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# Research and Development in International Enterprises 1999



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## Summary

Studies in research and development (R&D) cover 20 large Swedish manufacturing groups and foreign owned enterprises in Sweden. In total R&D expenditure has increased in Sweden between 1997 and 1999, close to SEK 7 billion and almost 300 employees (person-years).

### *Large Swedish groups in manufacturing industry*

R&D expenditure continues to remain at a high level. The focal point of R&D still remains in Sweden, although the large Swedish manufacturing groups have the majority of their employees abroad (70 per cent). Approximately 6 out of 10 employees working in R&D were in Sweden 1999.

In relation to GDP, Sweden has the highest level of R&D investment amongst OECD countries. Enterprises account for the majority of R&D expenditure, 2.86 per cent out of 3.80 per cent of GDP. In addition, R&D expenditure is still highly concentrated in a few large internationally active groups of enterprises. The manufacturing groups studied also had in 1999 more employees in R&D – both in Sweden and abroad – than the whole industrial sector had in Sweden in 1999.

The expenditure of large manufacturing groups on R&D amounted in 1999 to almost SEK 45 billion, of which approximately SEK 26 billion was in Sweden. Share of large manufacturing groups in R&D was 58 per cent in Sweden.

The number of R&D person-years in the 20 largest manufacturing groups together amounted to close to 39 000. Of these 16 800 R&D person-years were located abroad. Large manufacturing groups' R&D intensity (share of total employees in R&D activities) in Sweden is slightly more than three times higher than abroad.

The level of education of those carrying out R&D in large manufacturing groups does not vary much between Sweden and abroad. R&D person-years carried out by persons with higher education qualifications was close to 80 and 83 per cent in Sweden and abroad respectively. The number of R&D person-years with postgraduate qualifications in 1999 amounted to 4 077, of which approximately 2 200 were in Sweden. This means that slightly more than half of total research years were accounted for by staff in Sweden.

The R&D of large manufacturing groups is mainly located in the three large urban areas and also Västmanland and Östergötland. In Skåne, Västmanland, Dalarna and Blekinge, foreign owned enterprises dominate R&D spending.

Abroad large manufacturing groups had most employees in R&D activities in EU countries, followed by NAFTA (USA, Canada and Mexico) and the Nordic area. The USA, Germany and Italy were the three largest single countries.

The most important explanation for increases abroad was mainly access to outstanding research environments. In addition, there is a need to be able to adapt products or processes to specific customer/market requirements and also increased demand for the enterprise's services.

Almost all large manufacturing groups considered that the state can take measures allowing them to maintain or increase R&D expenditure in Sweden, at least in the long-term. Increased investments in education and research was given priority by many large manufacturing groups. Lower income tax was also mentioned by a number of the groups as an urgent priority.

### ***Foreign owned enterprises***

R&D activities have approximately doubled in foreign owned enterprises between 1997 and 1999. Their share of R&D person-years in the business sector increased from 19 to 36 per cent. Foreign owned enterprises spent nearly SEK 21 billion on R&D in Sweden, which was approximately SEK 2 billion more than large Swedish manufacturing groups invested abroad. Enterprises from the UK, USA and Switzerland invested most in R&D. Foreign owned enterprises dominated investments in medicine and the natural sciences in Sweden. Foreign owned enterprises accounted for most postgraduate and female researchers. Foreign owned enterprises and Swedish owned enterprises had 11 and 7 per cent researchers in their R&D. Female researchers accounted for 51 and 31 per cent respectively.

The main explanation for the increase in R&D expenditure in foreign owned enterprises in Sweden is that some Swedish groups with substantial R&D were taken over by foreign enterprises during the period 1997-1999. If these changes in ownership had not taken place, the figures would have shown rapid increases in the R&D of Swedish enterprises.

### ***Publications***

The Swedish Institute for Growth Policy Studies (ITPS) has in co-operation with Statistics Sweden (SCB) studied the scope and focus of research and development in international enterprises in 1999. ITPS took over responsibility for official statistics on *International Enterprises* from NUTEK (Swedish Business Development Agency) 2001-01-01. These reports can be obtained free of charge (as well as older reports) from the ITPS website [www.itps.se](http://www.itps.se). Publications are no longer issued in printed form.

### ***Brief overview of the study***

The study was based on a questionnaire to the 20 large groups in manufacturing industry, which dominate the activities of Swedish enterprises abroad and also R&D investments in the business sector in Sweden. The majority of these groups belong to the machinery/engineering industry. Three forestry groups and two in the chemical industry, as well as one group in steel and metal works are also included. In addition to the questionnaire, the ITPS register of foreign owned enterprises was combined with SCB's regular study of R&D in Sweden in 1999, and the results compared. There is also data about foreign owned enterprises with at least 50 employees. Comparisons have also been made between all Swedish and foreign owned enterprise R&D in Sweden. See also *Methods and quality assurance* at the end of the report.

### **Definition of international enterprises**

International enterprises consist of Swedish owned enterprises with subsidiaries abroad and foreign owned enterprises with subsidiaries in Sweden. Thus the term "international enterprise" refers to enterprises which have a company in at least two countries. An enterprise is defined as foreign owned if an owner outside Sweden has more than 50 per cent of the voting rights in the company. All other enterprises that are not defined as foreign owned are regarded as Swedish owned enterprises. The term "large groups" means that they have many employees abroad. Other information on variables etc can be found in the section *Methods and quality assurance*

## R&D in large manufacturing groups in 1999

### *International enterprises still dominate R&D in Sweden.*

In relation to GDP, Sweden has the highest level of investments in R&D amongst OECD countries. Enterprises account for the majority of R&D expenditure in Sweden, i.e. 2.86 per cent out of 3.80 per cent of GDP. In addition R&D expenditure in Sweden is still highly concentrated in a few large internationally active enterprise groups, both in terms of expenditure and person-years.

The 20 manufacturing groups studied also had in 1999 more employees in R&D – both in Sweden and abroad – than the whole of industry had in Sweden in 1999, with 38 850 and 35 380 person-years respectively. A comparison between R&D expenditure of large manufacturing groups and industry<sup>1</sup> shows that they account for 62 per cent of all R&D person-years and 56 per cent of all R&D expenditure in Sweden. The dominance of these groups measured in R&D person-years (number of employees) was thus somewhat higher than when measured in terms of R&D expenditure.

Approximately one-third of all employees in R&D in enterprises takes place in foreign owned enterprises. They increased their share from 19 to 36 per cent of all employees in enterprises R&D in Sweden between 1997 and 1999. In industry their share approached 40 per cent in 1999.

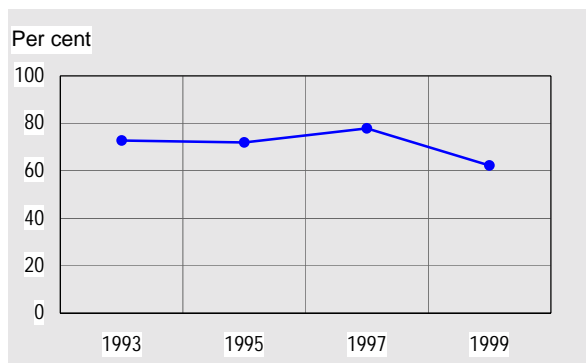
Some large Swedish manufacturing groups became foreign owned between 1997 and 1999, which means that the number of Swedish enterprises decreased and foreign enterprises increased their share of R&D in Sweden between these years. Despite these changes in ownership, R&D is still highly concentrated in a few large international groups in Sweden.

The large manufacturing groups studied had a total of 532 300 employees in 1999, of which 379 400 (71 per cent) were abroad. Of the 20 groups, five of them account for the majority of R&D in Sweden, approximately 91 per cent of R&D person-years in these groups in Sweden. These groups accounted for close to 80 per cent of the R&D of the 20 groups abroad in 1999 measured in R&D person-years.

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<sup>1</sup> R&D in the whole of industry (SCB's regular study) does not cover enterprises with fewer than 50 employees, while the questionnaire to the 20 large manufacturing groups, covering all companies irrespective of size,

**Diagram 1: Share of R&D person-years in the large manufacturing groups in Sweden 1993-1999**



The large manufacturing groups had 38 850 person-years in R&D which can be compared with close to 44 200 in the whole of the enterprise sector's R&D in Sweden. Their total R&D expenditure amounted in the same year to SEK 45 billion, which corresponds to 79 per cent of aggregate R&D expenditure in the enterprise sector in Sweden in 1999.

The five groups investing most in R&D in Sweden accounted in 1999 for 51 per cent of industry's total R&D expenditure in Sweden and for 57 per cent of all R&D person-years in industrial enterprises in Sweden.

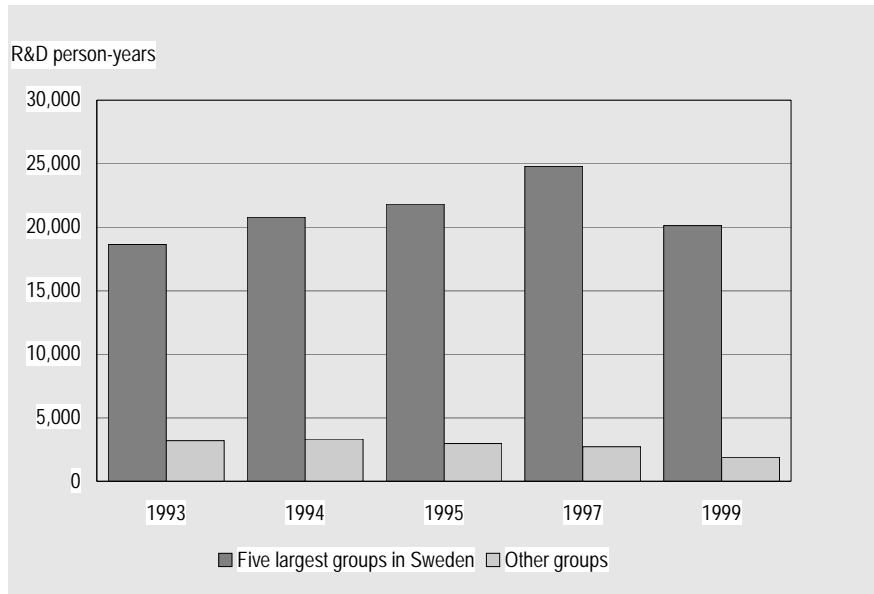
Fourteen of the 20 groups in 1999 were in the machinery/ engineering industry. These accounted for approximately 78 per cent of the large groups' employment abroad and 79 per cent of their employment in Sweden. Operations of Swedish enterprises abroad are thus still dominated by large manufacturing groups and especially the machinery/engineering industry.

