

Statistiska centralbyrån Statistics Sweden

# Science and Technology Indicators for Sweden 2007

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Statistics Sweden  
2009

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# Foreword

Statistics Sweden carries out statistical surveys on the resources devoted to R&D in Sweden. The surveys cover R&D activities within the four sectors; Business Enterprise Sector, the Higher Education Sector, the Government Sector (governmental agencies, county councils and municipalities) and the Private Non-profit Sector.

This booklet aims to provide an overview of science and technology indicators for Sweden 2007. International and national science and technology indicators have also been put together in order to get an overall picture of the R&D system in Sweden as well as comparisons with other countries.

Statistics Sweden, January 2009

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Lars Melin



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# What is R&D?

## R&D definitions

This booklet contains tables and charts on intramural R&D statistics and other science and technology indicators.

The statistics on research and development in Sweden use definitions and breakdowns based on those developed within The Organization for Economic Co-operation and Development (OECD).

Research and development activities (R&D) are defined as systematic work to find new knowledge or ideas with or without the aim of a particular purpose. Systematic work is further defined as that which uses research results, scientific knowledge or new ideas to bring about new material goods, services, processes, systems, methods, or significant improvements of those that already exist.

## Break in series

- In 2005 small enterprises (10–49 employees) were included in the Business Enterprise Sector for the first time. Figures for Business Enterprise sector in 2005 have also been revised.
- In 2005 municipalities and county councils were included in the Government sector for the first time.
- ALF (Agreement for Medical training and Research) resources, refers to an agreement on compensation that the central government pays to certain county councils to cover the majority of costs that clinical training and research incur. ALF resources are reported both in the R&D survey in the higher education sector and in the Government sector. In this publication the ALF resources are only included in the Higher Education sector.

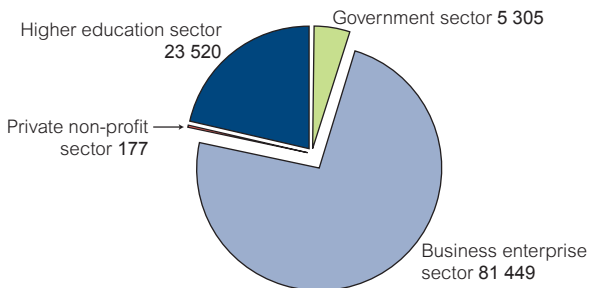


# What is the extent of R&D in Sweden?

## R&D expenditure

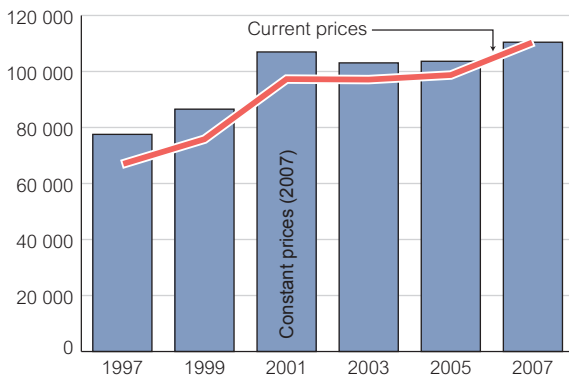
R&D activities are carried out in different sectors of society to various degrees. The main part of R&D expenditure in Sweden is in the business enterprise sector and accounts for about 74 percent of all R&D expenditure in Sweden. Aside from the business enterprise sector, higher education sector is also involved with R&D to a great extent. Of all R&D expenditure in the country, higher education sector account for 21 percent of the expenditure, amounting to SEK 23.5 billion. The public sector accounts for 5 percent of Sweden's total R&D expenditure, and the private non-profit sector contributes about 0.16 percent of Sweden's total R&D expenditure.

### Total R&D expenses in 2007, by sector *SEK millions*



For the first time since the end of the 1990s, R&D expenditure in 2003 dropped but increased again in 2005<sup>1)</sup> as well as in 2007.

