ETLA
ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 358-9-609 900
Telefax 358-9-601 753 World Wide Web: http://www.etla.fi/

Keskusteluaiheita – Discussion papers

No. 819

Raine Hermans – Terttu Luukkonen

FINDINGS OF THE ETLA SURVEY ON FINNISH BIOTECHNOLOGY FIRMS

Contact information:
Raine Hermans, Email: raine.hermans@etla.fi, Telephone: +358 9 6099 0207
Terttu Luukkonen, Email: terttu.luukkonen@etla.fi, Telephone: +358 50 570 7789

ISSN 0781-6847 10.09.2002

HERMANS, Raine – **LUUKKONEN**, Terttu, **FINDINGS OF THE ETLA SURVEY ON FINNISH BIOTECHNOLOGY FIRMS.** Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2002, 30 p. (Keskusteluaiheita, Discussion Papers, ISSN, 0781-6847; no. 818).

ABSTRACT: This paper presents the first results of ETLA and Etlatieto Ltd Study of Finnish biotechnology firms. The majority of Finnish biotechnology firms are quite young and still in the early stages of gainful economic activities. Their turnover, profits and exports are, for the younger firms in particular, still low, profits even negative, while their growth expectations are high. The high R&D intensity of especially younger firms indicates that their products are still largely in the development phase and that few of their products are yet in the market. The commercialisation process is long, and only a few of the innovations eventually turn out to be exploitable. This increases the risk assessed and the rate of returns required by the investors. Private and public venture capitalists are most interested in the young companies with relatively high risk and high growth prospects. The oldest firms are more often subsidiaries. This may reflect the fact that foreign companies are willing to take over a Finnish company when its growth prospects are close to being realised. Furthermore, large proportion of the companies have obtained some public funding for the research which led to the foundation of the company or which took place in some other stages of the life cycle of the company. Research spin-off companies in general have more hindrances than other start-up firms, and would benefit from more systematic training in relevant business skills, such as how to make a business plan, how to deal with patenting, and how to obtain funding from venture capital investors.

Key words: Biotechnology firms, corporate finance, public funding of private R&D, R&D collaboration.

FOREWORD

This paper presents the first results of ETLA and Etlatieto Ltd Study of Finnish biotechnology firms. It was written specifically for the international evaluation of Finnish biotechnology entitled Biotechnology 2002. At the request of the international evaluation panel, the authors have paid special attention to cohorts of entrants among biotechnology companies. These results will be incorporated in a more comprehensive report, to be published by the authors by the end of 2002.

Work has been divided between the authors in the following way: Raine Hermans has mainly been responsible for the analysis of ownership and other financial patterns, customer and export relations as well as for the regional location of the companies; Terttu Luukkonen for the analysis of company age and origin, R&D collaboration patterns, skills and educational level of companies, public funding as well as the impact of external funding. We are grateful to Sasu Hälikkä and Antti Tahvanainen who have assisted in the compilation and analysis of the data material.

Authors thank the international evaluation panel (assembled by the Ministry of Education) for their useful comments. We also thank our research project advisory board (participants from Finnish Bioindustries, Ministry of Trade and Industry, Academy of Finland, Statistics Finland, and TEKES) for helpful comments during the construction of the survey format. Financial support from TEKES (the National Technology Agency) is gratefully acknowledged.

CONTENTS

1. FINNISH BIOTECHNOLOGY FIRMS

1.1. Definitions

There has been some discussion, for instance, at the OECD, about the definition of biotechnology for statistical purposes. A single definition was agreed upon by an ad hoc meeting held in May 2002.[1] It is as follows: *"The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services."* In addition, a list-based definition specifies biotechnology processes in more detail. [2]

Biotechnology firms can be divided into two types. First, there are firms that develop biotechnology processes. Second, there are firms that apply biotechnology processes in their production. The first can be called biotechnology R&D firms (often called intermediaries) and the second biotechnology using firms. A single firm can belong simultaneously to both categories, and it may be called an integrated firm[3].

In the ETLA survey, the problem of defining biotechnology firms was solved in a practical way by using the firms in the database of the Finnish Bioindustries Federation as the population of Finnish biotechnology firms. This was done because the ETLA team had to produce background information for the international evaluation of Finnish biotechnology within a tight time-schedule. It turned out that The Finnish Bioindustries database had incomplete information on the most recently founded firms and the survey sample is not complete in this respect. The survey includes information about the research and development intensities of the firms and a verbal description of their key innovations. This information makes it possible to redefine the sample using the OECD definitions mentioned above.

1.2. Foundation and number of active firms

There are approximately 119 firms active in biotechnology in Finland at the moment (based on the number of firms founded by the end of 2001)[4]. The number of firms has been retrieved through the Federation of Finnish Bioindustries, biocentres, an earlier study of the topic[5], and other sources. The authors are well aware that this number may not capture every company active in biotechnology in Finland and that the border line between new biotechnology companies and companies in, e.g. software, is not easy to draw. There may also be a few that are not dealing with new biotechnology.

---

1 The third OECD ad hoc meeting on biotechnology statistics was held in Espoo, Finland 13-15 May 2002.

2 The following five categories were agreed on by the OECD ad hoc meeting. The list is indicative (not exhaustive):

a) DNA (the coding): genomics, pharmaco-genetics, gene probes, DNA sequencing/synthesis/amplification, genetic engineering.

b) Proteins and molecules (the functional blocks): protein/peptide, sequencing/synthesis, lipid/protein engineering, proteomics, hormones, and growth factors, cell receptors/signalling/pheromonics.

c) Cell/tissue culture, tissue engineering, hybridization, cellular fusion, vaccine/immune stimulants, embryo manipulation.

d) Process biotechnologies: bioreactors, fermentation, bioprocessing, bioleaching, bio-pulping, bio-bleaching, biodesulphurization, bioremediation and biofiltration.

e) Sub-cellular organisms: gene therapy, viral vectors.

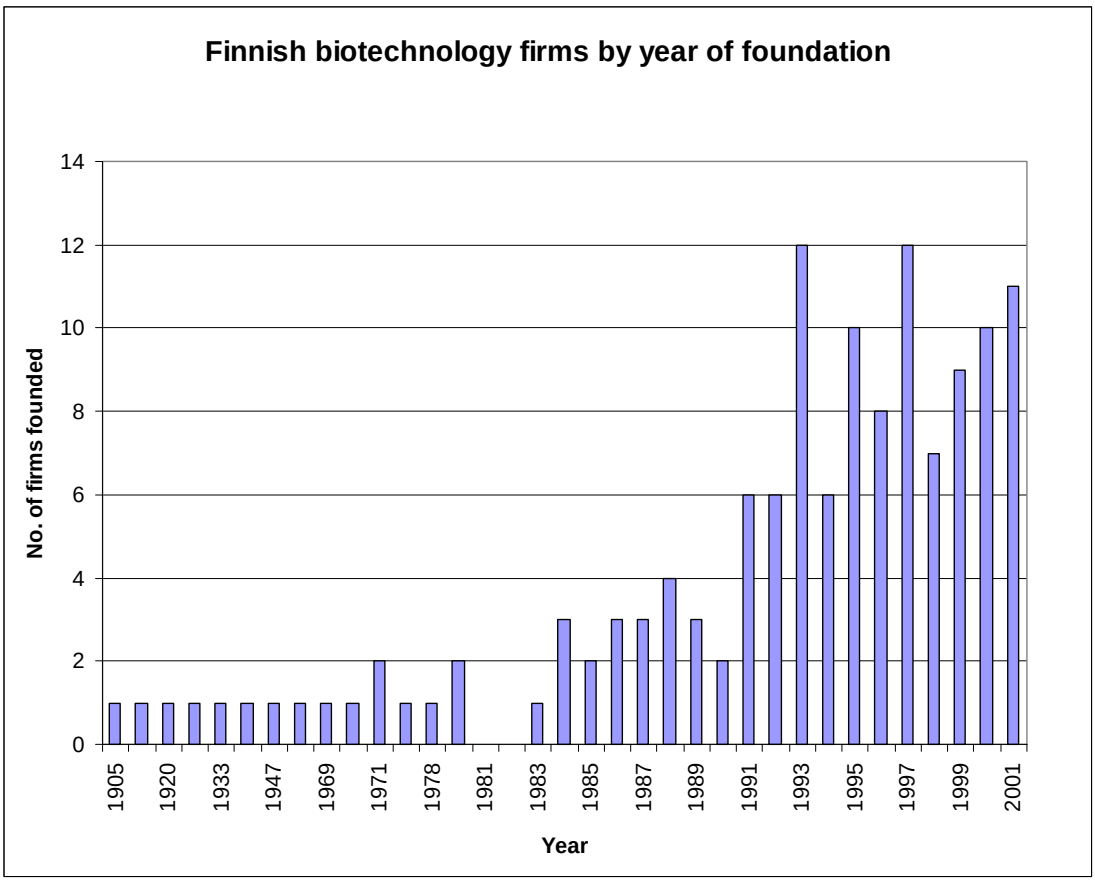
3 See Nilsson (2001).

4 By mid 2002, several new firms had been founded and this may become a new record year in this respect.

5 Halme (1994).

Figure 1 gives the years of foundation of Finnish biotechnology firms, including older, incumbent firms. This study is thus not restricted to new biotechnology firms or to firms that specialise only in biotechnology. It includes firms in areas such as pharmaceuticals, diagnostics, the food industry, and chemicals, which were operating at the time of the birth and introduction of new biotechnology in the 70s. These firms have adopted and learned to apply knowledge and techniques in new biotechnology in their search and manufacturing operations. The analysis of the survey data uses as a background variable the division of the companies into cohorts of entrants to the field, and the oldest group, that comprising firms founded before 1991, includes several incumbent firms.

Figure 1.



According to the data sources checked, by the end of 2001, 134 firms had been established (Figure 1). Of these, 15 have ceased to exist as independent firms active in the field. Five of these 15 firms have merged with other firms, six have just ceased to exist without formal notification, three have gone bankrupt, and one is inactive.

In the European context, Finnish biotechnology firms emerged somewhat later than corresponding firms in the UK, France or especially Sweden, however, earlier than those in Germany (*Table 1*).

Table 1. European dedicated biotechnology firms: distribution by cohorts of entrants.

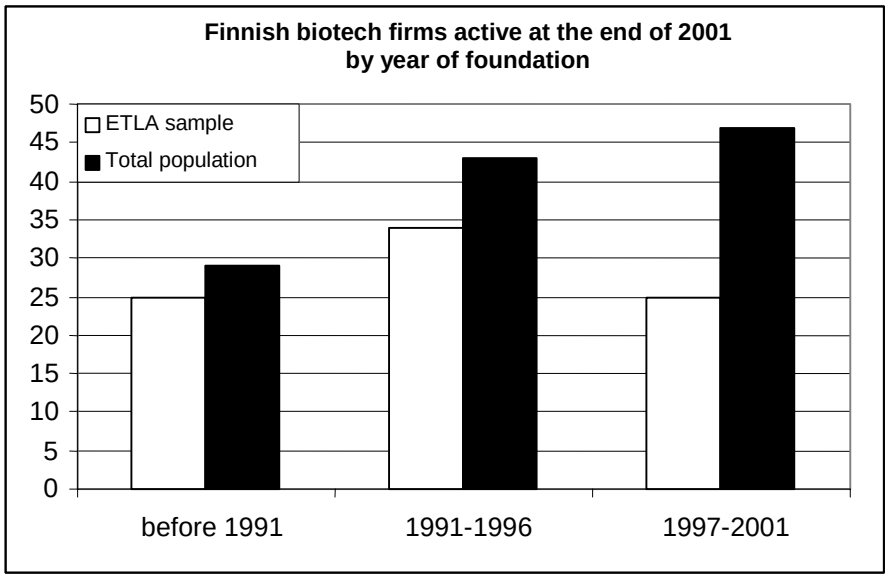
	Finland	UK	Germany	France	Sweden	EU15
	%	%	%	%	%	%
- 1991	26	33	20	32	38	31
1991-95	38	25	23	25	26	25
After 1995	36	42	57	43	36	44
No of firms	105	448	504	348	235	1930

Source for countries other than Finland: BID, University of Siena, in: European Competitiveness Report, 2001, European Commission. Data for Finland is based on ETLA and Etlatieto study and reports the number of dedicated biotechnology firms by the end of 2000. The source of the above EU report does not give the latest year of observation, but the authors assumed it to be 2000 and limited the number of Finnish firms accordingly. This is a warning that the data in the table may not be fully comparable.

2. SURVEY FINDINGS

The following findings are based on a survey carried out with Finnish biotechnology firms in March-May 2002 by ETLA and Etlatieto Ltd. The survey was carried out through telephone interviews. The surveyed firms (116) were obtained from the Finnish Bioindustries Association. After the deduction of mergers, acquisitions and other cleaning of the data[6], the total population was reduced to 97[7]. Eighty-four replied giving a response rate of 87%[8].

Figure 2.



Despite the high response rate, the sample is not as close to the total population, mentioned on page 5, as it seems by observing the response rates. The total population of Finnish bio-

[6] One consultant and one marketing firm were deleted at the final stage of cleaning the data.