### ***The focal point of R&D still remains in Sweden***

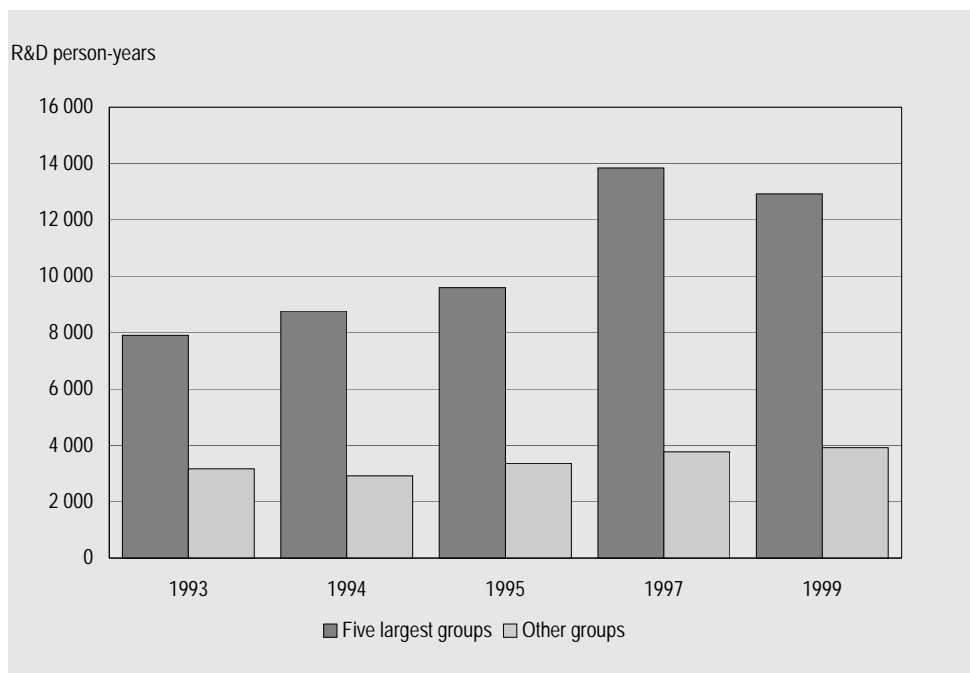
R&D expenditure of large Swedish manufacturing groups is still higher in Sweden than abroad. In these enterprises in Sweden about 22 000 person-years in R&D were carried out, and in subsidiaries abroad about 16 800 R&D person-years. Out of a total of SEK 45 billion R&D expenditure, SEK 26 billion was invested in Sweden.

The number of R&D person-years – both in Sweden and abroad –in the 20 largest manufacturing groups amounted in total to close to 38 850 in 1999. This is 6 300 lower than in 1997. Between 1997 and 1999 the amount of R&D person-years decreased both totally and in relative terms more in Sweden (20 per cent) than abroad (5 per cent). This change is mainly due to foreign acquisition of a number of large Swedish groups.

**Diagram 2: R&D person-years in the large manufacturing groups in Sweden 1993-1999**



**Diagram 3: R&D person-years in the large manufacturing groups abroad 1993-1999**

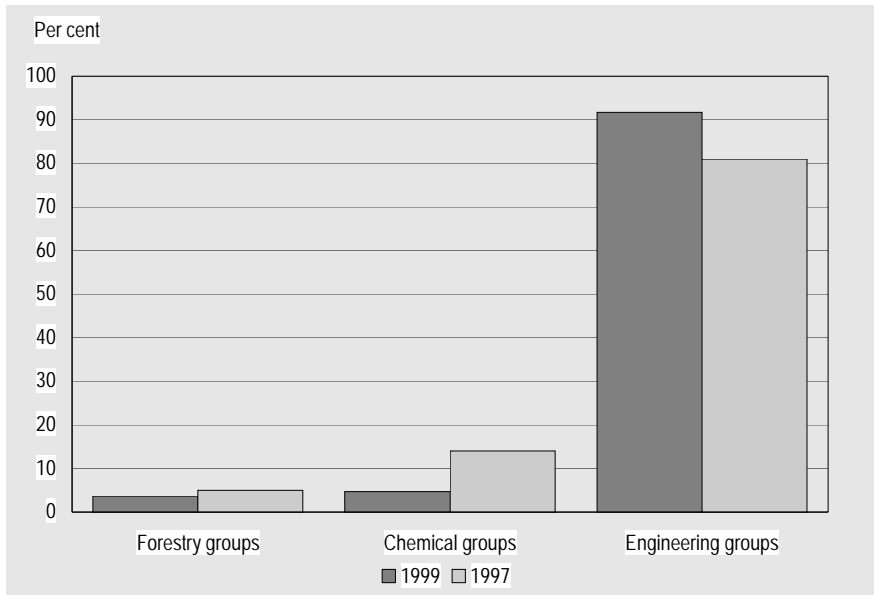


Despite the fact that the number of R&D person-years in large manufacturing groups decreased abroad, the share of R&D abroad increased from 39 to 43 per cent and the share in Sweden decreased from 61 to 57 per cent between 1997 and 1999. The reason for this is

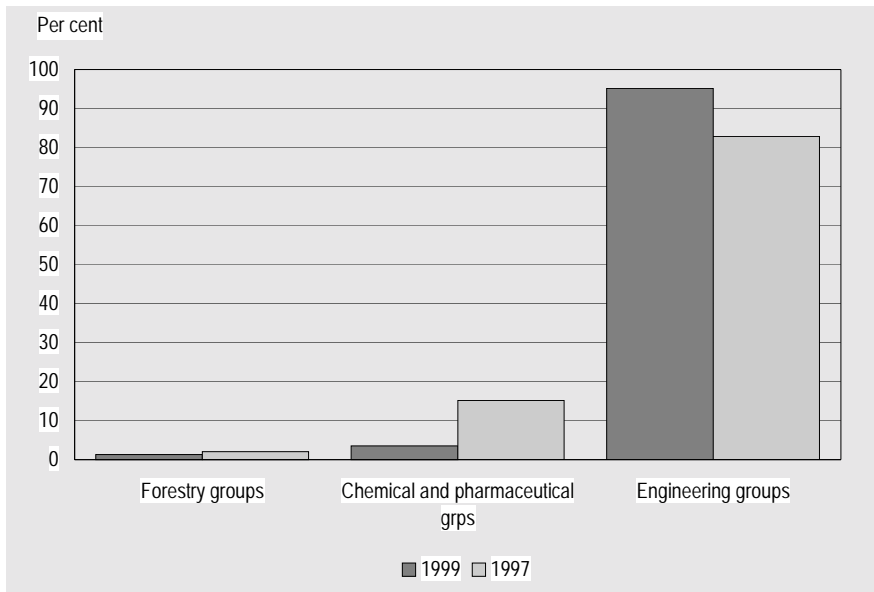
that the groups which were no longer included in the survey carried out most of their R&D in Sweden.

The machinery/ engineering groups accounted for the overwhelming share of R&D person-years abroad, close to 95 per cent. The groups included in other activities (chemicals excl. pharmaceuticals, steel and metal works) accounted for approximately 3 per cent of this expenditure, and forestry groups for the remainder.

**Diagram 4: R&D person-years in Sweden in the large manufacturing groups 1999 and 1997. Distribution by industry in per cent**



**Diagram 5: R&D person-years abroad in the large manufacturing groups 1999 and 1997. Distribution by industry in per cent**





### *The USA is still the largest investor in R&D*

The majority of R&D abroad is still carried out in the USA. Also in Germany and Italy, there is substantial R&D activity. Even though the largest amount of R&D in an individual country outside Sweden was carried out in the USA, the EU countries still as a whole dominated R&D expenditure. In terms of R&D person-years abroad, 52 per cent, or approximately 8 800 R&D person-years were carried out in the EU countries. The EU's share declined and NAFTA's (USA, Canada and Mexico) increased between 1997 and 1999.

**Table 1: R&D person-years, R&D expenditures (MSEK) and number of employees in large manufacturing groups.**

<i>Location</i>	<i>R&amp;D expenditures</i>		<i>R&amp;D person-years</i>		<i>Average number of employees</i>	
	1999	1997	1999	1997	1999	1997
<b>Total in world</b>	<b>44 975</b>	<b>46 332</b>	<b>38 846</b>	<b>45 135</b>	<b>532 720</b>	<b>574 449</b>
<b>Sweden</b>	<b>25 922</b>	<b>29 767</b>	<b>22 022</b>	<b>27 517</b>	<b>153 617</b>	<b>185 174</b>
<b>Abroad</b>	<b>19 053</b>	<b>16 565</b>	<b>16 824</b>	<b>17 618</b>	<b>379 103</b>	<b>389 275</b>
EU 15	9 055	8 760	8 814	10 013	168 324	193 077
NAFTA	7 425	6 088	5 660	5 170	102 125	86 569
Norden	1 732	1 481	1 669	1 740	20 214	23 216

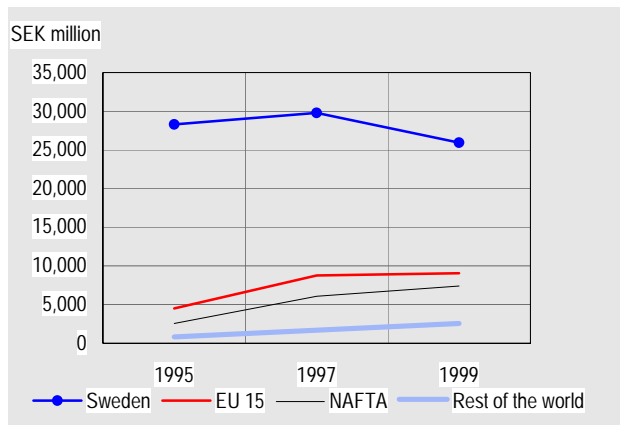
#### **Noter**

Some large Swedish groups came under foreign ownership during 1997-1999 but were included in the studies 1993-1994, 1995 and 1997. Instead three new manufacturing groups with less R&D activity have been included. These are changes to be taken into account when making comparisons between years. Denmark and Finland are included in both the Nordic area and EU 15.

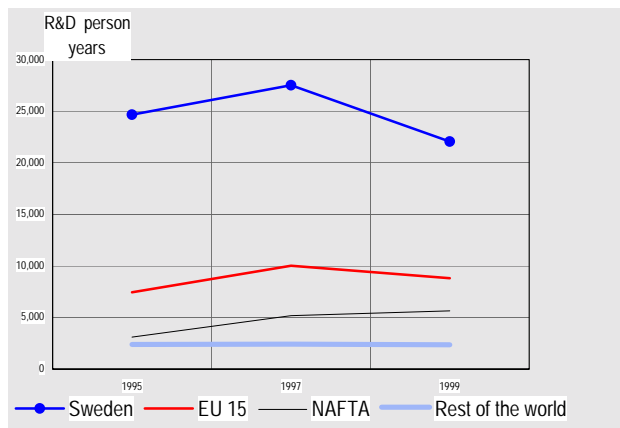
Swedish owned enterprises in the USA carried out 4 400 R&D person-years in 1999. This was 15 per cent more than in 1997. The relative increase was highest in France. The increase was close to 25 per cent between 1997 and 1999. In the UK, however, R&D person-years decreased by 61 per cent. This was largely related to the fact that certain groups were taken over by foreign owned enterprises between 1997 and 1999.

The NAFTA countries accounted for 34 per cent of R&D person-years. The shares of Latin America and Asia were both 3 per cent each. R&D person-years in the Nordic area amounted to 10 per cent. R&D in the Nordic countries has remained at a stable level for a long time.

**Diagram 6: R&D expenditure in large manufacturing groups 1999, 1997 and 1995. Distribution by region in per cent**



**Diagram 7: R&D person-years in the large manufacturing groups 1999, 1997 and 1995. Distribution by region**



### ***High R&D expenditure in Sweden and low internationalisation of R&D***

Large manufacturing groups' expenditure on R&D amounted in 1999 to almost SEK 45 billion, of which approximately SEK 26 billion was in Sweden. The share of large manufacturing groups' R&D was 42 per cent (36 per cent in 1997) abroad and 58 per cent in Sweden (64 per cent in 1997).

The amount of R&D abroad varies greatly between different groups and industries. The machinery/engineering groups with 43 per cent had a share which was somewhat higher than the average for large manufacturing groups. The groups classified under other activities, where chemical (excl. pharmaceuticals) as well as steel and metal works are covered, had a much lower share of foreign R&D than the average for large manufacturing groups, 31 per cent. The share of R&D carried out abroad was lowest in forestry groups, 23 per cent.

