Europe). The

Technical University of Denmark as well as Chalmers and Gothenburg University are among the hundred foremost universities in Europe, although the latter two have a lower rank than the former. In general terms, the leading academic environments in Europe are concentrated in the central section of western Europe, with London and Paris as the centre. Eastern Europe is clearly outside this area. Further, most of the world leading universities are outside of Europe and are mostly in North America.

Number of top 100 universities in Europe



Source: Institute for higher education at Shanghai Jiao Tong University. Map: Nordregio