[7] The survey was launched quickly because of the Biotechnology 2002 evaluation, and the data supplied by Finnish Bioindustries could not be complemented with other sources. Therefore, this number is a little lower than the total given in chapter 1.

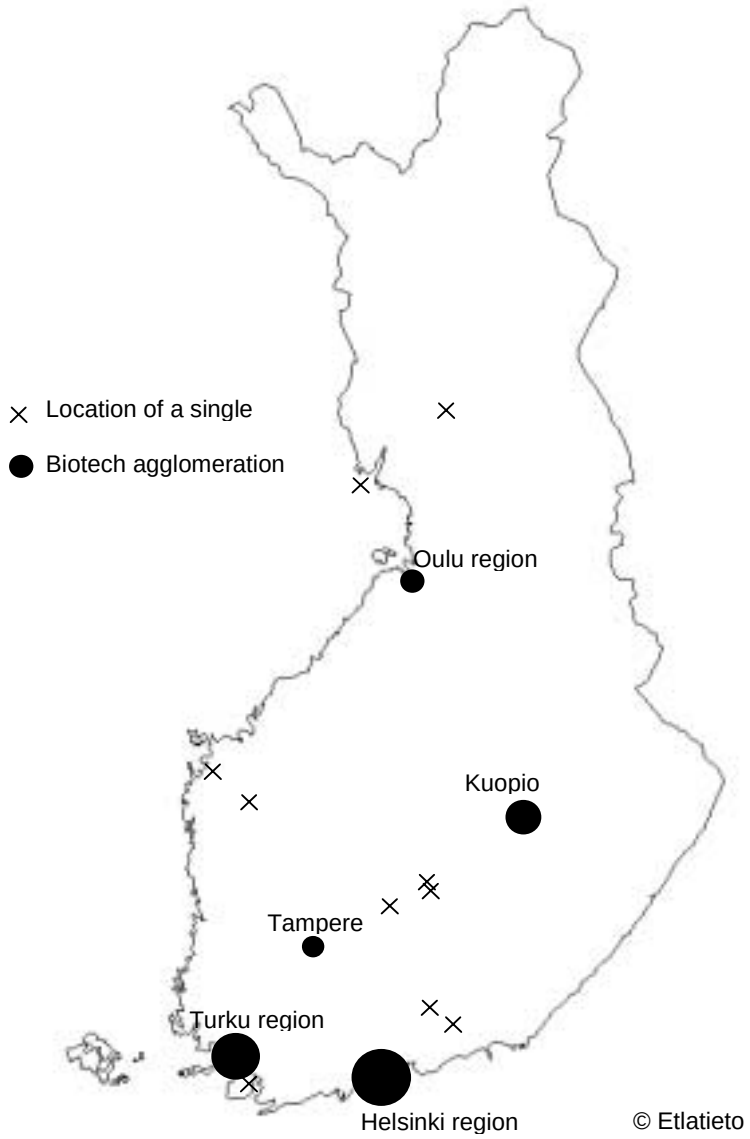
[8] The authors are grateful to the Finnish Bioindustries Association for its help in the conduct of the survey. The association sent a letter of recommendation to the companies in its register and this surely helped to achieve a high response rate, particularly since these companies are currently the objects of several studies and queries.

technology firms differs from the one registered by Finnish Bioindustries. There are proportionally fewer firms founded during 1997-2001 in the sample than firms in other age groups (Figure 2). However, the firms in the sample represent more than half of the firms in the corresponding segments in the total population. It is also to be noted that the difference between the total population and the sample was greatest among firms founded in 2000-2001.

2.1. Location of firms

The largest geographical concentration areas of biotechnology industry were located in the Helsinki and Turku regions.[9] About 65 percent of the firms were located in the regions or in their immediate surroundings. The other regional centres were located in Kuopio, Oulu and Tampere, listed in the order of magnitude, respectively. A tick mark indicates the location of a single company. It seems that proximity to the biotechnology-related knowledge centres in universities is an important driver for location decisions of the firms.[10]

Figure 3. Location of Finnish Biotechnology Firms



2.2. Foundation of firms

The survey respondents by year of foundation are given below in Table 2.

Table 2. Companies by year of foundation.

Year of foundation	Number	%
Before 1991	25	30
1991-1996	34	40
1997-2001	25	30
Total	84	100

In total, 50% of the companies were situated in a biocentre or a science park. As one might expect, the proportion of firms situated in such a centre or park was larger, the more recently the firm had been founded.

Table 3. Proportion of companies situated in a biocentre or a science park by year of foundation.

Foundation year	Percentage share of firms
Before 1991	20 %
1991-1996	59 %
1997-2001	68 %
Total	50 %

Sixty-seven per cent of the firms were spin-offs from research; 19 % from other companies. There was an overlap of 8%; that is, the companies were spin-offs from both research and other companies. In 91% of the research spin-offs, the person(s) who had founded the company had been involved in the research leading to the innovation and the foundation of the company.

Table 4. Spin-off from research in academia or at a research institute by year of foundation

Foundation year	Percentage share of firms
Before 1991	40 %
1991-1996	79 %
1997-2001	76 %
Total	67 %

The proportion of research spin-offs was smallest among the oldest firm group. This is understandable given that the group includes large incumbent firms in pharmaceuticals, food, and the chemical industry as well as, e.g., diagnostics firms, which have adopted new biotechnology in recent years. The proportion of research spin-offs was nearly equally large in the two more recently founded firm groups.

Table 5. Spin-off from another company by year of foundation

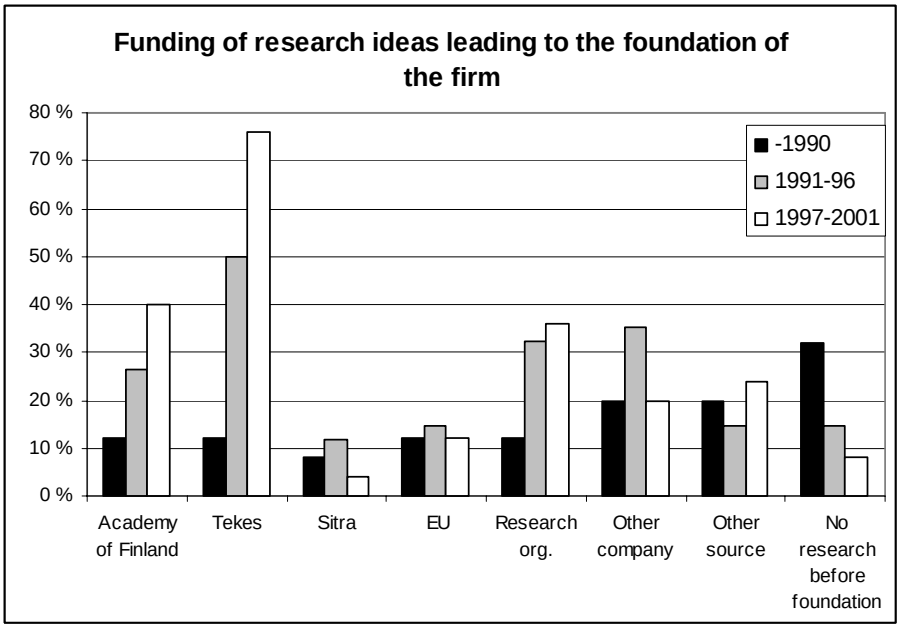
Foundation year	Percentage share of firms
Before 1991	12 %
1991-1996	18 %
1997-2001	28 %
Total	19 %

The proportion of company spin-offs grows somewhat in the younger firm groups. Whether this is an indication of a development cycle of firms in a new field or an artefact of small firm numbers is difficult to judge on the basis of this data. It is, nevertheless, possible that in a science-intensive sector such as biotechnology, the proportion of research spin-offs is large in the early growth period of the sector. Subsequently, when the total firm population becomes larger, the proportion of company spin-offs will also increase. A similar observation has been made on the basis of a sample of French biotechnology firms, though the latter sample was even smaller than the one for Finland[11].

2.3. Funding and difficulties in the start phase

Figure 4 indicates the proportion of firms that obtained funding from the various sources mentioned for the research leading to the establishment of the firm. The highest percentage of the firms had obtained funding from Tekes (National Technology Agency) for this research and the percentage was higher, the younger the firm was. The Academy of Finland and the research organisation, such as the university where the research was carried out, as well as another company had funded the R&D fairly often.

Figure 4.



The fact that funding from Tekes and the Academy of Finland was most prevalent in the youngest firm group probably reflects their increased research funds and increased investments in biotechnology in the more recent years.

Overall, 36% of the companies reported difficulties in the founding phase of the company. Difficulties were more frequent among research spin-offs (41%) than among other companies (25%). Being a company spin-off did not bring about any more problems compared with other companies.

When we looked at the cohorts of firms by year of foundation, the middle group, firms founded in 1991-96, reported difficulties most often (41% vs. 36% in the youngest firms group and 28% in the oldest firm group) (Figure 5.1). This finding was unexpected, but is

[11] Mytelka and Pellegrin (2001).

in line with other observations according to which the middle group, founded in 1991-96, had the largest percentage of research spin-off firms and slightly closer links with university research. The youngest firm group had a larger percentage of company spin-offs, and may therefore have been somewhat better equipped for business than the middle group. The finding may also reflect the fact that when firms in this middle cohort were founded, less help and knowledge was available for university researchers in the problems related to the know-how needed in setting up business. We have, however, to be very cautious in our interpretation because the group sizes are small.

Figure 5.1

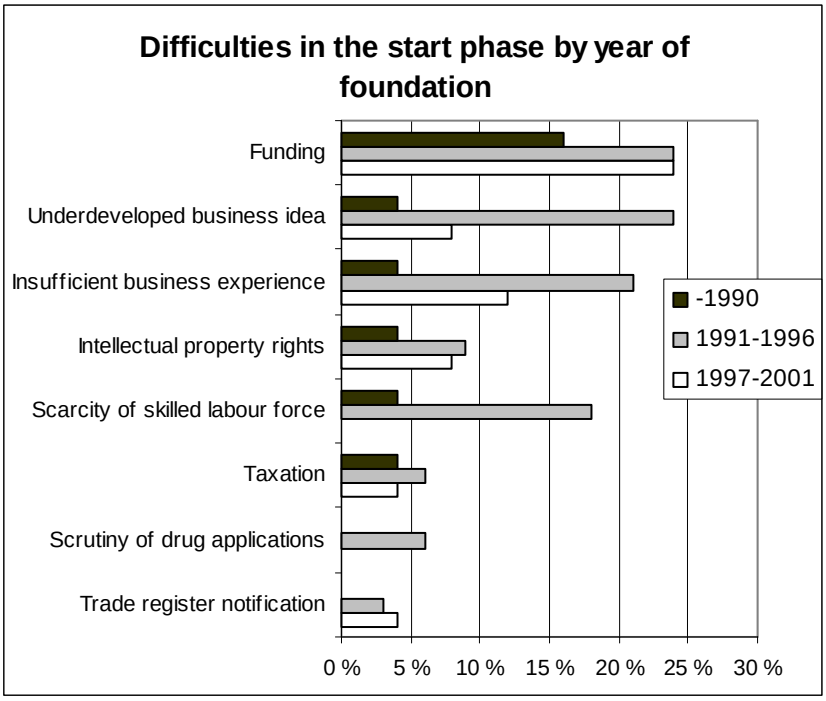
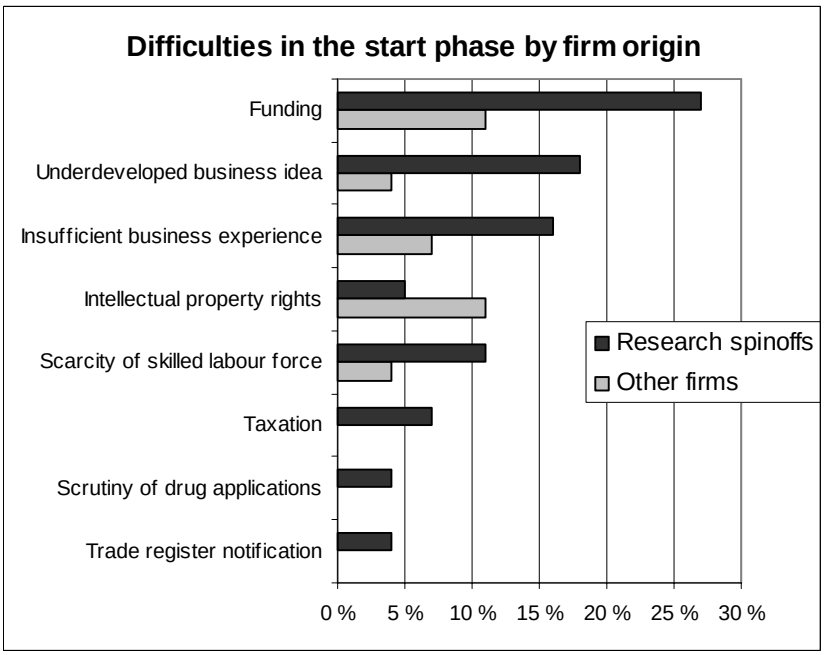


Figure 5.2



Overall, obtaining funding was the most frequent difficulty and research spin-offs had more difficulties in this respect than other firms did, as seen in Figure 5.2. The two

younger firm groups also had more problems than older firms in this respect. Insufficient business experience and underdeveloped business ideas were also problems for all firms, but especially so for the middle cohort and for the research spin-off firms. Research spin-offs had fewer problems with intellectual property rights than other firms did. These findings show that difficulties are not directly related to firm age, and that other factors matter, too, among others, firm origin as a research spin-off.