Alternatively, large manufacturing groups can be divided into two groups: those with a high share of R&D abroad, and those with a low share. Having a high share of R&D abroad means that the share produced outside Sweden is 50 per cent or more. In 1999 around 10 groups had more than half of their R&D abroad. These groups produced three quarters of their R&D abroad and in 1999 accounted for only 11 per cent of total R&D

expenditure of large manufacturing groups. Their R&D shares in Sweden and abroad were 5 and 19 per cent respectively.

The second group, which consists of some ten groups, has a low R&D share abroad. On the other hand, this group had the largest total investment in R&D. These groups had an average R&D share abroad of 38 per cent. In this group, there were several groups accounting for a large part of total R&D in the large manufacturing groups.

**Table 2: R&D expenditures (MSEK) in large manufacturing groups. Distribution by high and low R&D share abroad.**

<i>Share of R&amp;D</i>	<i>R&amp;D expend. SEK million</i>			<i>Share of R&amp;D abroad</i>
	<i>Total</i>	<i>Sweden</i>	<i>Abroad</i>	
<b>R&amp;D-activity 1999</b>				
High	4 892	1 219	3 673	75
Low	40 083	24 703	15 380	38
Total	44 975	25 922	19 053	42
<b>R&amp;D-activity 1997</b>				
High	4 363	1 130	3 233	74
Low	41 969	28 637	13 332	32
Total	46 332	29 767	16 565	36

**Notes**

High R&D share: The Group's R&D abroad was 50 per cent or more in 1999.

Low R&D share: The Group's R&D abroad was less than 50 per cent in 1999.

### ***R&D intensity highest in Sweden***

R&D intensity refers to how large a share of available resources are invested in research and development. Here R&D intensity is measured as R&D person-years in relation to total number of employees. The R&D of large manufacturing groups in Sweden showed higher R&D intensity than foreign groups, 14 and 4 per cent respectively. R&D intensity is a relational measure and thus influenced by factors other than purely R&D investments, e.g. the total number of employees. This means R&D intensity can decrease even though R&D person-years increases substantially.

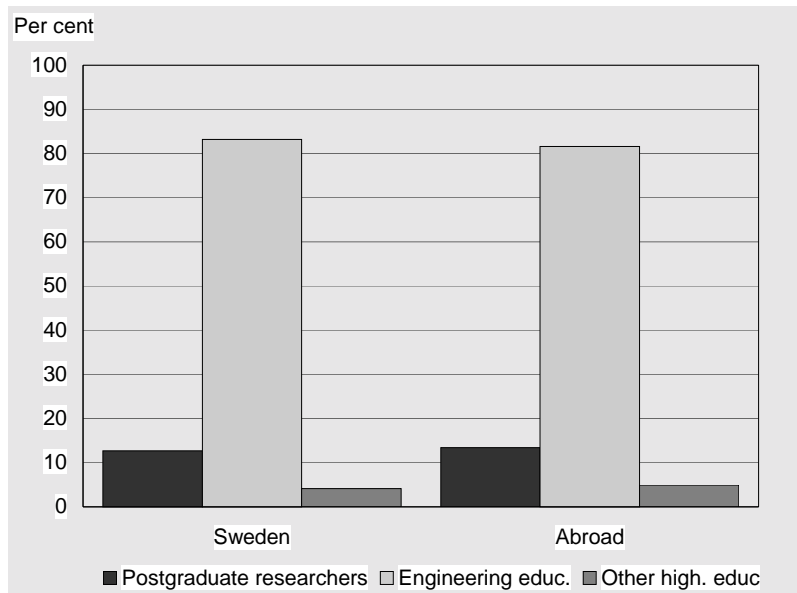
### ***Persons with higher education qualifications dominate R&D***

More than three-quarters of all R&D person-years in Sweden in 1999 were carried out by persons with persons with higher education qualifications (at least a three year post upper secondary education). The share abroad was somewhat higher. Of persons with higher education qualifications, approximately 13 per cent had postgraduate qualifications (licentiates and doctors), which was somewhat lower than in Sweden.

The share of engineers, approximately 80 per cent of all R&D employees, was approximately the same size in Sweden and abroad. Included in this category are all categories

with an engineering based education, including architects. It is difficult to translate foreign educational qualifications into their Swedish equivalents and care must be taken in interpreting these figures.

**Diagram 8: The R&D Educational structure of large manufacturing groups 1999**



***The state can contribute to making Sweden attractive in terms of R&D***

The latest studies of R&D in large manufacturing groups in Sweden and abroad have been supplemented by questions on how and why changes in R&D have taken place in different countries. In addition, one question has been put on the role of the state, namely the extent to which R&D activity of large manufacturing groups in Sweden can be influenced.

The groups accounting for the major increases in R&D between 1997 and 1999 abroad, stated that there had been an organic expansion and also in one case establishment of a new R&D facility. The most important explanation for increases abroad was mainly access to outstanding research environments. The attractiveness of a country is related to the existence of other innovative enterprises with high-quality requirements and access to research needed to fulfil their development needs. In addition, there was a need to be able to adapt products or processes to specific customer/market requirements and increased demand for the enterprise's services.

Almost all large manufacturing groups considered that the state can take measures allowing them to maintain or increase R&D expenditure in Sweden, at least in the long-term. Increased investment in education and research was given priority by many large manufacturing groups. Lower income tax was also mentioned by a number of groups as an important priority. The measures which most groups considered important appear in the table below.

**Table 3: Are there any government measures that would influence your group's future R&D activities in Sweden?**

Number of responses	Measures which large manufacturing groups considered most important by number of responses
7	Improve higher education, especially technical
6	Lower taxes, especially income taxes
4	Coordinate support to and strengthen research at universities and university colleges

Some groups also mentioned the following measures:

- Changes in costs and tax burden
- Support for developing new projects which are not given priority in core activities
- Increased public procurement
- Make it easier for larger numbers of foreign researchers to work for shorter period in Sweden
- Conditions of employment
- Support cooperation projects between schools and enterprises

## R&D in foreign owned enterprises in Sweden 1999

In 1999 the total number of employees in foreign owned enterprises was approximately 397 665. At the end of the year there was a total of 4 263 enterprises, where more than half the voting rights were owned by a foreign investor. Share of foreign owned enterprises of all employees in the business sector has continued to increase and amounted in 1999 to 17 per cent and 19 per cent in 2000. In 1999 a total of 354 enterprises with a foreign owner in Sweden were covered in the statistics on R&D. These enterprises had 149 098 employees, corresponding to approximately 37 per cent of the total number of employees in foreign owned enterprises in Sweden.

A comparison shows that R&D measures of foreign groups in Sweden was greater than those of Swedish groups abroad. In 1999 foreign owned enterprises invested almost SEK 21 billion in R&D in Sweden, which was approximately 2 billion more than investments of large manufacturing groups in R&D abroad.

On the other hand, measured in person-years R&D of large manufacturing groups was somewhat higher abroad than foreign owned enterprises' R&D in Sweden, 16 800 and 15 700 respectively.

**Tabell 4: Table 4: R&D in international enterprises 1993-1999.**

<i>Enterprise group</i>	<i>R&amp;D person-years</i>			
	1999	1997	1995	1993
Swedish enterprises abroad	16 824	17 618	12 953	11 075
Foreign enterprises in Sweden	15 682	8 455	8 369	4 835

### **Noter**

Some of the changes over time are due to foreign acquisition of Swedish groups.

R&D statistics in enterprises, where foreign owned enterprises are reported, in principle do not cover enterprises with fewer than 50 employees.

Changes over time in Table 4 must be interpreted with caution. As a result of changes in ownership, some large groups have changed nationality between 1993 and 1995, and also between 1997 and 1999.

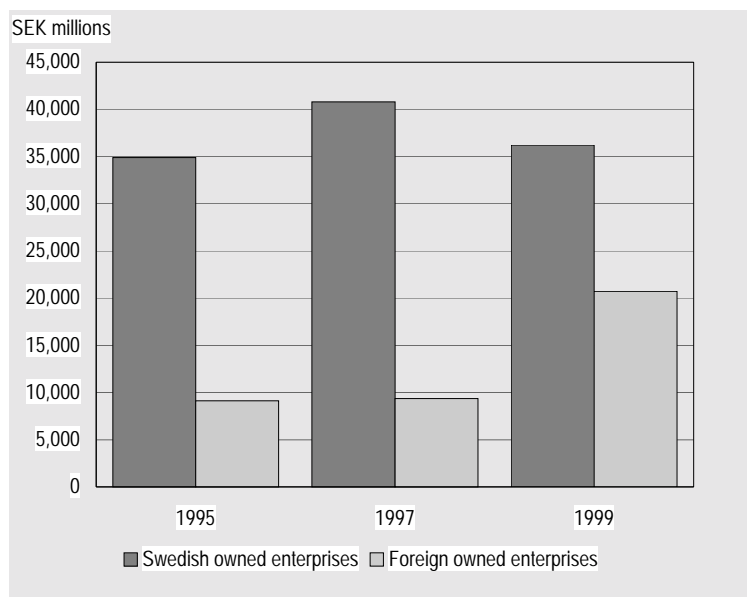
### ***R&D in foreign owned enterprises increases***

Foreign owned enterprises accounted for close to SEK 21 billion, which corresponded to approx. 36 per cent of total expenditure of enterprises in Sweden. This share was 19 per cent. in 1997. If the comparison is limited to industry, foreign owned industrial enterprises had a share of 41 per cent of the total industry R&D in Sweden. Foreign investors acquired a number of large Swedish groups between 1997 and 1999, which led to a substantial increase in R&D carried out by foreign owned enterprises in Sweden compared with the pre-

vious study. R&D in the enterprises acquired was very substantial during 1997. See also *Methods and quality assurance* at the end of the report.

As in previous years a larger proportion of R&D is carried out by foreign owned enterprises in industry. Their R&D expenditure amounted to SEK 19 billion.

**Diagram 9: R&D expenditure in foreign owned enterprises and in Swedish owned enterprises in Sweden 1995-1999**



***Most R&D took place in enterprises from the UK and USA***

The majority of R&D was carried out in foreign owned enterprises from the UK, USA, Switzerland and the Netherlands. Other countries making significant investments in R&D in Sweden were Germany and Finland.

**Tabell 5: Person-years and R&D-expenditures (MSEK) for R&D in foreign-owned and Swedish-owned-enterprises in Sweden 1999. Distribution by country**

<i>Country of location</i>	<i>R&amp;D- person-years</i>	<i>R&amp;D- expenditures</i>
<b>Swedish-owned enterprises in Sweden</b>	<b>28 488</b>	<b>36 234</b>
<b>Foreign owned enterprises in Sweden</b>	<b>15 682</b>	<b>20 720</b>
of which from:		
UK	4 488	7 611
USA	5 481	6 729
Switzerland	2 127	2 515
Netherlands	1 525	1 781
Germany	702	828
Finland	571	510
Norway	328	316
France	155	163
Denmark	115	100
Italy	31	46
Japan	36	30
Canada	42	27
Other countries	82	64
<b>Total</b>	<b>44 171</b>	<b>56 954</b>

**Not**

Data covers enterprises with more than 50 employees.