### R&D expenditure in Sweden 1997–2007 in current and constant prices SEK millions

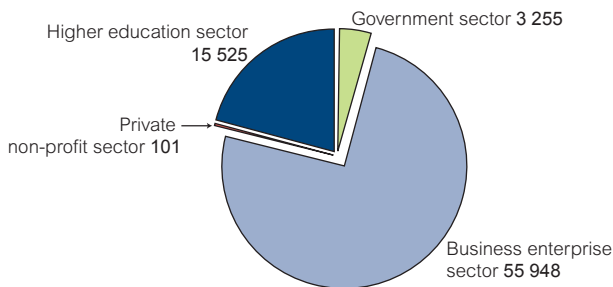


1 Break in series, see page 7.

## R&D man-years

As shown in the pie chart below, the business enterprise sector dominates R&D activities in Sweden also when looking at the number of R&D man-years carried out. A man-year is the work completed by one full-time employee during one year. In total, 75 percent of R&D man-years were carried out within the business enterprise sector. Within the higher education sector, 21 percent of all R&D man-years were carried out. Combined, the business enterprise sector and the higher education sector account for 96 percent of the total number of man-years in Sweden.

### Total number of man-years devoted to R&D 2007, by sector



## R&D expenditure as a share of GDP, international comparison

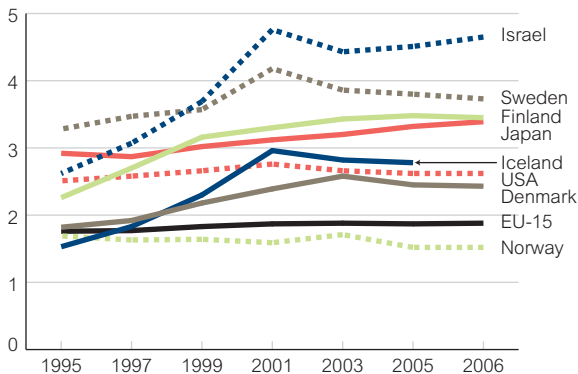
For many years Sweden has reached the goal of the Lisbon Strategy, which states that EU countries should invest 3 percent of GDP on research and development, and that at least two-thirds of these investments should come from the business enterprise sector. The Swedish business enterprise sector alone accounts for 74 percent of all Swedish R&D investments. Expenditure from the business enterprise sector accounts for 2.65 percent of GDP<sup>2)</sup> in 2007. However, between 2003 and 2005, the total R&D share of GDP and the share from the business enterprise sector dropped.

The following graph on the next page illustrates R&D expenditure as a share of GDP from a number of countries from 1995 to 2006. Israel has the highest proportion of R&D and also shows the largest increase during the period. Most of the countries show a tendency towards a weakening in the rate of increase of their R&D expenditure, measured as a share of GDP. Among the Nordic countries, Sweden together with Finland has raised its R&D share the most during the 1990s, mainly due to strong development in the business enterprise sector. Iceland has also developed well during the period, while the US shows a low growth rate when R&D expenditure are related to GDP. Of the Nordic countries, only Norway shows R&D expenditure below the EU 15 average.

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<sup>2)</sup> GDP November 2008

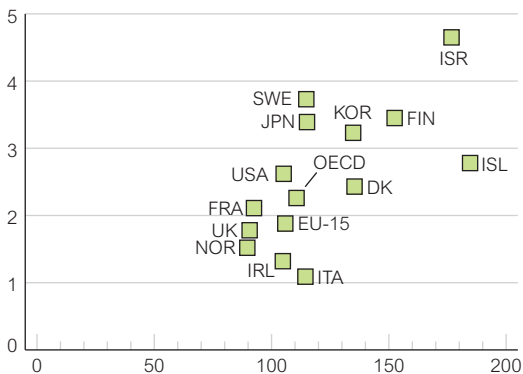
## R&D expenditure as a share of GDP in an international comparison 1995–2006 *Percent*



Source: Main Science and Technology Indicators 2008-1, calculations by Statistics Sweden

Development of R&D expenditure as a percentage of GDP can be followed better when indexed as in the following graph. When development is seen over a ten-year period for a number of countries, it is clear that Iceland is the country that has increased its share the most and has an R&D share close to 3 percent of GDP. Finland and Denmark have increased their R&D proportions more than Sweden. However, Norway shows a reduced R&D share over the ten-year period. Israel has the highest R&D share and also shows one of the strongest increases from an international perspective during the period.