2.4. General characteristics of the firms

The surveyed firms were most active in medicine and diagnostics, as is indicated by Figure 6. The sum of firms is over 84, since the figure takes into account the fact that some com

Figure 6. Industrial sectors in which firms were active (multiple replies)

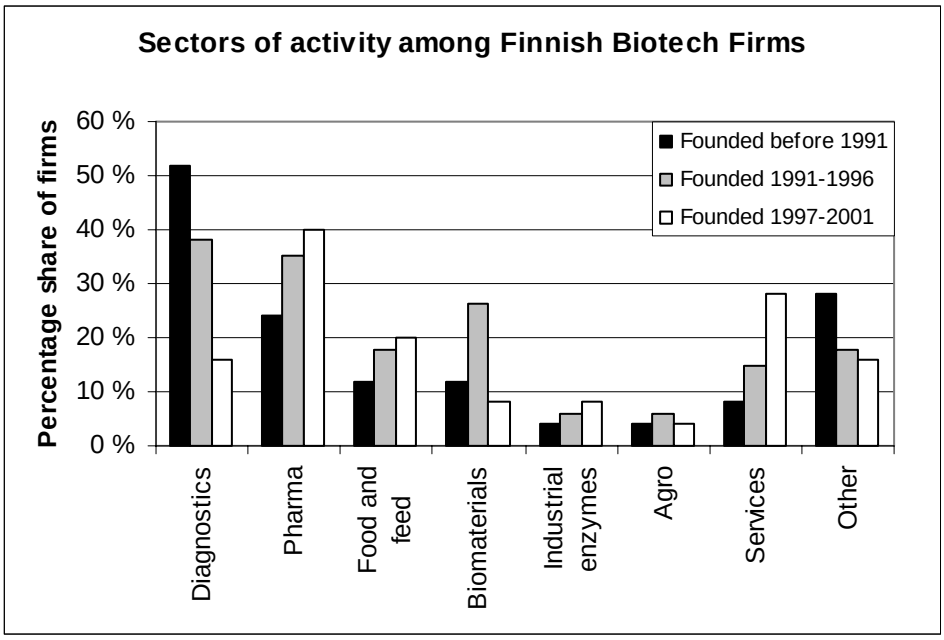
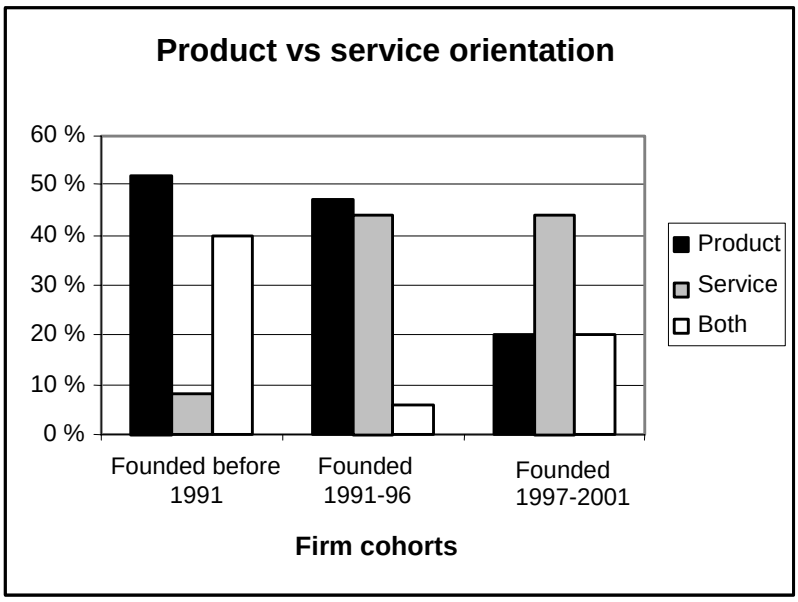


Figure 7.



panies have applications relevant for many sectors. The oldest firms were active particularly in diagnostics while the firms founded between 1991-96 were active in medicine, diagnostics and biomaterials. The youngest firms were active in medicine, services, and food and feed. The activity sectors are clearly expanding with new entrants in the field. The number of service firms has grown, particularly among the youngest firms. These are, for example, firms selling research and development services to other companies

Forty percent of all companies manufactured products while 33% were service-oriented and 20% aimed at both products and services. The firm cohorts differed in this respect: pure product orientation decreases in the youngest firm group, while at the same time, pure service orientation increases (Figure 7). Combining products and services is most frequent in the oldest group and increases again in the youngest group.

Figure 8 gives the turnover distribution of the biotechnology companies. The authors are aware that new biotechnology companies are often still at a stage at which they do not earn much. However, by displaying this information, we can get an idea of how advanced biotechnology companies are in economic activity. The skewed distribution of turnover is particularly evident when compared with SMEs in Finland in general (see Appendix 1).

Figure 8.

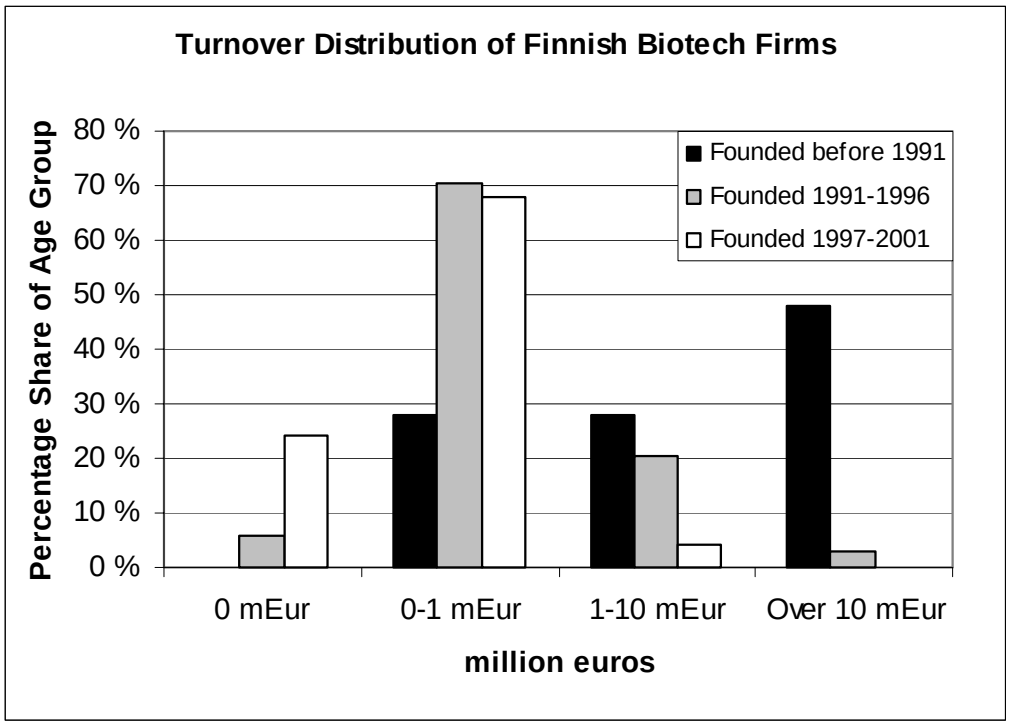


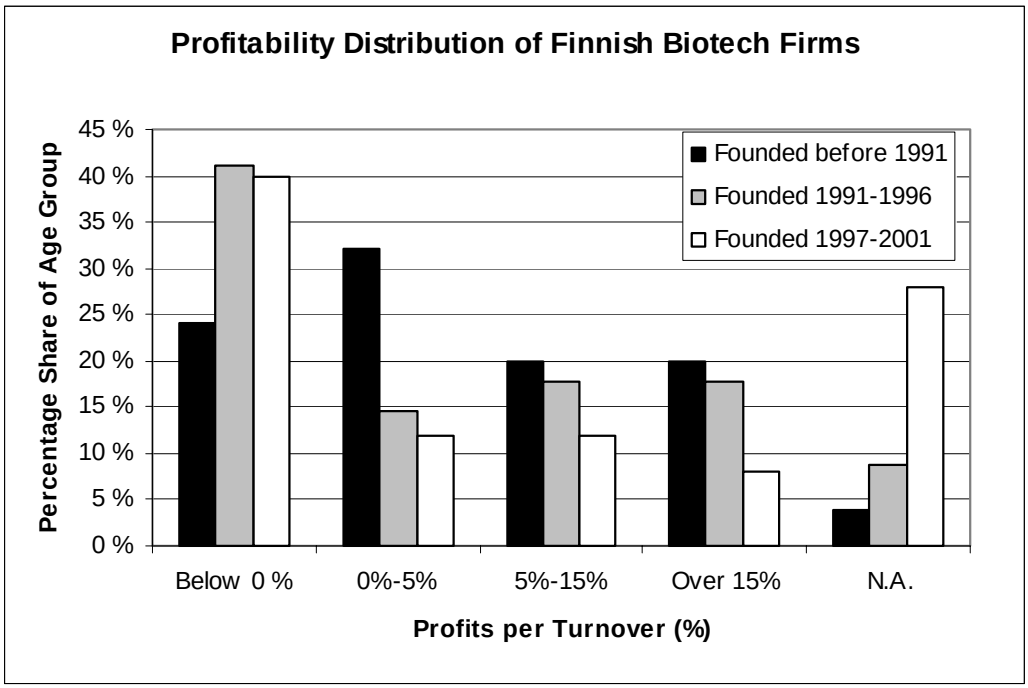
Table 6. Anticipated annual growth rate of turnover on average (weighted by firm size)

	Anticipated annual growth rate of turnover (5 years)
Founded before 1991	7 %
Founded 1991-1996	53 %
Founded 1997-2001	114 %
Total	10 %

Expectations concerning the growth of turnover are relatively high in the biotechnology industry. Generally speaking, the younger the firm, the higher are the expectations (Table 6). The business potential of older firms is higher because many of them have been active in their business areas even before the biotechnology era. However, even the oldest cohort expects to have larger growth rates than firms in the overall Finnish economy.

A large proportion of the firms founded from 1991-96 and 1997-2001 had negative earnings. If the turnover is small or there is no turnover at all, profitability cannot be highly positive. The survival of these companies depends on the realisation of their high growth prospects. Not surprisingly, the oldest cohort had more companies with some profits.

Figure 9.



2.5. Customers and markets

Generally, the chemical industry as a whole is the most important customer branch of Finnish biotechnology firms. For example, many biotechnological innovations are applied in pharmaceuticals and chemicals, but they are utilised in diagnostics and other sectors, too.

In particular the pharmaceuticals industry is the most important customer branch for all cohorts of firms (Figure 10). Health care and diagnostics and other services are important particularly for the oldest cohort and provide an important customer branch for almost half of the firms. Food and feed and other chemical industries are generally important customers of biotechnology firms. Agriculture and forestry, and environmental activities are customer branches for only a few biotechnology companies.