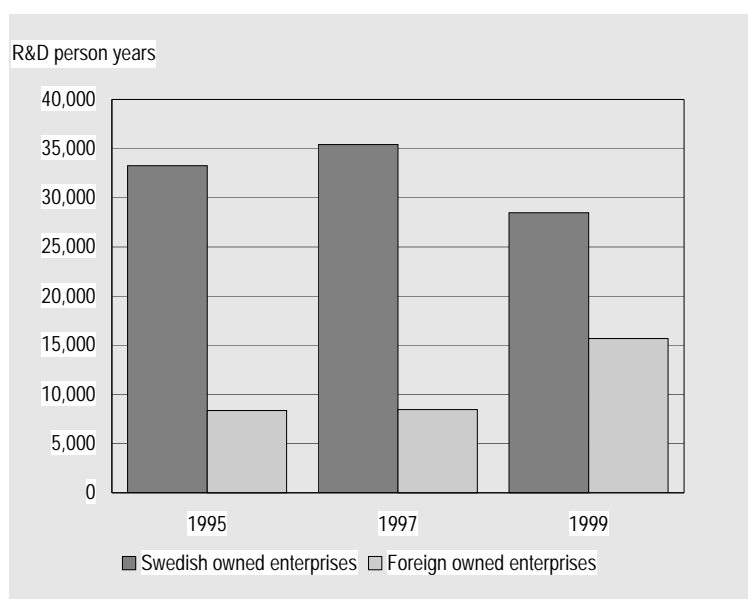


### ***Approximately one-third of R&D person-years takes place in foreign owned enterprises***

In 1999, 15 682 R&D person-years were carried out in foreign owned enterprises.

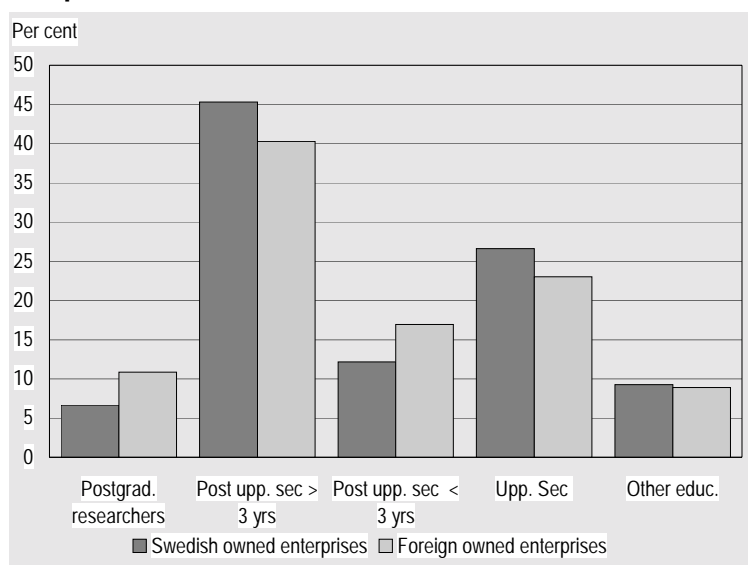
Between 1997 and 1999, the share of foreign owned enterprises in R&D person-years increased from 19 to 36 per cent. For the years 2000 and 2001, forecasts of foreign owned enterprises indicate an increase of 4 per cent in 2000 and a somewhat larger increase during 2001. During the period 2000-2001, this is estimated to increase by a total of 7 per cent. The forecast for the enterprise sector as a whole shows a corresponding upswing.

**Diagram 10: R&D person-years in foreign owned and in Swedish owned enterprises 1995-1999**



### ***Most persons with postgraduate qualifications work in foreign owned enterprises***

Close to 22 800 R&D person-years were carried out in 1999 by persons with higher education qualifications, including those with postgraduate qualifications. This accounts for more than half of all R&D person-years in the enterprise sector. The educational structure of R&D in foreign owned enterprises differs somewhat from that of other enterprises covered in the study. The share of R&D person-years carried out by persons with postgraduate qualifications in foreign owned enterprises, amounted in 1999 to 11 per cent, and for persons with a higher education of at least three years, the share of person-years was about 40 per cent. The corresponding figures for Swedish owned enterprises were 7 and 45 per cent respectively. Diagram 11 shows the relative distribution of R&D person-years by level of education.

**Diagram 11: Educational structure for R&D personnel in foreign and Swedish owned enterprises 1999**


### *Most female researchers work in foreign owned enterprises*

Almost a third of R&D person-years in foreign owned enterprises was carried out by women. This was higher than in the whole of the enterprise sector, 25 per cent. Among Swedish owned enterprises, 20 per cent of R&D person-years was carried out by women. Foreign owned enterprises also had the highest share of female researchers, approximately half of all researchers in foreign owned enterprises were women.

**Tabell 6: Number of person-years in R&D 1999. Distribution by gender.**

Business Sector	Number of person-years			Share % Women
	Women	Men	Total	
Foreign owned	5 048	10 634	15 682	32
Swedish owned	5 840	22 648	28 488	20
Total	10 888	33 283	44 171	25

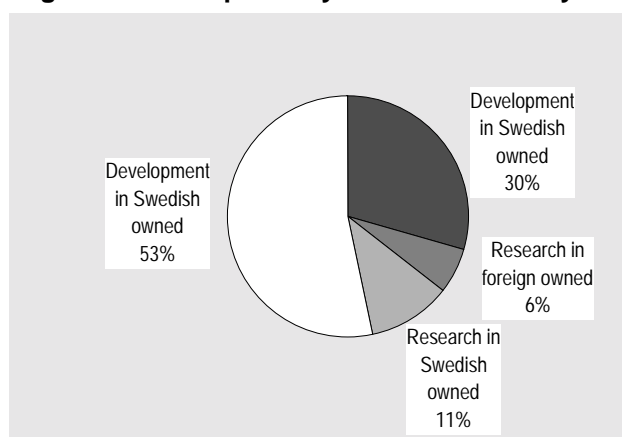
**Table 7: Person-years by post-graduate researchers in R&D 1999. Distribution by gender.**

Business Sector	Person-years for research			Share % Women <i>female</i>
	<i>Women</i>	<i>Men</i>	<i>Total</i>	
Foreign owned	1 329	1 297	2 626	51
Swedish owned	1 482	3 389	4 870	30
Total	2 811	4 686	7 497	37

### *More development than research*

In the whole of the enterprise sector, research is only a small part of R&D work. The share of research in foreign owned enterprises increased from 13 per cent in 1997 to 17 per cent in 1999. For Swedish owned enterprises, the corresponding figures were also 17 per cent in 1999. This means that development work accounted for 83 per cent in both groups of enterprises. Diagram 12 shows the distribution of R&D person-years in research and development. Foreign owned enterprises accounted for 30 per cent of development and 6 per cent of research work. The share of Swedish enterprises corresponded to 53 and 11 per cent respectively.

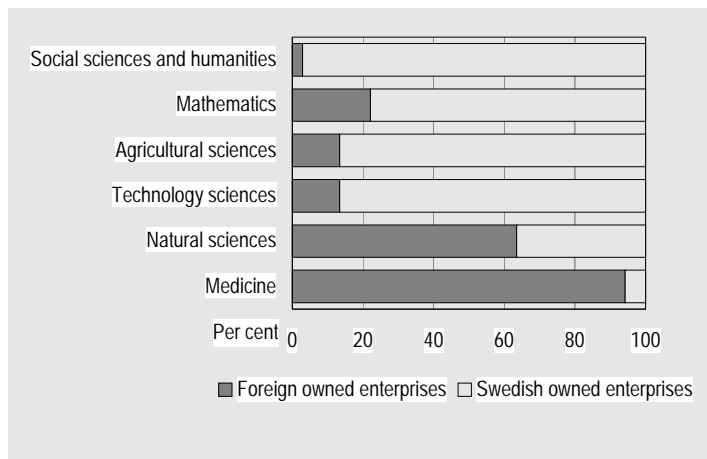
**Diagram 12: R&D person-years distributed by research and development**



***Medicine was the major research area in foreign owned enterprises***

Looking at research person-years by research discipline shows that the shares vary greatly between foreign owned and Swedish owned enterprises. Medicine was the largest research area in foreign owned enterprises, with 1 052 person-years. This corresponds to 40 per cent of the total number of person-years in foreign owned enterprises' R&D. Natural and technology sciences have a share of 35 and 25 per cent respectively. For Swedish owned enterprises, the corresponding figures were 1 per cent, 11 per cent and 84 per cent.

**Diagram 13: Research person-years in foreign owned and Swedish owned enterprises 1999. Distribution by area**



### ***R&D expenditure per R&D person-year is somewhat higher in foreign owned enterprises***

Average R&D expenditure per person-year in the enterprise sector in Sweden was SEK 1 289 000. R&D expenditure per person-year is somewhat higher in foreign owned enterprises, SEK 1 321 000, compared with SEK 1 272 000 for Swedish owned enterprises. Average R&D expenditure per person-year varies with size of enterprise and industry.

### ***Labour costs are lower than other current costs***

The share of labour costs and other running costs in foreign owned enterprises amounted to 39 and 51 per cent respectively. Corresponding shares for Swedish owned enterprises were 42 per cent and 52 per cent respectively. Investments made up a lower share of all R&D expenditure in both Swedish owned and foreign owned enterprises. The distribution between the two groups of enterprises has changed somewhat since 1997 as regards current costs for R&D (divided into labour costs and other current costs).

**Table 8: Currents costs and capital investments for R&D in foreign owned and Swedish owned enterprises in Sweden 1999. SEK million. Distribution by business sector.**

Business sector	Current costs				Investments		Total R&D expenditures	
	Labour costs		Other current costs		Foreign owned enterprises	Swedish owned enterprises	Foreign owned enterprises	Swedish owned enterprises
	Foreign owned enterprises	Swedish owned enterprises	Foreign owned enterprises	Swedish owned enterprises				
<i>Industry</i>								
Knowledge intensive	6 582	9 945	9 276	13 536	1 796	1 352	17 655	24 832
Capital intensive	486	1 100	449	683	64	115	999	1 897
Labour intensive	213	341	184	252	21	48	418	641
<i>Services</i>								
Knowledge intensive	645	3 612	513	4 093	48	428	1 206	8 133
Capital intensive	-	-	-	-	-	-	-	-
Labour intensive	203	314	224	366	16	50	443	731
Other activities	-	-	-	-	-	-	-	-
<b>Total</b>	<b>8 128</b>	<b>15 311</b>	<b>10 646</b>	<b>18 930</b>	<b>1 945</b>	<b>1 993</b>	<b>20 720</b>	<b>36 234</b>

#### **Notes**

Data is obtained from the Study of the R&D in the Enterprise sector 1999 covering non-financial enterprises with at least 50 employees. Industries included in different sectors are given in Facts on survey.

To preserve confidentiality, it has been necessary to put together knowledge intensive and capital intensive services with labour intensive services and other activities.

***Knowledge intensive enterprises continue to dominate R&D investment.***

As in 1997, knowledge intensive industry accounted for a significant share of the whole of industry's total R&D. Total expenditure on R&D amounted to SEK 42 billion. The share of R&D in knowledge intensive industry has increased from 89 per cent in 1997 to approximately 91 per cent in 1999 and in service enterprises, knowledge and capital intensive enterprises accounted for 89 per cent and labour-intensive enterprises (including other activities) for 11 per cent.

Looking at the enterprise groups individually, it can be stated that foreign owned knowledge intensive enterprises in industry accounted for 93 per cent of R&D carried out within this group. The share of Swedish owned enterprises was somewhat lower, 91 per cent.

In service enterprises, the differences are greater between Swedish owned and foreign owned enterprises. Foreign owned knowledge and capital intensive service enterprises accounted for 73 per cent of R&D, and labour-intensive enterprises (including other activities) accounted for the remainder.