## R&D expenditure as a share of GDP in percent together with index of this share from 1995 to 2006



Source: Main Science and Technology Indicators 2008-1, calculations by Statistics Sweden

# Where does R&D occur?

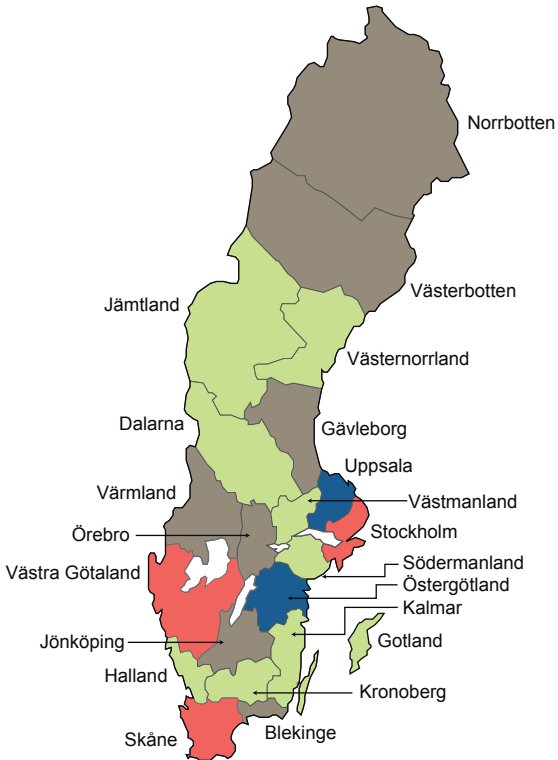
R&D activities in Sweden are concentrated to those counties where the largest businesses are located, as well as to areas with universities and institutes of higher education. As seen in the following table and chart, total R&D expenditure is

## Regional distribution of R&D expenditure 2007

*SEK millions*

	2007
Stockholms County	35 888
Västra Götalands County	25 838
Skåne County	18 032
Östergötlands County	6 841
Uppsala County	5 276
Västerbottens County	2 242
Örebro County	1 601
Norrbottnens County	1 506
Jönköpings County	1 378
Blekinge County	1 293
Värmlands County	1 245
Gävleborg County	1 090
Kronobergs County	859
Södermanlands County	850
Västernorrlands County	788
Dalarnas County	720
Västmanlands County	707
Kalmar County	427
Hallands County	281
Gotlands County	134
Jämtlands County	36
Not regionally distributed	3 419

highly concentrated to the three metropolitan counties of Stockholm, Västra Götaland and Skåne. About 72 percent of total R&D expenditure comes from these three counties.





# Who conducts R&D?

As illustrated in the table, the proportion of man-years carried out by women and men varies among different sectors.

The total proportion of man-years performed by men in R&D is 70 percent. The highest proportion of man-years performed by women is in the higher education sector, 46 percent. Also within the private non-profit sector, which is not presented in the table below, the share of R&D person years carried out by women was high. The highest proportion of man-years performed by men is in the business enterprise sector.

## R&D man-years 1997–2007 broken down by women and men

### Business enterprise sector

	Women	Men	Total
1997	24%	76%	43 881
1999	25%	75%	44 171
2001	25%	75%	49 433
2003	25%	75%	48 113
2005	25%	75%	56 106
2007	25%	75%	55 948

### Higher education sector

	Women	Men	Total
1997	35%	65%	18 197
1999	37%	63%	19 175
2001	38%	62%	19 837
2003	46%	54%	21 176
2005	46%	54%	17 686
2007	46%	54%	15 525