Figure 10. Most important customer branches by firm age

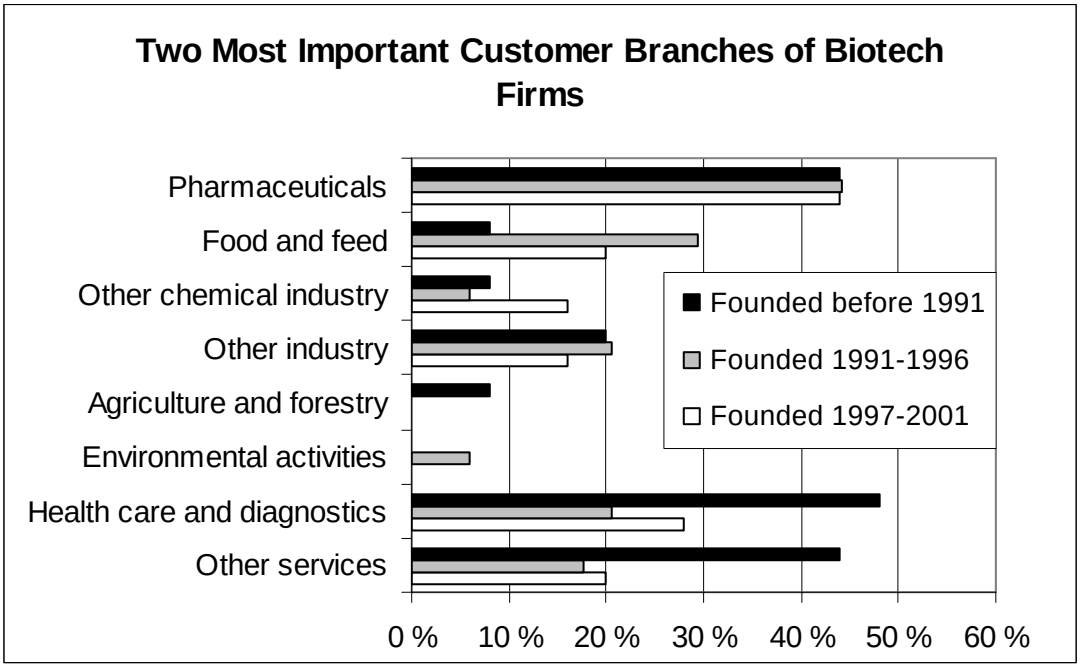
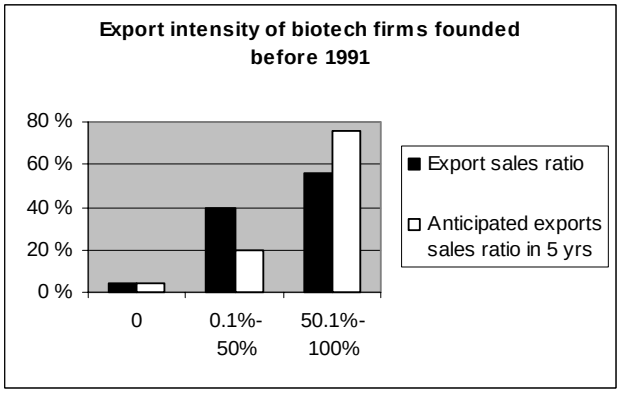
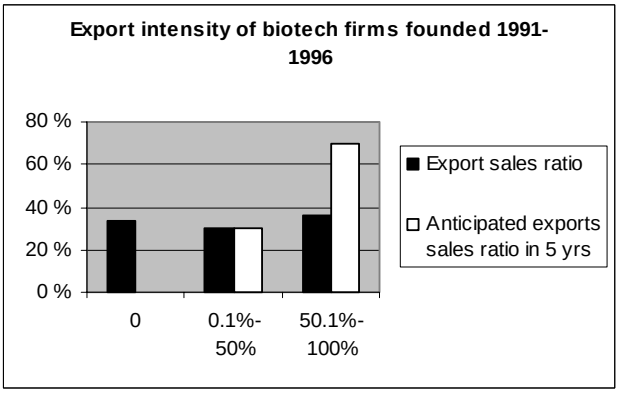
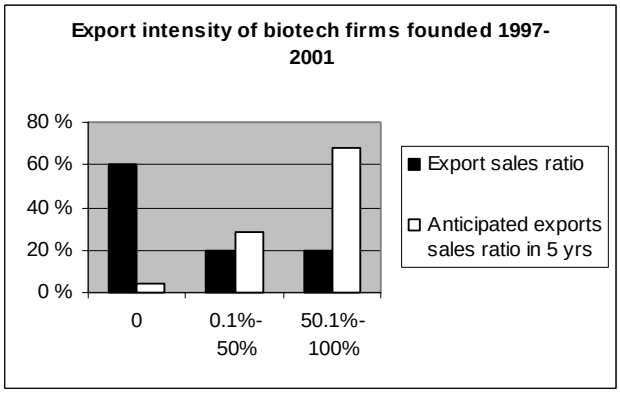


Figure 11. Present and anticipated (in 5 years) export intensity of the Finnish biotechnology firms.





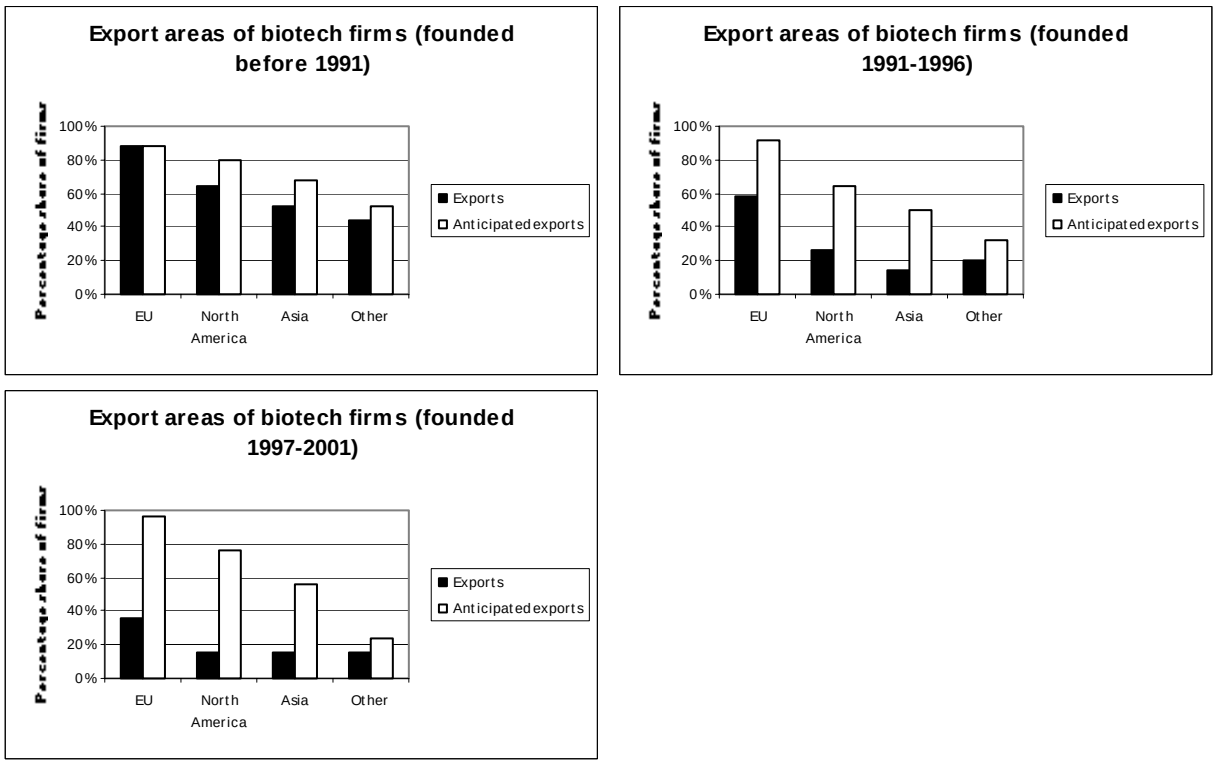


Export intensity is depicted in Figure 11 and is measured by exports to sales ratio. Sixty-seven per cent of the firms reported that they had exports. Non-response is here regarded as an indication of no exports. The proportion of non-response was the largest among the youngest firm group, which also had the smallest percentage of exports even with non-

response deducted. Over 60% of all firms expected that their exports would exceed half their sales within the next five-year period. Even the older firms expected that their export intensity would increase noticeably in the next five years. It is obvious that Finnish biotechnology firms are seeking growth by expanding to foreign markets. Particularly firms in the youngest cohort anticipate a large growth of export intensity and structural change in their exports.

The European Union was the most important export region of the Finnish biotechnology firms (Figure 12). Sixty-one per cent of the companies had some exports to the EU. This is not different from the general pattern of exports of Finnish industries, since the EU is overall the most important export area for Finland.[12] Over 90 percent of the biotechnology firms were planning exports to the EU area in the next five years. Thirty-five per cent of the companies exported to North America. Asia was also a fairly important export target area (26%) and the rest of the world was as important (26%). The oldest firms had wider export markets than the other firm groups. By contrast, the younger firms were expecting their exports to grow and their export regions to widen globally.

Figure 12. Present and anticipated export regions of Finnish Biotechnology firms.



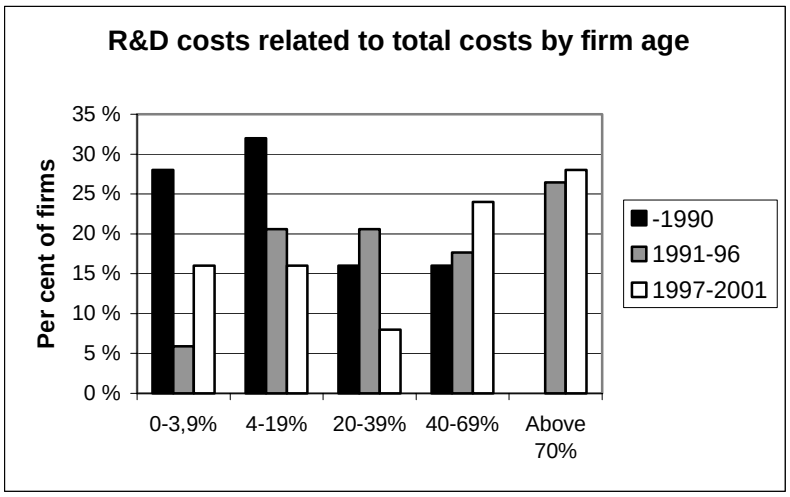
The large growth expectations of sales are based on anticipated rapid growth of demand for biotechnology products and services in global markets. In order to answer to the changing needs of global markets the firms, particularly the younger ones, still need to develop their products and services a great deal. The growth potential of biotechnology production has been realized only to a very limited extent. The high research and development (R&D) intensity of firms indicates that many of the products are still in the development phase and that their products are not yet in the market.

[12] Finnish industry exported over 50 per cent of their overall merchandise exports to EU countries in 2001 (see e.g. de Carvalho, 2002).

2.6. R&D intensity and R&D collaboration

When R&D intensity is analysed by firm age (Figure 13), the oldest and most mature firms have lower R&D intensities than the younger ones. However, the total sum of their R&D inputs in euros is noticeably high. We estimated the R&D costs of the Finnish companies as a whole.[13] The companies founded before 1991 had R&D investments of about 160 million euros in 2001. The younger companies spent less than 100 million euros in R&D activities altogether. In other words, the volume of

Figure 13. R&D intensity of the Finnish biotechnology firms by firm cohorts.



R&D investments was high in the oldest cohort of companies, but the R&D intensity was higher among the companies founded from 1991-2001. None of the oldest companies had R&D intensities above 70%, as did many of the younger companies. The difference compared with all Finnish SMEs is pronounced (appendix table). When calculating R&D intensities, R&D costs were related to total costs, since many of the more recently founded firms had very small turnover and had negative returns.

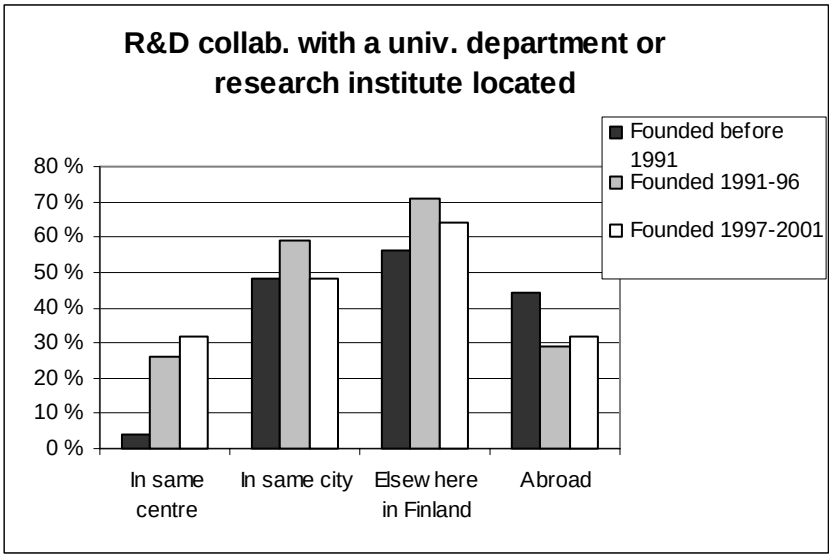
Fifty per cent of the companies were located in a biocentre or a science park. The division between the two is not clear-cut and therefore they are grouped together in this calculation. Of those situated in such a centre, 43 per cent collaborated in R&D with a university or research institute located in the same centre while 88% collaborated with a university department or a research institute in general. This shows that locality matters, but a company does not find all its partners from the same centre or in the same city. This as is evident also in Table 7.