In Swedish owned service enterprises, knowledge and capital intensive service enterprises accounted for 92 per cent of R&D in 1999. The remaining part was accounted for by labour-intensive enterprises (including other activities).

***Most R&D person-years in knowledge intensive industrial enterprises***

The number of person-years in the enterprise sector amounted to 44 171 in year 1999. The major part of R&D person-years was carried out by personnel working in knowledge intensive manufacturing enterprises, 31 169 person-years or 71 per cent.

In 1999 Swedish owned enterprises accounted for 60 per cent of R&D person-years in knowledge intensive industry, compared with 81 per cent in 1997.

Since R&D material for reasons of confidentiality does not allow a distinction to be drawn between knowledge intensive and capital intensive services, these business sectors have been put together into a single group. This accounted for 7 849 R&D person-years, of which 6 575 were in Swedish owned enterprises, corresponding to close to 84 per cent of R&D person-years in knowledge intensive and capital intensive sectors.

**Table 9: Foreign owned and Swedish owned enterprises. Number of person-years in R&D 1999. Distribution by business sector.**

Business sector	R&D person-years			Number of women		
	Foreign owned enterprises	Swedish owned enterprises	Total	Foreign owned enterprises	Swedish owned enterprises	Total
<i>Industry</i>						
Knowledge intensive	12 567	18 601	31 169	3 900	3 036	6 937
Capital intensive	1 054	2 016	3 070	406	557	963
Labour intensive	442	700	1 142	149	195	344
<i>Services</i>						
Knowledge intensive	1 273	6 575	7 849	391	1 861	2 252
Capital intensive	-	-	-	-	-	-
Labour intensive	345	596	942	201	191	393
Other activities	-	-	-	-	-	-
<b>Total</b>	<b>15 682</b>	<b>28 488</b>	<b>44 171</b>	<b>5 048</b>	<b>5 840</b>	<b>10 888</b>

**Noter**

Data is obtained from the Study of the R&D in the Enterprise sector 1999 covering non-financial enterprises with at least 50 employees.

Industries included in different sectors are given in Facts on survey.

To preserve confidentiality, it has been necessary to put together knowledge intensive and capital intensive services with labour intensive services and other activities.

***Swedish owned industrial enterprises continue to dominate software related R&D***

Costs for software related R&D amounted in 1999 to around SEK 14 billion. Close to SEK 12 billion or 86 per cent of these costs can be related to Swedish owned enterprises, and particularly knowledge intensive industrial enterprises. These enterprises accounted for close to 84 per cent of all software related R&D carried out in all enterprises in knowledge intensive industry in 1999.

Software related R&D amongst foreign owned enterprises is also highly concentrated in knowledge intensive manufacturing enterprises. During 1999 foreign owned enterprises invested close to SEK 2 billion in software related R&D. Of this, approximately 79 per cent was invested by knowledge intensive manufacturing enterprises. The corresponding figure for Swedish owned knowledge intensive manufacturing enterprises was 65 per cent. Outside industry, it is mainly enterprises in capital and knowledge intensive services which have the highest figures for software related R&D.

Software related R&D refers to research concerning the development of new or significant improvements to existing software. Software related R&D also includes R&D for software in an enterprise's final product, as well as R&D for software which is a part of an enterprise's product or process.

### ***Pharmaceuticals and transport equipment dominate***

Many enterprises run R&D covering a number of products and services. For this reason R&D statistics also present R&D by product groups. By studying both industries and product groups, a more detailed picture is obtained of R&D carried out in enterprises.

The overwhelming majority of R&D expenditure in foreign owned enterprises is related to pharmaceuticals and transport equipment, approximately two-thirds of the R&D expenditure of foreign owned enterprises in Sweden. Telecommunications and transport equipment dominate R&D expenditure in Swedish owned enterprises. In total these two product areas account for 57 per cent of R&D in Swedish owned enterprises.

Services in information technology and also research and development are dominant in both Swedish and foreign owned enterprises. Close to 4 and 2 per cent of the funds invested in R&D in foreign owned enterprises were directed to services in research and development and also in information technology. In Swedish owned enterprises, the shares were 5 per cent and 9 per cent respectively.

### ***Concentrated R&D***

R&D in the enterprise sector was mainly carried out in knowledge intensive enterprises. R&D in other enterprise sectors is significantly less. Amongst foreign owned enterprises, knowledge intensive enterprises in 1999 accounted for 91 per cent of the group's R&D expenditure and 88 per cent of R&D person-years. In Swedish owned enterprises, knowledge intensive enterprises accounted for 86 per cent of R&D expenditure and 85 per cent of person-years.

R&D is concentrated in a few enterprises. In 1999 the 10 largest Swedish owned enterprises ( based on R&D expenditure in Sweden) accounted for 55 per cent of the groups' R&D expenditure. Amongst foreign owned enterprises, the ten largest enterprises accounted for 73 per cent of R&D in 1999.

It is also clear that R&D is concentrated in the largest enterprises, also when R&D is measured by size of enterprise (number of employees). Enterprises with less than 1 000 employees accounted in 1999 for 75 per cent of R&D expenditure of foreign owned enterprises, or close to SEK 16 billion. Swedish owned enterprises with more than 1 000 employees accounted for close to SEK 26 billion, which corresponds to 71 per cent of total R&D expenditure of Swedish owned enterprises.



**Table 10: R&D Expenditure (SEK million) and person-years in R&D 1999.  
Distribution by size of enterprise (number of employees) and type of owner.**

**A. R&D person-years**

Enterprise Size of	R&D person-years								
	Foreign owned enterprises	(%)	Acc (%)	Swedish owned enterprises	(%)	Acc (%)	Enterprise Sector	(%)	Acc (%)
50-99	514	3	3	1 753	6	6	2 267	5	5
100-249	1 022	7	10	2 759	10	16	3 781	9	14
250-499	1 648	11	20	2 619	9	25	4 267	10	23
500-999	1 899	12	32	2 910	10	35	4 809	11	34
1000-	10 599	68	100	18 447	65	100	29 046	66	100

**B. R&D expenditures**

Enterprise size	R&D expenditures								
	Foreign owned enterprises	(%)	Acc (%)	Swedish owned enterprises	(%)	Acc (%)	Enterprise sector	(%)	Acc (%)
50-99	532	3	3	1 633	5	5	2 164	4	4
100-249	1 083	5	8	2 779	8	12	3 863	7	11
250-499	1 582	8	15	2 525	7	19	4 107	7	18
500-999	1 985	10	25	3 504	10	29	5 489	10	27
1000-	15 538	75	100	25 792	71	100	41 330	73	100

**Not**

Data is obtained from the Study of the R&D in the Enterprise sector 1999 covering non-financial enterprises with at least 50 employees.

***Sources of finance for in-house R&D***

Up to 80 per cent of R&D is financed through internal funds. Other enterprises and military authorities accounted for the majority of external financing, 9 and 6 per cent respectively. The share from abroad amounted to 3 per cent. The remaining financing comes from trade organisations, direct state grants, research foundations and other public bodies.

Here the different groups of enterprises exhibit different patterns. Amongst foreign owned enterprises, self-financing was 93 per cent, and for Swedish owned enterprises 72 per cent. Financing from enterprises within a group abroad was 3 per cent for foreign owned enterprises in Sweden and 1 per cent for Swedish owned enterprises. Financing from other en-

terprises within the same group in Sweden was 10 per cent for Swedish owned enterprises, and 2 per cent for foreign owned enterprises. Of all funds from the EU, SEK 235 million, 94 per cent went to Swedish owned enterprises.

**Table 11: Sources of finance for in-house R&D in foreign owned and Swedish owned enterprises in Sweden 1999, SEK million.**

Sources of finance	Swedish owned enterprises	Foreign owned enterprises	Total enterprise sector
Internal financing	26 217	19 169	45 386
Enterprises within own group in Sweden	3 727	445	4 172
Other enterprises in Sweden	809	100	909
Enterprises within same group abroad	347	714	1 061
Other foreign enterprises abroad	122	83	204
Funds from EU	220	14	235
Other Swedish financing	4 517	126	4 643
Other foreign financing	275	69	344
<b>Total enterprise sector</b>	<b>36 234</b>	<b>20 720</b>	<b>56 954</b>

**Notes**

Data is obtained from the study on R&D in the Enterprise Sector 1999 covering non-financial enterprises with at least 50 employees.

### **External R&D**

Enterprises make contributions to R&D and commission R&D from external units. Financing of R&D abroad has increased substantially during the 1990s and in 1999 amounted to SEK 16.6 billion. Of this, foreign owned enterprises accounted for SEK 4.7 billion or 28 per cent. Looking at each group of enterprises, it can be seen that foreign owned enterprises paid SEK 3.2 billion or 68 per cent to foreign units. Amongst Swedish owned enterprises, the corresponding figures were close to SEK 8 billion, which corresponds to 67 per cent. The largest share of R&D abroad financed from Sweden was carried out in enterprises within their own groups.

**Table 12: External costs of foreign owned and Swedish owned enterprises for R&D 1999, SEK million.**

R&D carried out by	Sources of finance		Total Enterprise sector
	Swedish owned enterprises	Foreign owned enterprises	
Enterprises within own group in Sweden	2 787	418	3 205
Other enterprises in Sweden	616	644	1 260
Enterprises within same group abroad	7 795	1 523	9 318
Joint venture enterprise abroad	15	85	100
Other enterprises abroad	126	1 324	1 450
R&D institutes abroad	40	202	242
Universities and university colleges	250	229	479
Trade organisations/research institutes	161	32	193
Other units in Sweden	92	164	256
Other units abroad	45	73	118
<b>Total enterprise sector</b>	<b>11 927</b>	<b>4 695</b>	<b>16 622</b>

**Notes**

Data is obtained from the study on R&D in the Enterprise Sector 1999 covering non-financial enterprises with at least 50 employees.

**Table 13: Expenditure (SEK million) and person-years for R&D in foreign owned and Swedish owned enterprises 1999. Distribution by county in Sweden.**

County	R&D person-years			R&D expenditures		
	Foreign owned enterprises	Swedish owned enterprises	Enterprise sector	Foreign owned enterprises	Swedish owned enterprises	Enterprise sector
Västra Götaland	5 954	6 578	12 532	7 868	6 876	14 744
Stockholm	3 374	11 353	14 726	5 197	16 665	21 862
Skåne	2 796	2 191	4 986	3 777	3 797	7 574
Västmanland	1 347	286	1 633	1 679	286	1 966
Dalarna	323	201	524	375	189	564
Västernorrland	253	342	594	236	271	507
Östergötland	243	2 261	2 504	239	2 889	3 128
Värmland	154	159	313	131	161	292
Uppsala	139	575	714	173	624	796
Blekinge	104	101	205	127	82	209
Jönköping	100	482	582	103	606	710
Other counties	416	3 190	3 606	406	3 184	3 590
Total distributed	15 200	27 718	42 918	20 312	35 629	55 941
Not regionally distributed	483	770	1 253	408	605	1 013
<b>Total</b>	<b>15 682</b>	<b>28 488</b>	<b>44 171</b>	<b>20 720</b>	<b>36 234</b>	<b>56 954</b>

**Noter**

Data is obtained from the study on R&D in the Enterprise Sector 1999 covering non-financial enterprises with at least 50 employees.

Expenditure and R&D person-years which could not be assigned to counties is due to enterprises responding to the simpler questionnaire, where no regional distribution of R&D person years and expenditure is done.