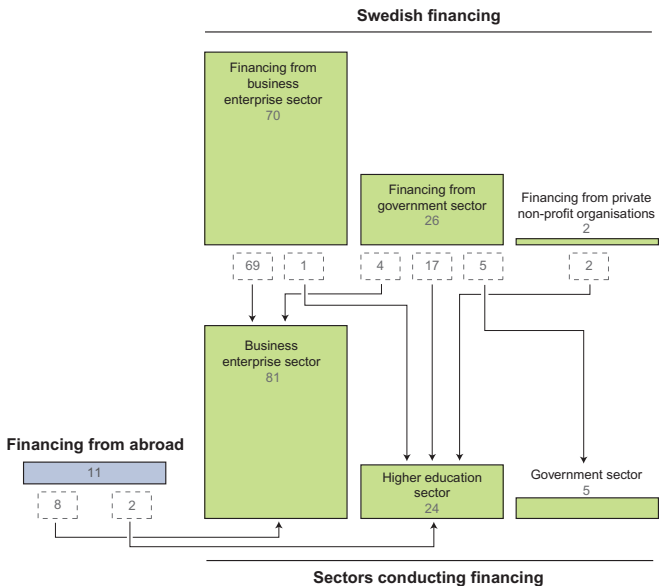
### Government sector

	Women	Men	Total
1997	33%	67%	3 334
1999	33%	67%	3 195
2001	32%	68%	2 817
2003	34%	66%	3 000
2005	36%	64%	3 391
2007	36%	64%	3 255

# How is R&D financed?

The flow chart on the next page illustrates the main financing flows among the various R&D financiers and the sector conducting R&D. In the business enterprise sector R&D activities are largely financed by funds from companies (85 percent). Financing is done by the enterprises themselves or by other companies. Financing of higher education sector shows another pattern with mainly public financing of which the government appropriations comprise a significant part. The government sector's own R&D activities are financed by public funds and mainly by government appropriations or funds from the military. Financing from abroad comprised slightly less than SEK 11 billion of R&D financing in 2007.

# Financing of R&D in Sweden in 2007 SEK billions



# Which results do the R&D activities lead to?

## Innovations

Innovations are based on results either from new technological development or new combinations of existing technologies, which means that R&D is an important component of the innovation process.

As shown in the table on the next page, 45 percent of the Swedish companies were innovative during 2004–2006. Among the Nordic countries, Finnish enterprises take the lead in innovation activities (51 percent) while Norway comes in last (36 percent). Germany is the leading country with the highest share of enterprises with innovation activities (63 percent). 20 percent of the Swedish enterprises introduced both product and process innovations. 13 percent of the Swedish enterprises introduced product innovation only and 10 percent process innovation only.

## Percentage of companies with innovation activities 2004–2006

Country	Companies with innovation activities	Product-innovative	Process-innovative	Product and process-innovative	Companies with ongoing and/or abandoned innovation activities
Austria	51	10	14	25	1
Belgium	52	11	13	22	5
Denmark	47	9	12	16	10
Finland	51	13	11	22	5
Germany	63	19	9	27	8
Ireland	47	15	12	19	2
Luxembourg	48	17	6	23	2
Netherlands	36	11	9	14	2
Norway	36	12	7	12	5
Sweden	45	13	10	20	2
United Kingdom	38	..	..	..	..

Source: Eurostat

## Patents

A patent is often seen as a measure of the result of technologically oriented research. When companies invest capital and time to obtain the protection of a patent, the patent is regarded as an indicator of expectations that such investments will generate income as compensation for the investment. Thus the patent represents an important source to illustrate patterns of technological changes. However, all inventions or innovation activities do not result in patents and all patents are not used with an economic aim in sight.

When the number of patent applications at the EPO (European Patent Office) measured in millions of inhabitants are studied, we see that there were 248 applications in Sweden in 2005. This is an increase compared to 2003, as shown in the table below. Sweden took fourth place in the number of applications in 2005. This can be compared to the EU 15 average which was 137 applications in 2005, and the OECD average which was 103 applications during the same year. In comparing the Nordic countries, Finland had the most applications in 2005, or 260 applications. Switzerland had the most applications to the EPO per million inhabitants, or 410 applications.

## Number of patent applications at the EPO per million inhabitants 1995–2005

	1995	1997	1999	2001	2003	2005
Canada	28	41	52	53	56	70
Denmark	95	118	160	167	187	190
Finland	141	198	273	264	242	260
France	86	104	119	118	126	127
Germany	159	213	254	263	262	278
Iceland	42	58	128	73	107	85
Ireland	28	36	62	63	55	63
Japan	100	121	146	154	164	172
Korea	10	14	22	34	66	105
Luxembourg	79	121	141	163	195	220
Netherlands	113	155	187	241	210	199
Norway	55	71	83	78	73	92
Sweden	173	233	247	235	222	248
Switzerland	237	302	346	379	365	410
United Kingdom	66	79	98	93	90	85
United States	81	94	108	104	108	111
Total OECD	63	79	93	94	98	103
<b>EU-15</b>	<b>83</b>	<b>108</b>	<b>129</b>	<b>132</b>	<b>132</b>	<b>137</b>