Table 7. Of all respondents, the following proportions collaborate with:

Other university department or research institute located in the same city	52%
Other Finnish university department or research institute	64%
Foreign university department or research institute	35%

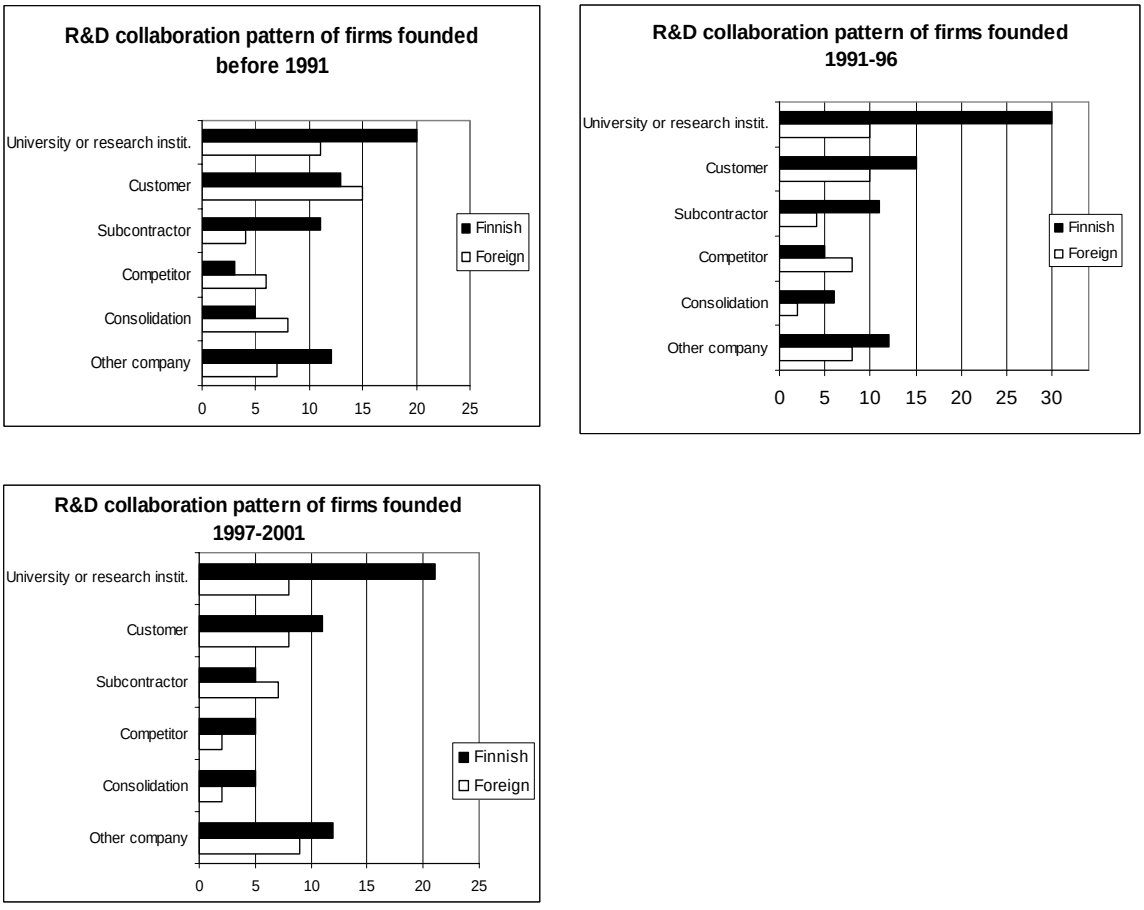
[13] Estimation procedure was based on the weighted sums. Weights were constructed from the age groups. Each age group was weighted according to the relative shares of the sample out of the entire population of the Finnish biotech firms.

Figure 14.



Collaboration within the same centre was least important for the oldest companies, which were least often situated in a biocentre or a science park. Four companies among this oldest group were located in a biocentre or a science park and only one of them collaborated with a university department or research institute situated in the same centre. The oldest companies apparently had most resources to collaborate with a foreign department or institute.

Figure 15.



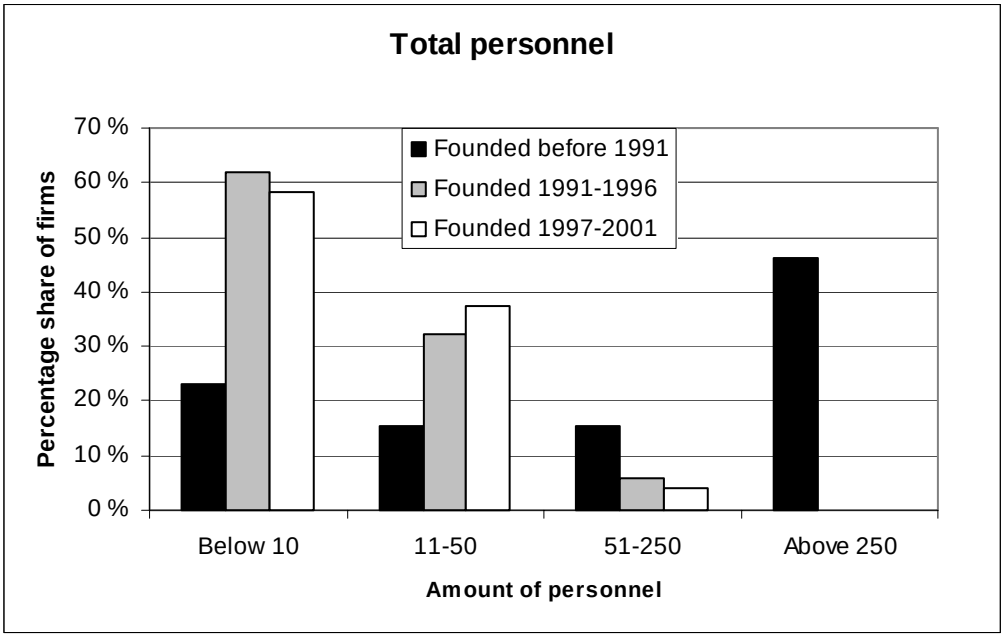
Of all respondents, 90 % reported that they had had R&D collaboration with other companies or research organisations during the last three years. The most frequent partners were universities or research institutes and domestic universities or research institutes in particular (Figure 14).

A major difference between firm cohorts was the fact that the oldest firm group had more R&D collaboration with their customers and subcontractors as well as with other companies (Figure 15). Interestingly, these firms had more collaboration with foreign customers and competitors compared with those in Finland. They also had more collaboration with other units in the same consolidation of companies and again with those abroad. The fact that they collaborated within the same consolidation is understandable given that they were on average larger companies and more often belonged to such a group.

2.7. Personnel and skills

Finnish companies involved in biotechnology activities, founded before 1991, employ over 10,000 people. The companies founded in 1991-2001 employ over 1,000 people. Therefore the size of business varies strongly by firm age.

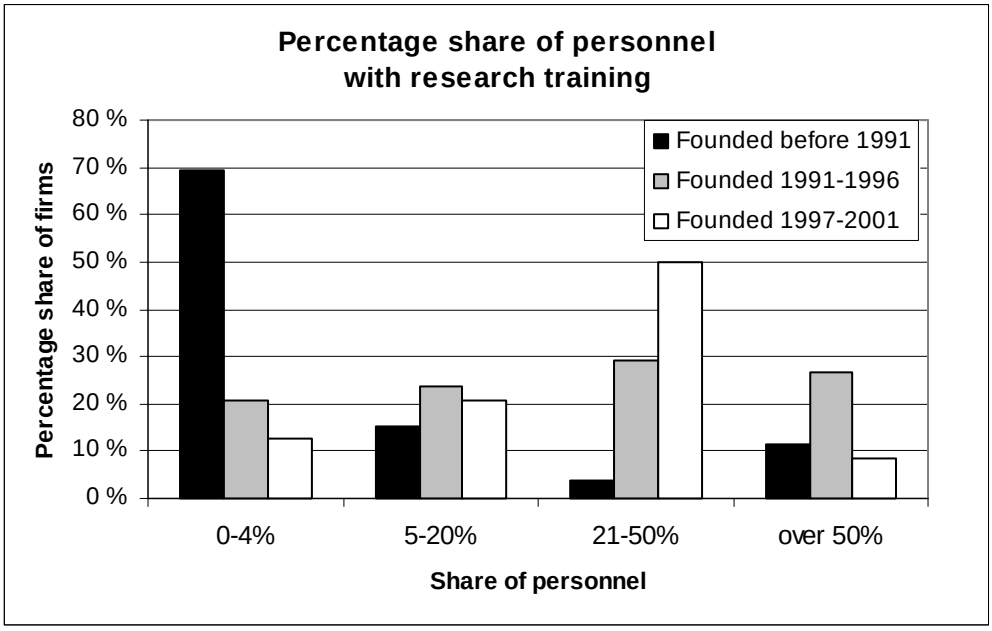
Figure 16. Size of personnel in Finnish biotechnology companies by firm age



The majority of the firms in the two later entrant groups were really very small with personnel of fewer than 10 employees (Figure 16). By contrast, over 40% of the oldest firms were large with personnel of 250 or more. Biotechnology firms had very large proportions of academically qualified personnel. This was true particularly for the latest entrants in the field (Figure 17) reflecting their greater R&D intensity and future growth potential.

Additionally, 60% of all firms had personnel with some university position or tasks: 22% employed a professor, 36 % a docent, 27 % employed a person/persons who gave lectures, and 30% a person/persons who supervised student theses. These findings indicate close

Figure 17.[14]

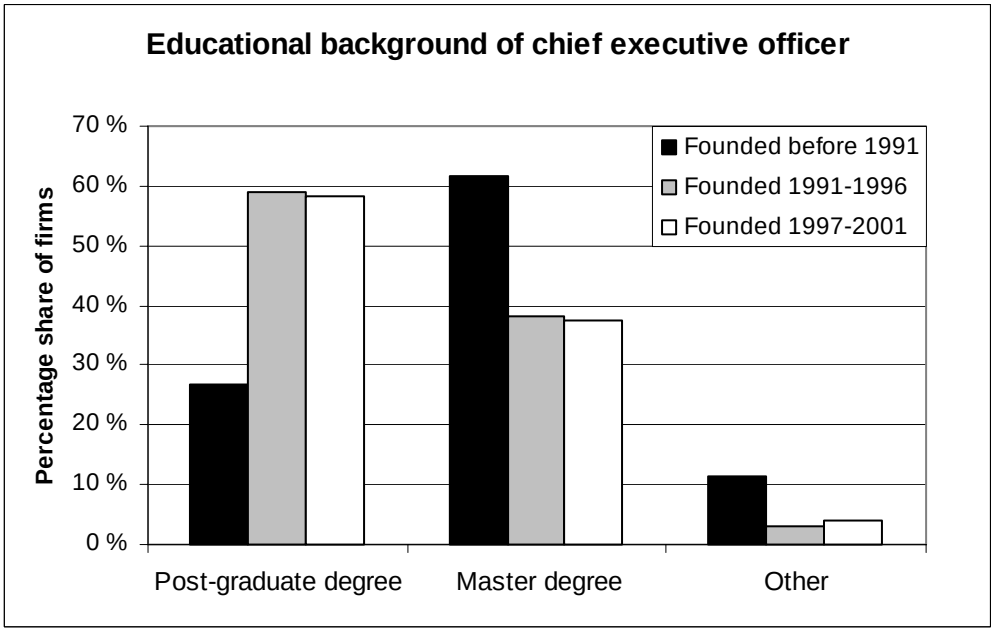


university links. A sizeable proportion, 30% of the firms, said that they had had difficulties in finding highly trained personnel.

Skills of CEOs

A large percentage, about half of the CEO's of biotechnology firms, had research training (a doctorate or licentiate's degree) (Figure 18). Again, the newest firm cohorts had the highest percentages of highly trained CEOs.

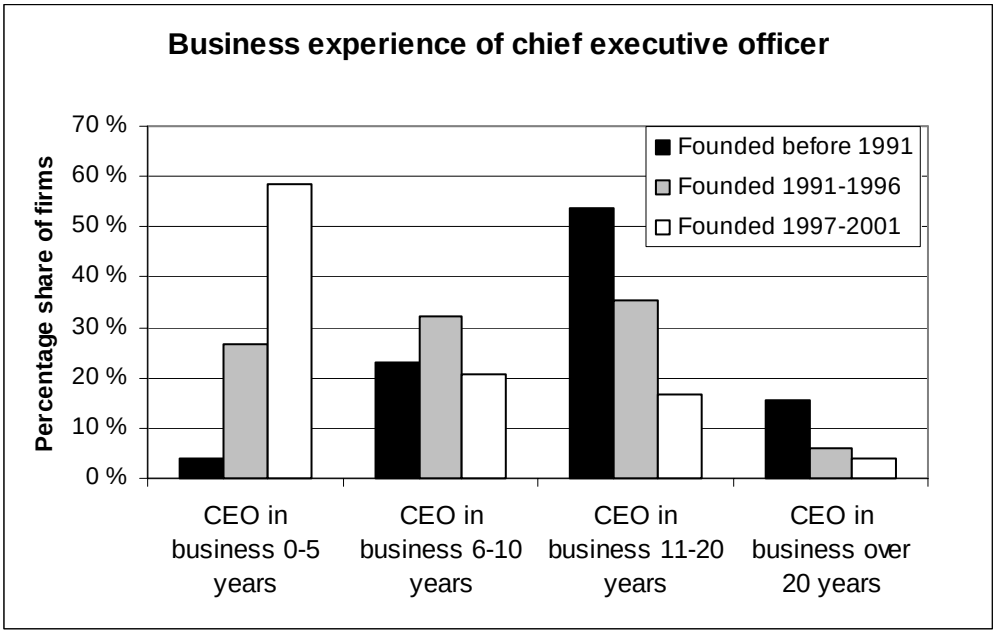
Figure 18.