***Most R&D in large urban areas***

Both Swedish owned and foreign owned enterprises have most of their R&D in large urban areas. The biggest investments were made in Stockholm, Västra Götaland and Skåne. In total, these three counties account for 73 per cent of R&D expenditure in Swedish owned enterprises, and 80 per cent of R&D expenditure of foreign owned enterprises in Sweden.

The share of R&D expenditure of foreign owned enterprise in the county of Västmanland amounted to 85 per cent, while 82 per cent of all R&D person-years in the county was carried out at local units in foreign owned enterprises. Other counties with a relatively large share of R&D in foreign owned enterprises are Dalarna and Blekinge.

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**Tabel 15**  
**R&D person-years (FTE) in large manufacturing groups <sup>1</sup> performed by persons with higher education qualifications 1999.**

Country	Level of education <sup>2</sup>						Persons with higher education Total <sup>3</sup>
	Resear- chers	Share Resear- chers	Engi- neers	Share engi- neers	Others with higher education	Share Others with higher education	
<b>Total in world</b>	<b>4 077</b>	<b>13</b>	<b>25 939</b>	<b>83</b>	<b>1 415</b>	<b>5</b>	<b>31 431</b>
<b>Sweden</b>	<b>2 205</b>	<b>13</b>	<b>14 551</b>	<b>83</b>	<b>725</b>	<b>4</b>	<b>17 481</b>
<b>Abroad <sup>4</sup></b>	<b>1 872</b>	<b>13</b>	<b>11 388</b>	<b>82</b>	<b>690</b>	<b>5</b>	<b>13 950</b>
<b>EU 15</b>	<b>982</b>	<b>13</b>	<b>5 972</b>	<b>81</b>	<b>437</b>	<b>6</b>	<b>7 391</b>
<b>NAFTA</b>	<b>632</b>	<b>14</b>	<b>3 849</b>	<b>82</b>	<b>198</b>	<b>4</b>	<b>4 679</b>
<b>Nordic area.</b>	<b>212</b>	<b>15</b>	<b>1 215</b>	<b>84</b>	<b>18</b>	<b>1</b>	<b>1 445</b>
USA	468	13	2 991	82	197	5	3 656
Germany	219	13	1 313	77	166	10	1 698
Denmark, Finland and Norway <sup>5)</sup>	212	15	1 215	84	18	1	1 445
Netherlands	136	16	665	80	30	4	831
Canada	118	16	617	84	1	0	736
UK	110	14	648	83	20	3	778
Italy	110	11	766	76	129	13	1 005
Spain	86	15	476	83	11	2	573
France	46	8	471	83	49	9	566
Other countries	367	14	2 226	84	69	3	2 662

#### Notes

1) Some large Swedish groups became foreign owned between 1997-1999 but were included in the studies 1993-1994, 1995 and 1997. Instead three new engineering groups have been included.

These are changes that should be taken into account when making comparisons between years.

2) Rough estimate from data provider

3) Persons with at least 3 year higher education

4) Difficulties in translating foreign education into their Swedish equivalents.

5) To preserve confidentiality, it has been necessary to put these countries together.



**Table 16**  
**R&D person-years (FTE) in large manufacturing groups <sup>1</sup> performed by persons with higher education qualifications 1997.**

Country	Level of education <sup>2</sup>						Persons with higher education Total <sup>3</sup>
	Reser- chers	Share Resear- chers	Engi- neers	Share engi- neers	Others with higher education	Share Others with higher education	
<b>Total in world</b>	<b>2 513</b>	<b>9</b>	<b>20 009</b>	<b>74</b>	<b>4 564</b>	<b>17</b>	<b>27 086</b>
<b>Sweden</b>	<b>1 505</b>	<b>11</b>	<b>9 754</b>	<b>69</b>	<b>2 912</b>	<b>21</b>	<b>14 171</b>
<b>Abroad <sup>4</sup></b>	<b>1 008</b>	<b>8</b>	<b>10 255</b>	<b>79</b>	<b>1 652</b>	<b>13</b>	<b>12 915</b>
<b>EU 15</b>	<b>595</b>	<b>8</b>	<b>5 737</b>	<b>79</b>	<b>950</b>	<b>13</b>	<b>7 282</b>
<b>NAFTA</b>	<b>281</b>	<b>7</b>	<b>3 078</b>	<b>81</b>	<b>441</b>	<b>12</b>	<b>3 800</b>
<b>Nordic area.</b>	<b>54</b>	<b>4</b>	<b>1 167</b>	<b>90</b>	<b>72</b>	<b>6</b>	<b>1 293</b>
USA	222	8	2 259	80	342	12	2 823
UK	325	19	970	58	372	22	1 667
Germany	92	6	1 135	80	192	14	1 419
Denmark, Finland and Norway <sup>5</sup>	54	4	1 167	90	72	6	1 293
Italy	42	5	711	80	137	15	890
Netherlands	25	3	864	91	65	7	954
France	34	8	277	68	94	23	405
Canada	51	7	587	80	99	13	737
Spain	19	4	446	92	20	4	485
Other countries	145	6	1 839	82	259	12	2 243

**Notes**

1) Some large Swedish groups became foreign owned between 1997-1999 but were included in the studies 1993-1994, 1995 and 1997. Instead three new engineering groups have been included.

These are changes that should be taken into account when making comparisons between years.

2) Rough estimate from data provider

3) Persons with at least 3 year higher education

4) Difficulties in translating foreign education into their Swedish equivalents.

5) To preserve confidentiality, it has been necessary to put these countries together.

**Tabel 17**  
**R&D intensity in large manufacturing groups 1. Distribution by country and country groups 1999.**

Country	R&D- person- 2) years 2	Average number employees	R&D- intensity  (%) <b>(A)/(B)</b>
	<b>(A)</b>	<b>(B)</b>	
<b>Total in world</b>	<b>38 846</b>	<b>532 720</b>	<b>7</b>
<b>Sweden</b>	<b>22 022</b>	<b>153 617</b>	<b>14</b>
<b>Abroad</b> <sup>3</sup>	<b>16 824</b>	<b>379 103</b>	<b>4</b>
<b>EU 15</b>	<b>8 814</b>	<b>168 324</b>	<b>5</b>
<b>NAFTA</b>	<b>5 660</b>	<b>102 125</b>	<b>6</b>
<b>Nordic area.</b>	<b>1 669</b>	<b>20 214</b>	<b>8</b>
USA	4 440	85 971	5
Germany	1 990	35 607	6
Denmark, Finland and Norway <sup>3</sup>	1 669	20 214	8
Canada	885	7 395	12
Italy	1 246	27 159	5
Netherlands	985	10 758	9
UK	954	26 494	4
France	679	23 643	3
Spain	665	10 074	7
Other countries	3 311	131 788	3

**Notes**

1) Some large Swedish groups became foreign owned between 1997-1999 but were included in the studies 1993-1994, 1995 and 1997. Instead three new engineering groups have been included.

These are changes that should be taken into account when making comparisons between years.

2) A person-year is the work a full-time employee carries out in a year.

3) To preserve confidentiality, it has been necessary to put these countries together.

**Table 18**  
**R&D intensity in large manufacturing groups 1. Distribution by country and country groups 1997.**

Country	R&D- person- <sup>2)</sup> years	Average number employees	R&D- intensity  (%) <b>(A)/(B)</b>
	<b>(A)</b>	<b>(B)</b>	
<b>Total in world</b>	<b>45 135</b>	<b>574 449</b>	<b>8</b>
<b>Sweden</b>	<b>27 517</b>	<b>185 174</b>	<b>15</b>
<b>Abroad</b>	<b>17 618</b>	<b>389 275</b>	<b>5</b>
<b>EU 15</b>	<b>10 013</b>	<b>193 077</b>	<b>5</b>
<b>NAFTA</b>	<b>5 170</b>	<b>86 569</b>	<b>6</b>
<b>Nordic area</b>	<b>1 740</b>	<b>23 216</b>	<b>7</b>
USA	3 865	72 122	5
Germany	1 894	44 160	4
Denmark, Finland and Norway <sup>3)</sup>	1 740	23 180	8
Canada	983	8 310	12
Italy	1 166	30 758	4
Netherlands	1 215	11 863	10
UK	2 469	30 465	8
France	543	23 429	2
Spain	641	10 080	6
Other countries	3 102	134 908	2

**Notes**

1) Some large Swedish groups became foreign owned between 1997-1999 but were included in the studies 1993-1994, 1995 and 1997. Instead three new engineering groups have been included.

These are changes that should be taken into account when making comparisons between years.

2) A person-year is the work a full-time employee carries out in a year.

3) To preserve confidentiality, it has been necessary to put these countries together.

**Table 19**  
**R&D expenditure in large manufacturing groups<sup>1</sup> in Sweden 1999, SEK million.**

Business sector	Enterprise group	R&D expenditure	Share of sector (%)
<b>Forest industry<sup>2)</sup></b>			
	Lge. manufacturing grps	731	91
	Total forestry industry	800	100
<b>Engineering industry<sup>3)</sup></b>			
	Lge. manufacturing grps	24 153	72
	Total engineering industry	33 363	100
<b>Other activities<sup>4)</sup></b>			
	Lge. manufacturing grps	1 038	45
	Total other activities	2 185	100
<b>Total</b>			
	<b>Lge. Manufacturing grps<sup>5)</sup></b>	<b>25 922</b>	<b>56</b>
	<b>Total industry<sup>6)</sup></b>	<b>46 442</b>	<b>100</b>

**Notes**

1) Some large Swedish groups became foreign owned between 1997-1999 but were included in the studies 1993-1994, 1995 and 1997. Instead three new engineering groups have been included.

These are changes that should be taken into account when making comparisons between years.

2) Forestry industry refers to the following branches forestry and Pulp and paper (SNI 01 and 21).

3) Engineering industry refers to the following branches: Manufacture of fabricated metal products, except machinery and equipment (SNI 28); Manufacture of machinery and equipment (SNI 29); Manufacture of electrical and optical equipment, machinery and apparatus, radio, TV and communications equipment, medical, precision and optical instruments, watches and clocks (SNI 30-33); Manufacture of transport equipment (SNI 34-35).

4) Other activities refers to the following branches: Chemicals excl. pharmaceutical industry; steel and metal works (SNI 24 excl 24,42 and SNI 37).

5) Consolidated financial statement that activities belonging to e.g. the service sector are included in their accounts as an industrial activity.

6) Data is obtained from the Study of R&D in the Enterprise sector 1999 covering non-financial enterprises with at least 50 employees.

**Table 20**  
**Number of person-years in large manufacturing groups <sup>1</sup> in Sweden 1999, SEK million.**

Business sector	Enterprise group	R&D- person-years	Share of sector (%)
<b>Forestry industry<sup>2)</sup></b>			
	Lge. manufacturing grps	807	96
	Total forestry industry	841	100
<b>Engineering industry<sup>3)</sup></b>			
	Lge. manufacturing grps	20 219	77
	Total engineering industry	26 193	100
<b>Other activities<sup>4)</sup></b>			
	Lge. manufacturing grps	996	44
	Total other activities	2 260	100
<b>Total</b>			
	<b>Lge. Manufacturing grps<sup>5)</sup></b>	<b>22 022</b>	<b>62</b>
	<b>Total industry<sup>6)</sup></b>	<b>35 380</b>	<b>100</b>

**Notes**

1) Some large Swedish groups became foreign owned between 1997-1999 but were included in the studies 1993-1994, 1995 and 1997. Instead three new engineering groups have been included.

These are changes that should be taken into account when making comparisons between years.

2) Forestry industry refers to the following branches: forestry and Pulp and paper industry (SNI 01, 21).