Source: Main Science and Technology Indicators 2008-1, calculations by Statistics Sweden

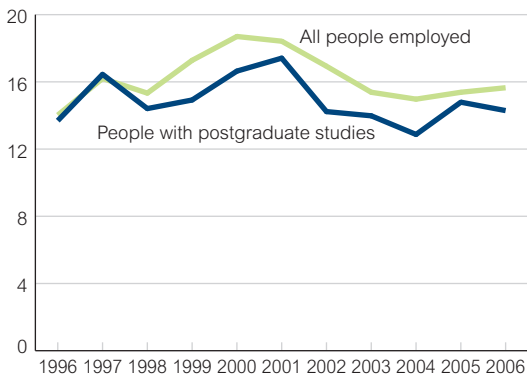


## Mobility among the highly educated

The importance of knowledge diffusion and knowledge transfer are often mentioned as vital factors to create sustainable economic growth. A way which enables knowledge transfers, especially tacit knowledge, is when people change workplace and bring their know-how to a new setting. The mobility of people with postgraduate studies is especially important to consider as a source of specialized knowledge.

Mobility, here defined as the proportion of individuals within a group which change workplace between two years, was slightly lower for people with postgraduate studies compared with all people employed during the period 1996–2006.

### Mobility among all people employed and people with postgraduate studies 1996–2006



## Doctorate holders

Doctorate holders, being the highest educated group, are considered most likely to contribute to the advancement and diffusion of knowledge and technologies. As such, they often are seen as one of the key actors behind the creation of innovation and knowledge-based economic growth. Therefore, it is especially interesting to study these people in detail.

The number of doctorate holders was estimated to be 54 894 in 2006. About one third of these were women and two thirds were men. Most of the doctorate holders were within the age class 35–44 years old.

### Number of doctorate holders by sex and age class 2006

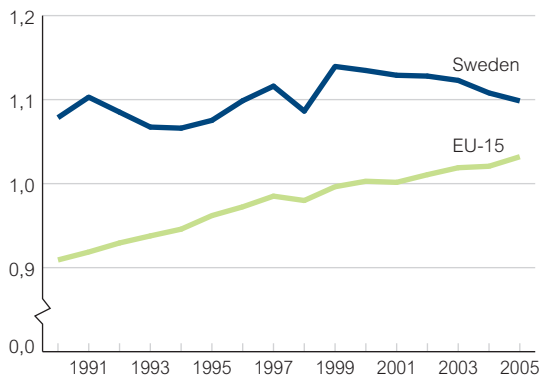
	Men	Women	Total
Less than 35 years old	4 224	3 142	7 366
35–44 years old	10 121	5 880	16 001
45–54 years old	9 055	4 447	13 502
55–64 years old	9 623	3 759	13 382
65–69 years old	3 542	1 101	4 643
<b>Total</b>	<b>36 565</b>	<b>18 329</b>	<b>54 894</b>

# Scientific Publications

Bibliometrics are often used to measure scientific productivity by the number of publications and the impact the publications have on the scientific community by the number of citations they receive. Though, the average citation rate of Swedish publications give a reflection of how Swedish publications are noticed by the scientific world.

The citation rate of Swedish publications decreased slightly between 1999 and 2005 while that of the EU-15 countries increased.<sup>1)</sup>

## Field normalised citation rate, 1990–2005



Source: Thomson Reuters and Swedish Research Council

1 The citation statistics are based on all citations received during the publication year and the two following year.

The following table show the publication volume and average citation rate for the 10 most highly cited countries 2004–2006. United States maintain a leading position in terms of both volume and number of citations. The publications from Switzerland are cited second highest followed by Netherlands and Denmark. Sweden is found on position six.

### Publication volume and average citation rate 2004–2006

	Number of publications per year	Average citation rate
USA	269 066	1.34
Switzerland	11 253	1.31
Netherlands	17 605	1.23
Denmark	6 335	1.23
United Kingdom	64 396	1.13
Sweden	12 302	1.11
Canada	34 152	1.07
Germany	57 780	1.05
Belgium	9 105	1.05
Finland	6 387	1.03

Source: Thomson Reuters and Swedish Research Council



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