[14] Research training means a doctor's degree or a licentiate's degree (both above the master's degree).

The average business experience of the CEOs was greater than expected (Figure 19). However, the youngest firms had the largest percentages of less experienced CEOs, which may hamper their business performance. In other words, relatively old and large companies employ CEOs with extensive business experience.

Figure 19.



Manufacturing and marketing skills

Since it is often assumed that science-based firms lack manufacturing and marketing skills, these were also studied in the survey. The majority of all firms, however, had some skills, though firm age and origin play a role here. The proportion of firms having manufacturing skills has been calculated taking into account the firms that made products or products and services (N=51). Pure service firms have been left out, since manufacturing skills were not relevant for them.

Table 8. Manufacturing and marketing skills in the company

	Manufacturing skills	Marketing skills
Full-time expert	73%	49%
Part-time expert	18%	29%
Expertise bought outside the firm	24%	13%
No expertise at all	8%	20%

When comparing firm cohorts, not surprisingly, older firms had full-time expertise in both manufacturing and marketing skills more often than younger firms, while the latter resorted more often to part-time expertise. It is to be noted that differences were not large with regard to manufacturing skills. We may assume that companies that only had external or part-time expertise were not as well equipped for manufacturing or marketing activities as those firms that had the expertise in-house. There was a small group of companies that did not have any expertise at all. Because of small percentages and small group sizes, we cannot draw any clear-cut conclusions about the differences between cohorts in this re-

spect. Still, it is to be noted that the middle cohort most often had no expertise at all in marketing. (Table 9).

Table 9. Manufacturing and marketing skills by year of foundation

	Before 1991	1991-96	1997-2001
Full-time manufacturing expertise	78%	72%	60%
Part-time manufacturing expertise	9%	28%	20%
Expertise bought outside the firm	17%	33%	20%
No manufacturing expertise at all	9%	6%	20%*
Full-time marketing expertise	68%	38%	44%
Part-time marketing expertise	16%	32%	36%
Expertise bought outside the firm	9%	22%	0%
No marketing expertise at all	16%	26%	16%

*Only one out of five companies

Table 10. Manufacturing and marketing skills by research spin-off

	Research spin-off	Not research spin-off
Full-time manufacturing expertise	65%	85%
Part-time manufacturing expertise	23%	10%
Expertise bought outside the firm	26%	20%
No manufacturing expertise at all	10%	5%
Full-time marketing expertise	39%	68%
Part-time marketing expertise	36%	14%
Expertise bought outside the firm	13%	14%
No marketing expertise at all	25%	11%

Research spin-offs had less full-time and more part-time expertise in both manufacturing and marketing and more often had no expertise at all when compared with companies that were not research spin-offs by origin. We conclude that research spin-offs are not as well prepared for business as companies with other origins.

2.8. Ownership structure

The survey paid relatively close attention to the ownership and other sources of corporate finance.[15] It was noticeable first that the owners take part in business activities and planning by joining the boards of the younger firms. There is an incentive to look after investments carefully when the business risk is high in the start phase of a company. Secondly, older companies seemed to have more foreign owners and foreign-controlled members in boards than younger firms.

In total, one third of the firms reported that their ownership structure had changed in the last three years (Table 11). The largest percentage was in the group of companies founded in 1991-96. Ownership seems to be fairly concentrated: the shares of the three largest shareholders exceeded 50% of the shares in 82 per cent of the companies. Furthermore, the cumulative share of the board members exceeded 50% of the total shares in 64% of the companies. The cumulative share is highest among the youngest firms probably because their owners wish to oversee their interests as members of boards due to high business risks. The operative management and the chair of the board were seldom the same person. The boards of the oldest firm group included foreign owners and representatives of foreign institutions more often than the other firms did.

[15] See Ernst & Young report (2002) for financial structures in international framework.

Table 11. Ownership structure of firms, by year of foundation

Year of foundation								
	< 1991		**1991-1996**		**1997-2001**		**Total**	
The ownership structure has changed within the last three years	6	24 %	16	47 %	8	32 %	30	36 %
The shares of the three largest shareholders exceed 50% of the total shares	21	84 %	29	85 %	19	76 %	69	82 %
The cumulative share of the members of the board exceeds 50% of the total shares	11	44 %	22	65 %	21	84 %	54	64 %
The chairman of the board and the CEO is the same person	2	8 %	8	24 %	3	12 %	13	15 %
Company has foreign owners	14	56 %	9	26 %	9	36 %	32	38 %
The board of directors includes representatives of foreign institutions	8	32 %	10	29 %	6	24 %	24	29 %
Number of companies	*25*		*34*		*25*		84	

Table 12. Sources of equity, last accounting year, by year of foundation

The number and proportion of firms that reported the particular source								
	< 1990		**1991-1996**		**1997-2001**		**Total**	
Principal owner	18	72 %	19	56 %	17	68 %	54	64 %
Management and personnel	8	32 %	17	50 %	19	76 %	44	52 %
Private persons, e.g. business angels	2	8 %	9	26 %	6	24 %	17	20 %
Sitra[16]	2	8 %	9	26 %	7	28 %	18	21 %
Other public sector venture capitalist	0	0 %	3	9 %	0	0 %	3	4 %
Private venture capital company	9	36 %	5	15 %	4	16 %	18	21 %
Private financial institution	0	0 %	5	15 %	3	12 %	8	10 %
Other companies	7	28 %	4	12 %	3	12 %	14	17 %
Other	1	4 %	6	18 %	4	16 %	11	13 %
Number of companies	*25*		*34*		*25*		84	

The owners of Finnish biotechnology companies are classified according to their influence on the companies. The categories are divided into two parts, that is, principal owners and other investors. *A principal owner (PO) is an owner who has a strong influence on the plan-*

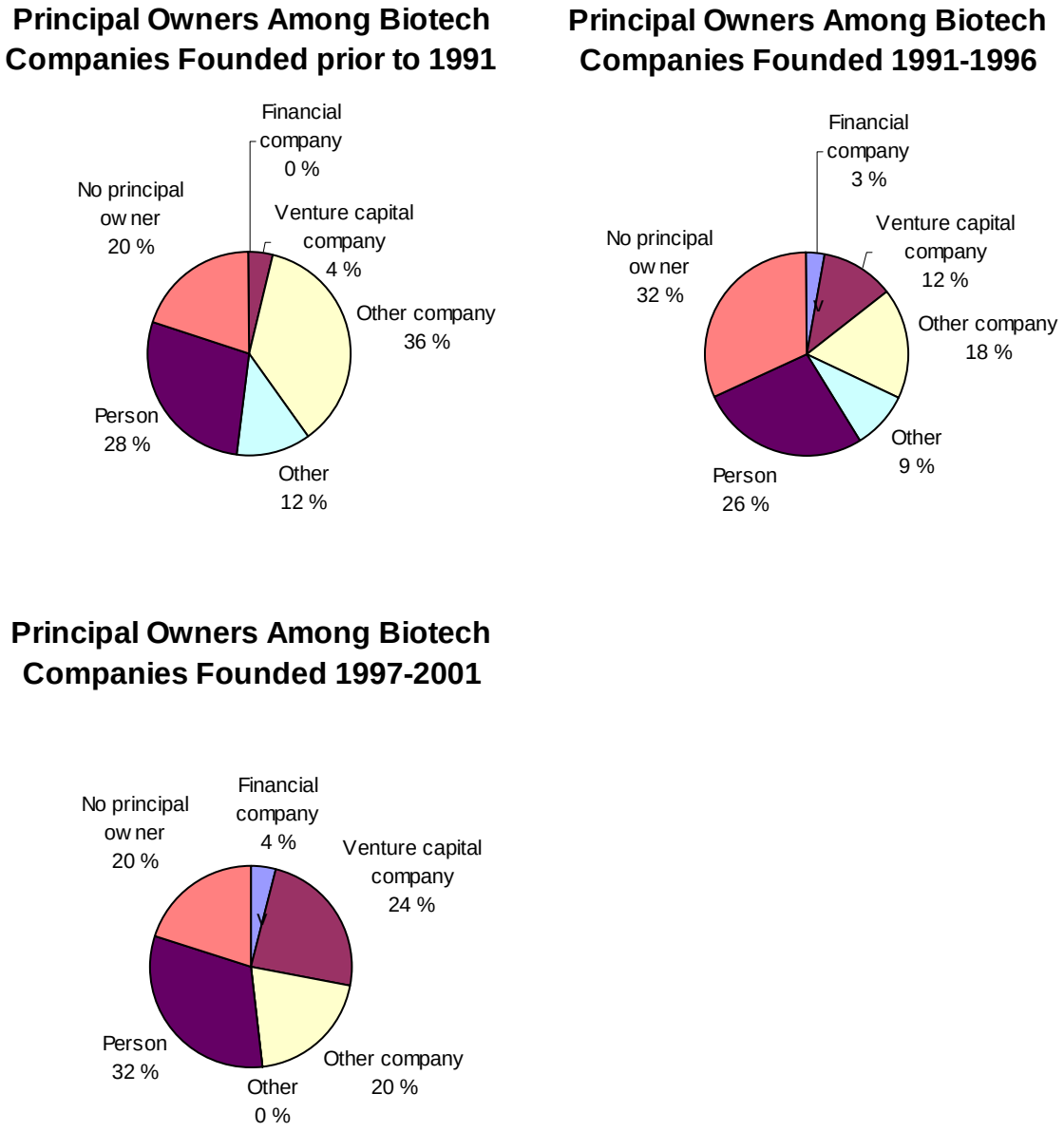
[16] Sitra is an independent public fund under the responsibility of the Finnish Parliament. Its operations are mainly financed through income from endowment investments and project finance. Sitra has an important role in the development of business based on knowledge and know-how. Public equity investment for the start-up and early stages of companies is concentrated in Sitra.

ning and decision-making of a firm. Alternatively, the PO can be an investor who simply owns the largest share of the firm's equity. Sources other than PO are classified in Table 12.

More than one half of the companies had POs. Management and personnel were often owners in young firms. The public venture capitalist Sitra had invested in many young firms while private venture capitalist companies and other companies favoured the oldest cohort judged by the number of firms invested in by them. However, the overall amount of investment changes the picture: private venture capital companies own the largest equity shares in the youngest firms.[17]

Figure 20 depicts the distribution of principal owners (POs) according to the age of the firms.

Figure 20.



[17] See Hermans and Tahvanainen (2002).

The figure above depicts the relative shares of the POs in the firms. The youngest and medium cohorts of firms had a person as the most typical PO. The oldest companies had other non-financial companies as the most typical PO. Venture capital companies acted as a PO in 13% of the companies. The younger the company, the larger the share of firms with a venture capital company as a PO. Sitra, a public venture capital company, was a principal owner in half the cases in the venture capital company group.

Table 13. A person (not an organization) as a principal owner

	Number	Per cent
The principal owner is a person	25	29 %
The person has contributed to the start phase of a firm	23	27 %
The person deals with the daily duties of the firm	24	28 %

Figure 20 shows that persons were equity holders in many young companies. When a person was the principal owner, this person was very active during the start-up phase of a firm. This person was also active in the operative management of the business. This is consistent with the relative shares depicted above in Table 13. PO persons holding equity mostly belong to the management or personnel in young companies.

2.9. Sources of capital loans and debt

The public financing institutions Tekes and Sitra are the major players as capital loan suppliers among Finnish biotechnology firms (Table 14). Private domestic venture capitalists and other investors are focused on financing young biotechnology companies. Capital loan finance is often bound to other forms of finance in order to guide the solvency ratios of a firm and the risk level of an investor.

Table 14. The sources of capital loans, last accounting year, by year of foundation

The number and proportion of firms that reported the particular source	Companies founded in the period							
	< 1990		**1991-1996**		**1997-2001**		**Total**	
Private domestic venture capitalist	2	8 %	1	3 %	3	12 %	6	7 %
Sitra	1	4 %	6	18 %	6	24 %	13	15 %
Finnvera	0	0 %	2	6 %	1	4 %	3	4 %
Tekes	6	24 %	15	44 %	10	40 %	31	37 %
Other	1	4 %	3	9 %	8	32 %	12	14 %
Number of companies	*25*		*34*		*25*		84	

Capital loans hold greater risks than conventional loans for investors. The interests for capital loans are only paid from the retained earnings of a company. If company has a negative profit, it does not have to pay the interest for capital loans. Therefore, the interest rate for a capital loan is often set relatively high compared with the interest rate of a con-

ventional loan. Despite the high cost of this form of finance, capital loans are counted as a part of the total equity in a balance sheet. Therefore, capital loans improve the solvency of young biotechnology firms with highly negative profits due to heavy investments in R&D. This explains at least partially the popularity of capital loans among the youngest biotechnology companies.