3) Engineering industry refers to the following branches: Manufacture of fabricated metal products, except machinery and equipment (SNI 28); Manufacture of machinery and equipment (SNI 29); Manufacture of electrical and optical equipment, machinery and apparatus, radio, TV and communications equipment, medical, precision and optical instruments, watches and clocks (SNI 30-33); Manufacture of transport equipment (SNI 34-35).

4) Other activities refers to the following branches: Chemicals excl. pharmaceutical industry; steel and metal works (SNI 24 excl 24,42 and SNI 37).

5) Consolidated financial statement that activities belonging to e.g. the service sector are included. in their accounts as an industrial activity.

6) Data is obtained from the Study of R&D in the Enterprise sector 1999 covering non-financial enterprises with at least 50 employees.

**Table 21**  
**R&D expenditure per person-year in large manufacturing groups<sup>1</sup> in Sweden 1999, SEK million.**

Business sector	Enterprise group	R&D-expenditure	R&D-person-years	R&D expenditure (SEK 000s) person-year
<b>Forestry industry<sup>2)</sup></b>				
	Lge. manufacturing grps	731	807	906
	Total forestry industry	800	841	952
<b>Engineering industry<sup>3)</sup></b>				
	Lge. manufacturing grps	24 153	20 219	1 195
	Total engineering industry	33 363	26 193	1 274
<b>Other activities<sup>4)</sup></b>				
	Lge. manufacturing grps	1 038	996	1 042
	Total other activities	2 185	2 260	967
<b>Total</b>				
	<b>Lge. Manufacturing grps<sup>5)</sup></b>	<b>25 922</b>	<b>22 022</b>	<b>1 177</b>
	<b>Total industry<sup>6)</sup></b>	<b>46 442</b>	<b>35 380</b>	<b>1 313</b>

**Notes**

1) Some large Swedish groups became foreign owned between 1997-1999 but were included in the studies 1993-1994, 1995 and 1997. Instead three new engineering groups have been included.

These are changes that should be taken into account when making comparisons between years.

2) Forestry industry refers to the following branches forestry and Pulp and paper industry (SNI 01, 21).

3) Engineering industry refers to the following branches: Manufacture of fabricated metal products, except machinery and equipment (SNI 28); Manufacture of machinery and equipment (SNI 29);

Manufacture of electrical and optical equipment, machinery and apparatus, radio, TV and communications equipment, medical, precision and optical instruments, watches and clocks (SNI 30-33); Manufacture of transport equipment (SNI 34-35).

4) Other activities refers to the following branches: Chemicals excl. pharmaceutical industry; steel and metal works (SNI 24 excl 24,42 and SNI 37).

5) Consolidated financial statement that activities belonging to e.g. the service sector are included. in their accounts as an industrial activity.

6) Data is obtained from the Study of R&D in the Enterprise sector 1999 covering non-financial enterprises with at least 50 employees.

**Table 22**  
**Number and share of person-years in foreign-owned and Swedish-owned enterprises in Sweden by business sector 1999.**

Business sector	Enterprise group	R&D person-years		Share of the sector (%)	
		1999	1997	1999	1997
<b>Knowledge intensive</b>					
Industry	Foreign owned	12 567	5 710	40	19
	Swedish owned enterprises	18 601	24 662	60	81
	Total	31 169	30 373	100	100
Services	Foreign owned	1 273	960	16	13
	Swedish owned enterprises	6 575	6 545	84	87
	Total	7 849	7 506	100	100
<b>Capital intensive</b>					
Industry	Foreign owned	1 054	1 040	34	32
	Swedish owned enterprises	2 016	2 177	66	68
	Total	3 070	3 216	100	100
Services	Foreign owned	-	-	-	-
	Swedish owned enterprises	-	-	-	-
	Total	-	-	-	-
<b>Labour intensive</b>					
Industry	Foreign owned	442	446	39	26
	Swedish owned enterprises	700	1 299	61	74
	Total	1 142	1 745	100	100
Services	Foreign owned	345	299	37	29
	Swedish owned enterprises	596	743	63	71
	Total	942	1 042	100	100
<b>Total industry</b>	Foreign owned	14 063	7 196	40	20
	Swedish owned enterprises	21 317	28 138	60	80
	Total	35 380	35 334	100	100
<b>Total services</b>	Foreign owned	1 619	1 259	18	15
	Swedish owned enterprises	7 172	7 289	82	85
	Total	8 791	8 547	100	100
<b>Other activities</b>	Foreign owned	-	-	-	-
	Swedish owned enterprises	-	-	-	-
	Total	-	-	-	-
<b>Business sector</b>	Foreign owned	15 682	8 455	36	19
	Swedish owned enterprises	28 488	35 427	64	81
	<b>Total</b>	<b>44 171</b>	<b>43 881</b>	<b>100</b>	<b>100</b>

**Notes**

All data is obtained from the study on R&D in the Enterprise Sector 1999 covering non-financial with at least 50 employees.

Industries included in different sectors are given in *Methods and quality assurance*

To preserve confidentiality, it has been necessary to put together knowledge intensive and capital intensive services with labour intensive services and other activities

**Table 23**  
**R&D expenditure in foreign-owned and Swedish-owned enterprises in Sweden by**  
**business sector 1999, SEK million.**

Business sector	Enterprise group	R&D expenditure		Share of sector (%)	
		1999	1997	1999	1997
<b>Knowledge intensive</b>					
Industry	Foreign owned	17 655	6 699	42	19
	Swedish owned enterprises	24 832	29 433	58	81
	Total	42 487	36 132	100	100
Services	Foreign owned	1 206	937	13	11
	Swedish owned enterprises	8 133	7 265	87	89
	Total	9 338	8 202	100	100
<b>Capital intensive</b>					
Industry	Foreign owned	999	912	34	29
	Swedish owned enterprises	1 897	2 226	66	71
	Total	2 896	3 138	100	100
Services	Foreign owned	-	-	-	-
	Swedish owned enterprises	-	-	-	-
	Total	-	-	-	-
<b>Labour intensive</b>					
Industry	Foreign owned	418	341	39	24
	Swedish owned enterprises	641	1 072	61	76
	Total	1 059	1 413	100	100
Services	Foreign owned	443	466	38	37
	Swedish owned enterprises	731	800	62	63
	Total	1 174	1 266	100	100
<b>Total industry</b>	Foreign owned	19 072	7 952	41	20
	Swedish owned enterprises	27 370	32 732	59	80
	Total	46 442	40 684	100	100
<b>Total services</b>	Foreign owned	1 648	1 403	16	15
	Swedish owned enterprises	8 863	8 064	84	85
	Total	10 512	9 467	100	100
<b>Other activities</b>	Foreign owned	-	-	-	-
	Swedish owned enterprises	-	-	-	-
	Total	-	-	-	-
<b>Business sector</b>	Foreign owned	20 720	9 355	36	19
	Swedish owned enterprises	36 234	40 796	64	81
	<b>Total</b>	<b>56 954</b>	<b>50 151</b>	<b>100</b>	<b>100</b>

**Notes**

All data is obtained from the study on R&D in the Enterprise Sector 1999 covering non-financial enterprises with at least 50 employees.

Industries included in different sectors are given in *Methods and quality assurance*

To preserve confidentiality, it has been necessary to put together knowledge intensive and capital intensive services with labour intensive services and other activities



**Table 24**  
**R&D expenditure per R&D person-year in foreign-owned and Swedish-owned enterprises**  
**in Sweden by business sector 1999, SEK million.**

Business sector	Enterprise group	R&D expenditure SEK million		R&D person years R&D person years		Expenditure/ Person year (SEK 000s)	
		1999	1997	1999	1997	1999	1997
<b>Knowledge intensive</b>							
Industry	Foreign owned	17 655	6 699	12 567	5 710	1 405	1 173
	Swedish owned enterprises	24 832	29 433	18 601	24 662	1 335	1 193
	Total	42 487	36 132	31 169	30 373	1 363	1 190
Services	Foreign owned	1 206	937	1 273	960	947	976
	Swedish owned enterprises	8 133	7 265	6 575	6 545	1 237	1 110
	Total	9 338	8 202	7 849	7 506	1 190	1 093
<b>Capital intensive</b>							
Industry	Foreign owned	999	912	1 054	1 040	948	877
	Swedish owned enterprises	1 897	2 226	2 016	2 177	941	1 023
	Total	2 896	3 138	3 070	3 216	943	976
Services	Foreign owned	-	-	-	-	-	-
	Swedish owned enterprises	-	-	-	-	-	-
	Total	-	-	-	-	-	-
<b>Labour intensive</b>							
Industry	Foreign owned	418	341	442	446	945	765
	Swedish owned enterprises	641	1 072	700	1 299	916	826
	Total	1 059	1 413	1 142	1 745	928	810
Services	Foreign owned	443	466	345	299	1 282	1 561
	Swedish owned enterprises	731	800	596	743	1 225	1 076
	Total	1 174	1 266	942	1 042	1 246	1 215
<b>Total industry</b>	Foreign owned	19 072	7 952	14 063	7 196	1 356	1 105
	Swedish owned enterprises	27 370	32 732	21 317	28 138	1 284	1 163
	Total	46 442	40 684	35 380	35 334	1 313	1 151
<b>Total services</b>	Foreign owned	1 648	1 403	1 619	1 259	1 018	1 114
	Swedish owned enterprises	8 863	8 064	7 172	7 289	1 236	1 106
	Total	10 512	9 467	8 791	8 547	1 196	1 108
<b>Other activities</b>	Foreign owned	-	-	-	-	-	-
	Swedish owned enterprises	-	-	-	-	-	-
	Total	-	-	-	-	-	-
<b>Business sector</b>	Foreign owned	20 720	9 355	15 682	8 455	1 321	1 106
	Swedish owned enterprises	36 234	40 796	28 488	35 427	1 272	1 152
	<b>Total</b>	<b>56 954</b>	<b>50 151</b>	<b>44 171</b>	<b>43 881</b>	<b>1 289</b>	<b>1 143</b>

**Notes**

All data is obtained from the study on R&D in the Enterprise Sector 1999 covering non-financial least 50 employees.

Industries included in different sectors are given in *Methods an quality assurance*

To preserve confidentiality, it has been necessary to put together knowledge intensive and capital intensive services with labour intensive services and other activities

## Methods and quality assurance

This section describes how the study was carried out, sampling, definitions and quality.

### *Background*

The Swedish Institute for Growth Policy Studies (ITPS) is a new Government Agency responsible for official statistics as laid down in the Act on Official Statistics (2001:99) and the annex to the Ordinance (2001:100) on Official Statistics *International Enterprises*. ITPS took over this responsibility from NUTEK in 2001-01-01. This responsibility covers, amongst other things, making a study of research and development in international enterprises, i.e. Swedish owned enterprises operating abroad and foreign owned enterprises operating in Sweden. This study has been carried out together with Statistics Sweden (SCB). Results from previous studies have been published in *Research and development in International Enterprises 1997* and in *Swedish Industry and Industrial policy*. Statistical reports (including earlier reports) can be obtained free of charge from the ITPS website:

[www.itps.se](http://www.itps.se)

### *Use*

Economic development in Sweden and Swedish growth are highly dependent on the activities of international enterprises. Research and development in the business sector is for example highly concentrated in a few large manufacturing groups. Information on trends and scope of R&D activities of enterprises in Sweden and abroad provides an important source of knowledge for industrial and trade policy. ITPS is one of the major users of statistics and provides the Government and the Swedish Riksdag with studies to assist policy makers. Other important users are researchers, journalists, trade unions and trade organisations. ITPS supplies a number of international organisations with research material on globalisation of enterprises. EU, OECD and UNCTAD develop, for example, their own databases and issue publications.

### *Definitions*

The definitions and categories used to describe R&D are based on those which have been agreed on in the OECD (Organisation for Economic Cooperation and Development), in the Frascati Manual.

*Research and development (R&D)* is an activity which takes place on a systematic basis to increase the body of knowledge, including knowledge of people, culture and society, as well as the application of this knowledge to new areas and to develop or improve products, systems and methods.

*Basic research* To systematically and methodically develop new knowledge and new ideas without any preconceived purpose in mind.

*Applied research:* To systematically and methodically develop new knowledge and new ideas for a specific purpose.

*Development work:* To systematically and methodically make use of research findings, scientific knowledge and new ideas in order to develop new products, new processes, new systems or make substantial improvements to those that already exist.

### ***Variables***

The variables studied primarily relate to in-house R&D, i.e. R&D carried out by own personnel.

*R&D person-years:* A person-year is the work a full-time employee carries out in the course of a year. A person in full-time employment, but only using half of this time for R&D is regarded as carrying out 0.5 person-years in R&D.

*Levels of education:* R&D person-years carried out by employees within a group are reported in terms of level of education as set out below:

*Postgraduate qualifications* refers to licentiates and doctors. A Master's degree is in this study not regarded as a postgraduate qualification.

*Post upper secondary education of at least three years* refers to a first degree in higher education, graduate engineer - or other university diploma.

*Technical education* refers to all categories with an engineering qualification, including architects.

*Expenditure on in-house R&D:* Expenditure on in-house R&D is that expenditure which is related to R&D work carried out by employees of the enterprise or group. It consists of labour costs (salaries and fringe benefits), other costs and also annual investments made in material facilities.

*Expenditure on external R&D:* Expenditure on external R&D refers to expenditure which is related to R&D work carried out by staff outside the enterprise. Purchases of R&D from other enterprises in the same group are regarded as external R&D.

### ***The large manufacturing groups***

The study is based on a survey of the 20 largest Swedish owned manufacturing groups in terms of the number of employees abroad. The sample is drawn from an annual survey of all groups in Sweden which have at least one subsidiary abroad. Large manufacturing groups dominate both in terms of the number of employees in the business sector outside Sweden and R&D investments in Sweden. This sample should provide a good picture of R&D activities abroad. The statistical unit is the group, i.e. the group of enterprises which are consolidated in the annual report of the group. In a few cases for technical reasons, a member of a group is studied instead of the group as a whole.

#### ***Groups studied***

*The five largest:* LM Ericsson, Celsius, Saab and Scania, Volvo (excl. Volvo PV) and Sandvik.

*Other groups:* AGA, Assa Abloy, AssiDomän, Atlas Copco, BT Industries, Cardo, Electrolux, Gambro, Haldex, Holmen, Perstorp, SCA, SKF and Svedala Industri. Scancem has also been studied, but is reported under the group of foreign owned enterprises. The

division into the five largest and others has been made on the basis of the R&D expenditure of the group in Sweden.

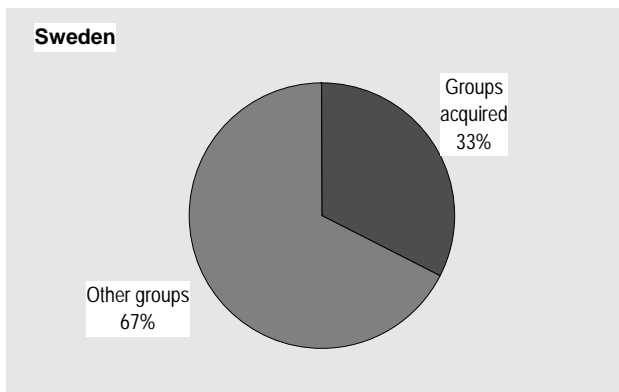
*Changes in the large manufacturing groups*

Some changes that have taken place in the population between different periods of the study due to reorganisation of enterprises may make comparability more difficult. Comparisons between 1997 and 1999 are made still more difficult by the fact that some large groups became foreign owned and were replaced by others with a lower level of R&D. However, the principle for selection of the samples has remained the same.

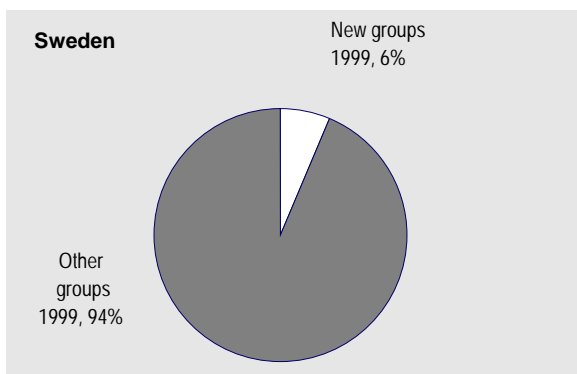
The groups which became foreign owned were engineering, chemical, and pharmaceutical groups i.e. in industries with major R&D expenditure in Sweden. In the previous survey, these groups had close to SEK 13 billion in R&D, of which SEK 10 billion was in Sweden. The three new Swedish groups had R&D expenditure which amounted to SEK 2 billion, of which close to SEK 1.7 billion was in Sweden.

This may lead to a reduction in the R&D carried out by large manufacturing groups in Sweden and abroad, and to a substantial increase in that carried out by foreign owned enterprises in Sweden. If changes in ownership had not taken place and the population had remained the same, the R&D of large manufacturing groups in Sweden would have increased substantially between the years 1997 and 1999.

**Diagram 14: Share of R&D expenditure in 1997 in Swedish groups which became foreign owned during the period 1997-1999**



**Diagram 15: The share of the three new groups in R&D expenditure in 1999**



The questionnaire has remained largely unchanged during the periods 1993-1995 and 1997. The study in 1999 has been supplemented by questions about how and why major changes took place in different countries. In addition, there is also question on whether the state can influence the extent of R&D in Sweden.

### *Comparability with other statistics*

The report contains comparisons between large manufacturing groups and industries and the enterprise sector/business sector. As the R&D statistics do not cover all enterprises, the total for industries and the enterprise sector is underestimated. Only non-financial enterprises with more than 50 employees are included. The study of large manufacturing groups means there is an overestimate in these comparisons, since these groups also contain services as well as enterprises with at least 50 employees. At the same time these comparisons involve an under-estimate of the R&D of large manufacturing groups, since they are not operating in all industries. If the comparison between large manufacturing groups and industry is limited to those industries where large manufacturing groups are active, their share of R&D expenditure and person-years increases from approximately 50 per cent to 71 and 75% of R&D in industry respectively.

### *Overall reliability*

In previous years the cost of R&D for individual groups was booked in a country other than where it was carried out. This has also happened this year with the result that some groups have stated that they have employees in countries where the costs they have reported are either too low or non-existent. Since 1997 the situation has improved for the better. The reason for the improvement in reporting R&D carried out abroad is greater focus on R&D and also that the requirements for improvement from different parties have increased. This change led in 1997 to a substantial increase in R&D expenditure abroad and a reduction in the Swedish proportion of the groups, compared with the studies in 1993-1994 and 1995. However, the problem remains in some groups, but it does not affect to the same extent the geographical distribution between Sweden and abroad as before. Despite improvements in the last two studies, it can still be stated that a geographical division of R&D – especially between Sweden and abroad – is still much more reliable if it is measured in terms of number of person-years than R&D expenditure.

### *Non-response*

21 groups were covered in the survey. All have responded to the questionnaire. One group became foreign owned after the study was completed and this is the reason 20 Swedish groups are presented in the report. There is a partial non-response as two groups were not able to provide information on the number of person-years in R&D. Some have also made estimates of the number of person-years. The total number of R&D person-years is somewhat underestimated. No allowance has been made for this. The level of education and, in particular, personnel with an engineering education are in certain cases based on estimates. In addition, it is difficult to translate foreign educational qualifications into their Swedish equivalents.

### *Foreign owned enterprises*

The ITPS register of foreign owned enterprises has been combined with the regular R&D statistics provided by SCB. The study covers all non-financial enterprises which have more than 50 employees. In 1999 the number of foreign owned enterprises covered in the study amounted to 354. These enterprises had 149 098 employees, corresponding to approximately 37 per cent of the total number of employees in all foreign owned enterprises in Sweden. The data only refers to their activities in Sweden.

The statistical unit is the enterprise. Foreign owned enterprise refers to enterprises where more than half of the voting rights are foreign owned, which is the definition used in the OECD.

### *Statistical groups*

Ohlsson/Vinell<sup>1</sup> have developed a classification of manufacturing industry based on relative use of production resources by different industries. The service sector is not usually divided into knowledge, capital and labour-intensive sectors. Nutek prior to the Swedish Long-Term Survey (LU 99) made a division of enterprises in all industrial branches into knowledge, capital and labour-intensive. This division has been used here.

Enterprises in this report are divided into different sectors in accordance with the following:

#### **Industries**

*Knowledge intensive:* publishing, electronic and tele products, machines, transport equipment, pharmaceuticals and detergents, office equipment and computers, precision instruments.

*Capital intensive:* mining and metal extraction, pulp and paper, petrochemicals, chemicals (excluding pharmaceuticals and detergents) other chemicals.

*Labour-intensive:* Food, textiles and clothing, wood, rubber and plastics, metals, other manufacturing.

#### **Services**

*Knowledge-intensive:* Business services, education, health and medical care, culture and sports etc.

*Capital-intensive:* transport and communication

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<sup>1</sup> Lennart Ohlsson and Lars Vinell. in a Swedish study on "Forces leading to growth" (Tillväxtens drivkrafter – En studie av industriers framtidsvillkor.)

## Industrial classification

The classification by activities has been made according to the Swedish Standard Classification of Economic Activities SNI 92, which is based on the statistical classification of economic activities in the European Union, NACE Rev. 1.

- 22 Publishing; printing and reproduction of recorded media
- 29 Manufacture of machinery and equipment
- 30 Manufacture of office machinery and computers
- 33 Manufacture of medical, precision and optical instruments, watches, and clocks
- 24.4–5 Manufacture of pharmaceuticals, soaps and detergents
  
- 31 Manufacture of electrical machinery and apparatus
- 32 Manufacture of radio, television and communication equipment and apparatus
  
- 34–35 Manufacture of transport equipment
- Total knowledge-intensive industry**
  
- 21 Manufacture of pulp, paper and paper products
- 23 Manufacture of coke, refined petroleum products and nuclear fuel
- 26 Manufacture of other non-metallic products
- 27 Manufacture of basic metals and fabricated metal products
- 10–14 Mining and quarrying
- 24 Manufacture of chemicals and chemical products
- Total capital-intensive industry**
  
- 20 Manufacture of wood and wood products, except furniture
- 25 Manufacture of rubber and plastics products
- 28 Manufacture of fabricated metal products, except machinery and equipment
- 15–16 Manufacture of food, beverage and tobacco
- 17–19 Textile, wearing apparel and leather products
- 36–37 Other manufacturing industry
- Total labour-intensive industry**
  
- 65–67 Financial intermediation
- 71–74 Business Services
- 80–85 Education, health etc
- 90–93 Other community, social and personal services
- Total knowledge-intensive industry**
  
- 70 Real estate activities
- 60–64 Transport and communication
- Total capital-intensive services**
  
- 45 Construction
- 55 Hotels and restaurants
- 50–52 Wholesale and retail trade, repair of personal and household goods
- Total labour intensive services**
  
- 01–05 Agriculture, forestry and fishing
- 40–41 Electricity, gas, heating and water supply
- Total other activities**



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