Table 15. The sources of debt, last accounting year, by year of foundation

The number and proportion of firms that reported the particular source								
	< 1991		**1991-1996**		**1997-2001**		**Total**	
Private domestic financial institutions	15	60 %	9	26 %	4	16 %	28	33 %
Finnvera[18]	5	20 %	7	21 %	4	16 %	16	19 %
Tekes	6	24 %	6	18 %	4	16 %	16	19 %
Other public sector institution	2	8 %	6	18 %	2	8 %	10	12 %
Other companies (loans)	5	20 %	5	15 %	4	16 %	14	17 %
Person	3	12 %	1	3 %	2	8 %	6	7 %
Other forms of liabilities (e.g. accounts payable)	20	80 %	27	79 %	16	64 %	63	75 %
Number of companies	*25*		*34*		*25*		84	

The public sector has been an active lender to all age groups of biotechnology firms. By contrast, in the oldest firm cohorts domestic financial institutions prefer established biotechnology companies as clients. The private sector has focused on lending money to a relatively small part of companies. Other firms have supplied loans to 20 percent of biotechnology firms. Persons are debtors in only few cases. Three quarters of the firms have other forms of liability, for instance, accounts payable.

2.10. Public funding

Below are two figures about public funding of biotechnology companies at any time before the survey. This is a major difference when compared with the data on debts and sources of debts in the previous section. These concern the last accounting year, and therefore, there are some differences in the figures.

Tekes was particularly important for all firm groups. Depending on the type of funding or firm group, Sitra, the Ministry of Trade and Industry, Finnvera and the EU also played a role. Figures 21-23 give percentages of firms receiving various forms of public funding. They do not reveal how much funding each firm received.

[18] Finnvera plc is a specialised financing company, owned by the Finnish state. It promotes the domestic operations of Finnish companies (in all industries) and furthers their exports by sharing the financing risks of companies. In 2001 Finnvera's financing for the domestic operations of enterprises was EUR 708,3 million.

Figure 21. Public funding (aid and loan guarantees) by source, any time before the survey

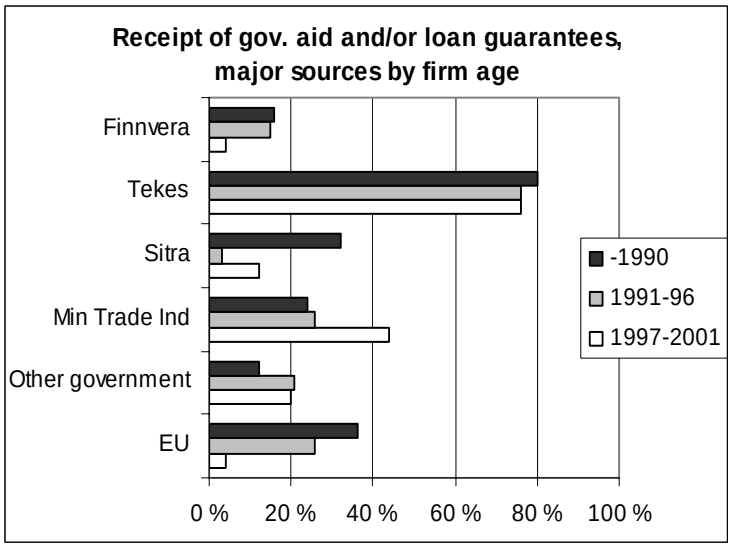


Figure 22. Public funding (equity and debt finance) by source, any time before the survey

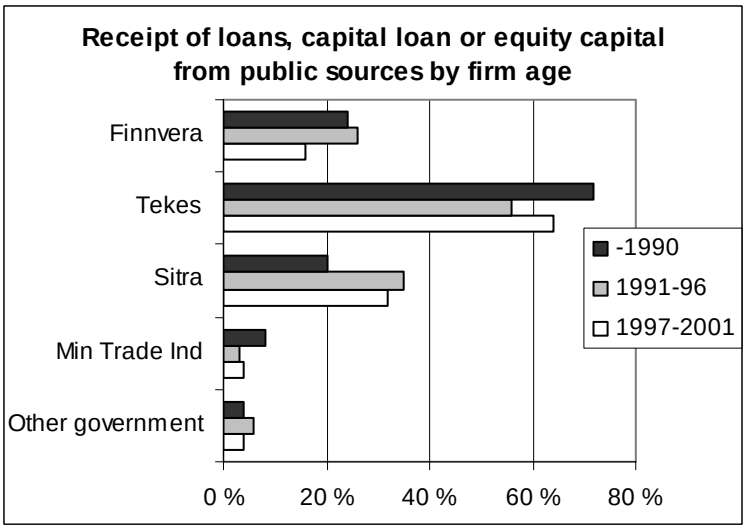
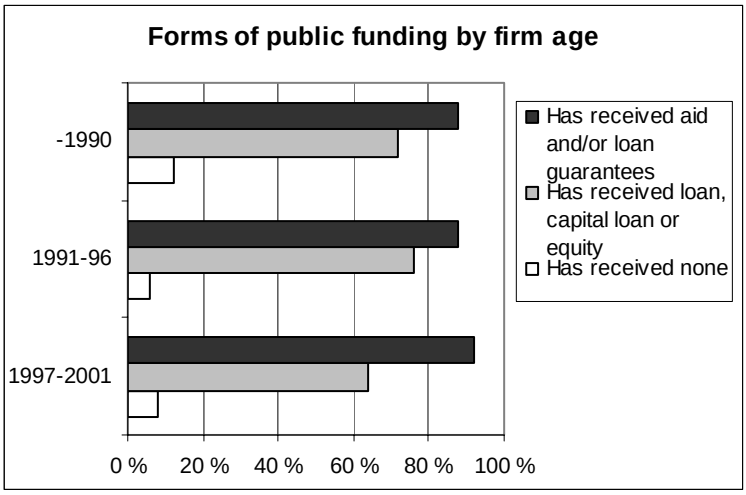


Figure 23 gives the percentages of firms that had received at least one of the above forms of public aid: direct aid, loan guarantees, loans, capital loans or equity. More firms have received direct aid or loan guarantees than loan, capital loan or equity. The difference was greatest among the youngest firm group. A very small percentage of al firms had not benefited from either form of public funding.

In addition to the funding reported above, thirty-five per cent of all the firms said that their collaborative partner had received research money from the Academy of Finland for a project which was related to developing the knowledge base of the company after the foundation of the firm. There were not differences between firms that were research spin-off and other firms. However, firms founded from 1991-96 had the highest percentages in this respect: 44 % of them said that their partners had received Academy research money while the percentage was 28% for the oldest and youngest firm group. This again indicates the close relationship the middle group had with academic researchers.

Figure 23. Type of public funding, any time before the survey



2.11. Impact of funding

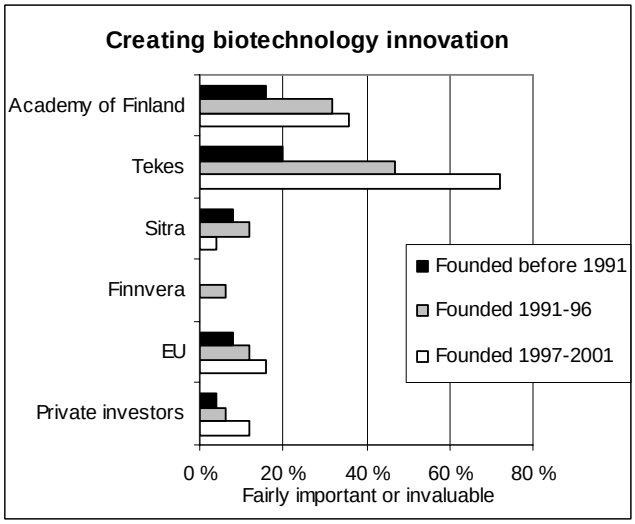
The impact of public and private funding in the different phases of establishing the firm is given in Figure 24 in the next section. Each figure gives the percentage of companies that regard the different funding sources as fairly important or invaluable for the particular phases in the life cycle of the firm.

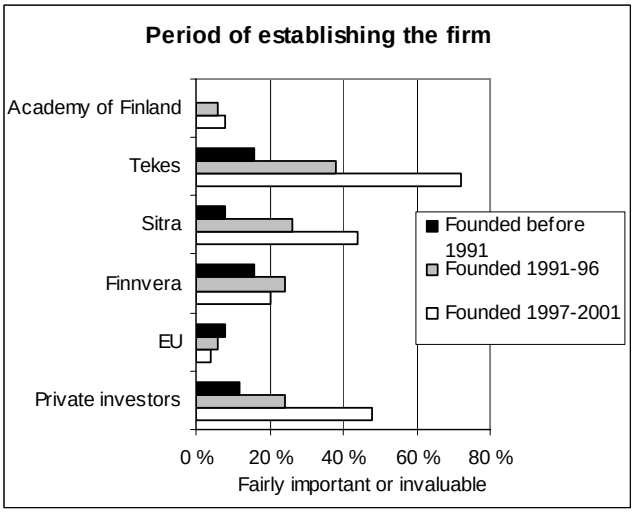
Aside from creating international R&D and customer relations, the role of Tekes is more important than that of other organisations. This can be understood by taking into account that, as seen in Figures 21-22, Tekes support has concerned a large majority of the firms and more firms than any other source of funding. There are differences between firm cohorts in the importance of different sources of funding. For the youngest firms, outside funding was even more important than for other firms in the very early phases: in the creation of the biotechnology innovation, the period of establishing the firm, and starting company R&D. Probably many of the youngest firms have not yet reached the commercialisation phase and therefore, the different funding sources have not been as important as for the middle group. Still, private investors played a greater role for the youngest firms than for other firms in almost all phases.

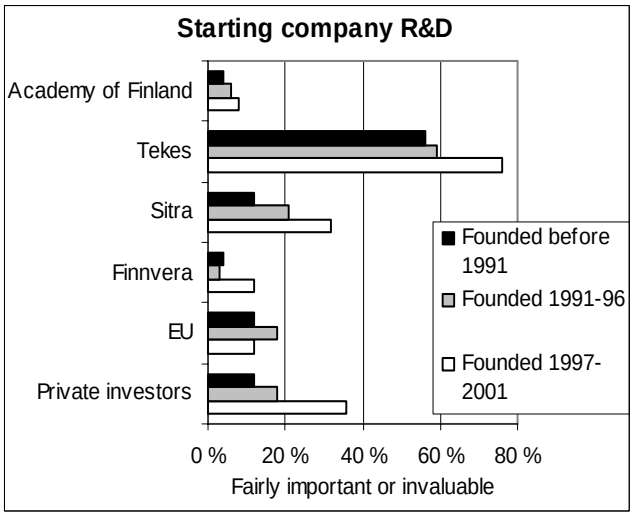
Another observation concerns the relative importance of different funding sources in the various phases. Private investors are overall more important in the commercialisation phase as well as in the creation of international R&D and customer relations while Tekes and the Academy of Finland are important in the creation of biotechnology innovations.[19] It is to be noted that Tekes funding is mainly intended for R&D projects. These findings could be interpreted to indicate that Tekes supports the creation of innovations and their commercialisation in a large proportion of firms while private investors and Sitra pick up the most promising firms for business success.

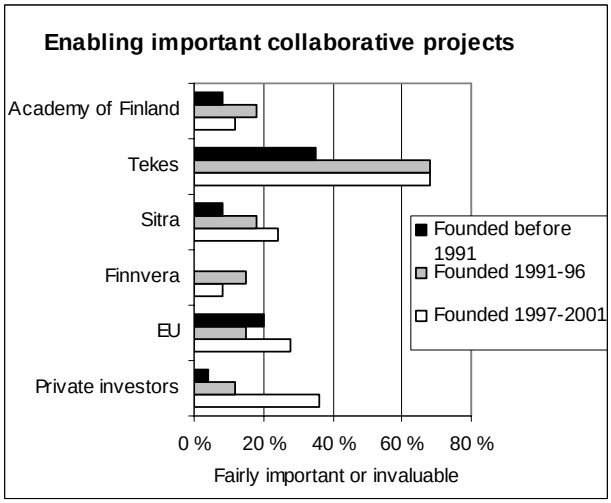
[19] The Academy of Finland mainly funds scientific research conducted at universities and research institutes.

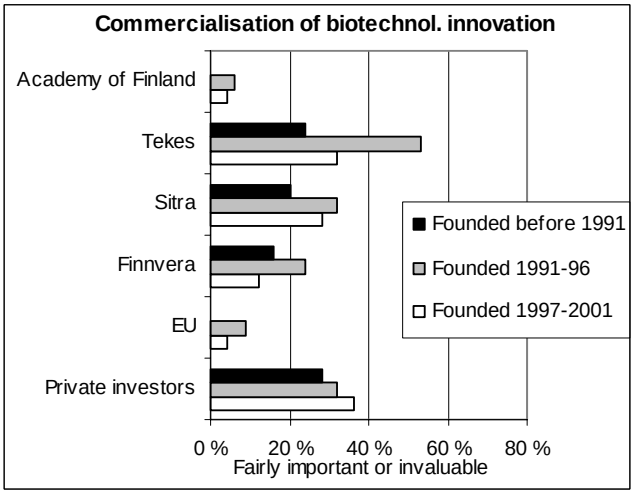
Figure 24. Impact of funding at different stages in firm life cycle

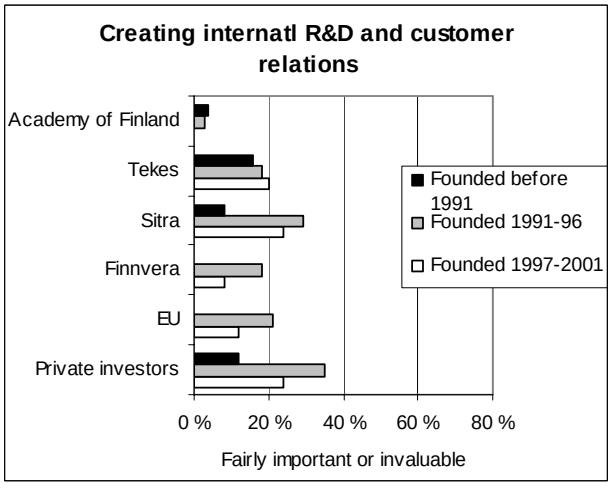








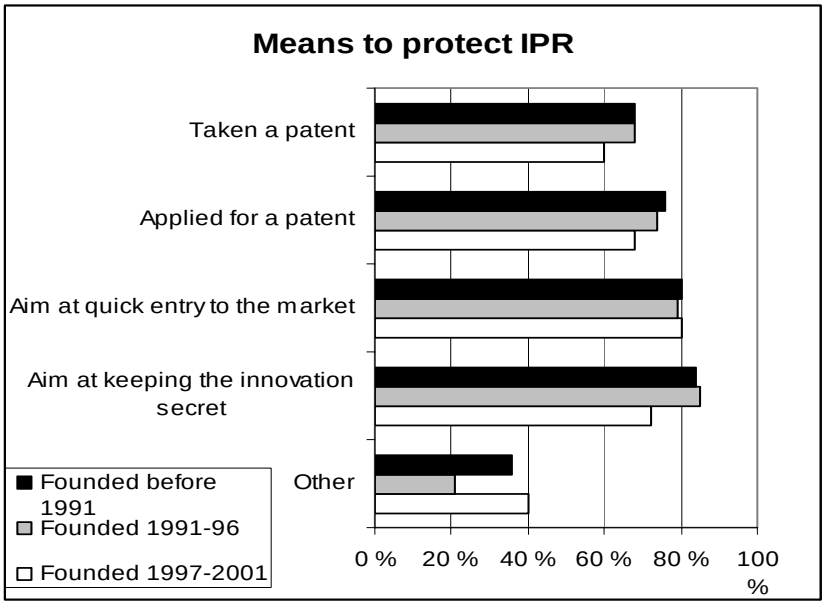




2.12. IPR issues

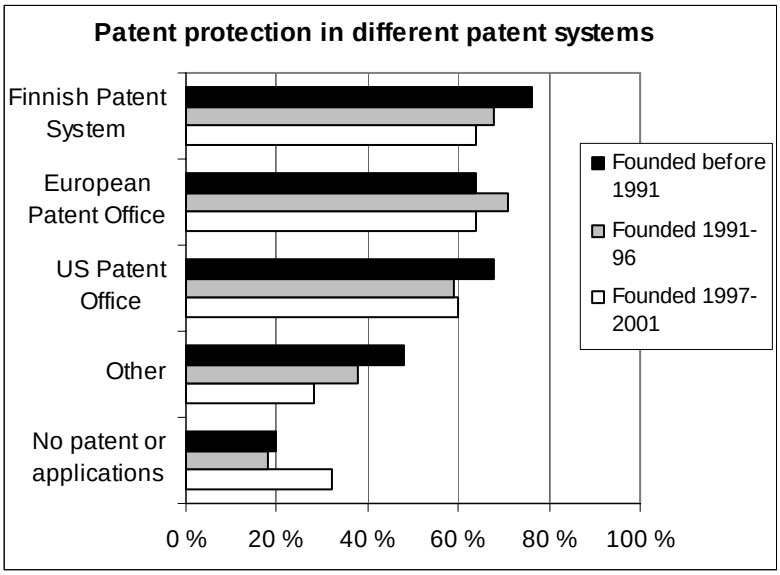
Seventy-two per cent of the companies had taken or applied for a patent. Patent protection was, however, only one of the means of protecting the intellectual property of the company, as is seen in the figure below. Nine per cent of the respondent companies had not used any of the means listed to protect their intellectual property.

Figure 25.



The percentage of companies, which have taken or applied for a patent, was 74% according to Figure 25 and 77% according to Figure 26. There is a small discrepancy between the answers to these two questions. The discrepancy is, however, small, in absolute terms, 3 companies that have replied in an inconsistent manner. We can conclude that around three-quarters of the companies have resorted to patenting as a means of protecting their intellectual property.

Figure 26.



The quarter of companies that had neither applied nor taken a patent was not more eager to use other means to protect their IPR than those which had resorted to patenting, quite the contrary. When comparing firms of different age cohorts, the youngest firms more often than others had not taken or applied for a patent: 32% vs. 24% in the earlier cohorts. Consequently, one of the reasons why companies had not relied on patent protection was probably the fact that their innovations were not developed enough. The survey does not give any further explanation for the finding.

When comparing the frequencies of different means to protection of the intellectual property, there were very small differences between different firm cohorts.

The Finnish, European and US systems were used almost as frequently. In the category 'other', the countries listed most often were the following: Japan 19 mentions, Australia 9 mentions, China 5 mentions, Russia 3 mentions, and New Zealand 3 mentions.

Differences between firm cohorts in their propensity to patent in the various patent systems were fairly small. There is, however, some tendency for older firms to patent more often in the Finnish and the US system as well as in other systems. Still, judging by the patenting activity, all firms were clearly aiming at diverse foreign markets. Thirty per cent of all firms had bought the rights to produce the products of other firms through licensing or other agreements.

3. CONCLUDING REMARKS

The majority of Finnish biotechnology firms are quite young and still in the early stages of gainful economic activities. Their turnover, profits and exports are, for the younger firms in particular, still low, profits even negative, while their growth expectations are high. We could even claim that the greater the accounting losses, the higher is the anticipated growth of sales revenues in the future, if the losses are due to high R&D expenses. The high R&D intensity of especially younger firms indicates that their products are still largely in the development phase and that few of their products are yet in the market. Furthermore, the commercialisation process – from the discovery to a profitable production process – may easily take from 10-15 years. At the same time, only a few of the innovations turn out to be exploitable. This increases the risk assessed and the rate of returns required by the investors. The high risk can be reduced if a company has an innovation portfolio that is wide enough. This, in turn, implies high R&D intensity and decreases the current profits.

Ownership structures vary by cohorts of firms. Over 60 % of the companies reported that they had a principal owner[20]. This seems to hold for all age groups of companies. However, the structure of principal owners varies a great deal by firm age. The youngest firms are financed and owned by private venture capital companies to a greater extent than by other non-financial firms. The oldest firms are more often subsidiaries. This may reflect the fact that foreign companies are willing to take over a Finnish company when its growth prospects are close to being realised. Private and public venture capitalists are most interested in the young companies with relatively high growth prospects. Although the risk is high, the expected rates of return are high, too. When a venture funding company invests in

[20] A principal owner holds a relatively large share of the company's equity or has a noticeable influence on the decision-making within a firm.

a small start-up company, it influences the running of business and provides an important source of business know-how for the company.

The study shows that a large proportion of the companies have obtained some public funding for the research which led to the foundation of the company or which took place in some other stages of the life cycle of the company. Un particular Tekes has funded relevant activities for the majority of the firms.

The examination of firms by the cohorts of entrants indicated that the middle cohort, firms founded in 1991-96, was not more advanced in business skills or economic activities than the firms founded later. The middle group turned out to be still quite research intensive and to have close links with university research. It apparently takes a longer time to acquire all the competencies and know-how needed for successful business activities. It is also possible that the middle group did not have as much help and advice at the time when their businesses were set up compared with the advice available for start-up firms today. This group is still at an early stage in business development. Research spin-off companies in general have more hindrances than other start-up firms, and would benefit from more systematic training in relevant business skills, such as how to make a business plan, how to deal with patenting, and how to obtain funding from venture capital investors.

LITERATURE

de Carvalho, Anthony (ed.) (2002): The Finnish Economy and Society. No. 2, ETLA and EVA, Helsinki.

Ernst &Young (2002): Beyond Borders – The Global Biotechnology Report 2002.

European Competitiveness Report, 2001, European Commission.

Halme, Kimmo (1994) Uudet yritykset biotekniikkasektorilla 1994, VTT Teknologian tutkimuksen ryhmä, Työpapereita no 11/94, Espoo.

Hermans, Raine – Tahvanainen, Antti (2002): Ownership and Financial Structures in Finnish Biotechnology SMEs - A Descriptive Analysis, ETLA Discussion paper, forthcoming.

Hyytinen, Ari – Pajarinen, Mika (2002): Small Business Finance in Finland: A Descriptive Study. ETLA, The Research Institute of the Finnish Economy discussion paper no. 812.

Mytelka, Lynn K. - Pellegrin, Julie (2001): Can SMEs survive? Static vs. dynamic externalities in the French biotechnology industry, paper presented at the DRUID Summer Conference, Aalborg, June 12-15.

Nilsson, Anna S. (2001): Biotechnology Firms in Sweden. Small Business Economics, No. 17, 91-103.

Zucker, G. Lynne – Darby, Michael R. – Armstrong, Jeff (1998): Geographically localizes Knowledge: Spillovers or Markets. *Economic Inquiry, vol. XXXVI, pp. 65-86.*

Appendix. Comparison between Finnish biotechnology firms and all the small and medium sized firms in Finland.[21]

		SME biotechnology companies in ETLA survey		Finnish SME companies in total[22]
		n	%	%
Turnover in million euro	< 0.2	36	49 %	15 %
	0.2-1.5	23	31 %	56 %
	1.6-8.0	8	11 %	24 %
	>8	6	8 %	5 %
Number of employees	<5	31	43 %	44 %
	5-20	21	29 %	41 %
	>20	21	29 %	15 %
Age of firm, years[23]	0-2	11	15 %	5 %
	3-4	13	18 %	9 %
	5-24	48	66 %	70 %
	>24	1	1 %	16 %
Exports / turnover	0 %	27	38 %	70 %
	0-1 %	1	1 %	22 %
	2-5 %	6	8 %	4 %
	6-10 %	1	1 %	2 %
	>10 %	37	51 %	3 %
	N/A	1	1 %	0 %
R&D expenditure / total costs (The total population of Finnish companies: R&D exp. / turnover)	0 %	8	11 %	53 %
	0-1 %	2	3 %	23 %
	2-5 %	2	3 %	13 %
	6-10 %	3	4 %	3 %
	>10%	56	79 %	6 %
	N/A	2	3 %	0 %
Predicted annual growth rate of turnover for the next 5 years (3 years in total)	<0 %	0	0 %	1 %
	0-1 %	4	6 %	31 %
	2-5 %	0	0 %	20 %
	6-10 %	8	11 %	23 %
	>10 %	59	83 %	21 %
	N/A	2	3 %	5 %
Holds patents	Yes	46	63 %	6 %
	No	27	37 %	94 %
Total number of observations		73	100 %	754

[21] Eleven firms were classified as large firms in the original sample. Hence, biotech firms presented above were small and medium size enterprises (SME). The firm was classified as a large company if two out of three following conditions were matched: the firm has more than 250 employees, its turnover is more than 40 million euros, or its total balance is more than 27 million euros.

[22] Hyytinen, Ari – Pajarinen, Mika (2002): Small Business Finance in Finland: A Descriptive Study. ETLA, The Research Institute of the Finnish Economy discussion paper no. 812. The data of Finnish firms in total have been weighted to replicate the Finnish small business population as a whole.

[23] Data on the ages of the biotech firms describe the total population of the Finnish biotech firms established before 2002. Total number of SME biotech companies is 106.

E L I N K E I N O E L Ä M Ä N T U T K I M U S L A I T O S (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, FIN-00120 HELSINKI

Puh./Tel. (09) 609 900 Telefax (09) 601753
Int. 358-9-609 900 Int. 358-9-601 753
http://www.etla.fi

KESKUSTELUAIHEITA - DISCUSSION PAPERS ISSN 0781-6847

No 786 PETRI ROUVINEN, Competitiveness in the New Economy. 01.02.2002. 17 p.

No 787 PASI HUOVINEN – HANNU PIEKKOLA, Early Retirement and Use of Time by Older Finns. 25.02.2002. 19 p.

No 788 PANU PELKONEN, Esitutkimus rekrytointiongelmien ja tuotannon yhteyksistä Suomen teollisuudessa 1987-2000. 18.02.2002. 24 s.

No 789 ERKKI KOSKELA – MARKKU OLLIKAINEN – MIKKO PUHAKKA, Saddles, Indeterminacy and Bifurcations in an Overlapping Generations Economy with a Renewable Resource. 18.02.2002. 30 p.

No 790 MINNA JUKOMAA – JUSSI KOIVISTO – MARJA TAHVANAINEN, Recruitment of Foreign IT Professionals in Finland. 22.02.2002. 23 p.

No 791 KARI E.O. ALHO, EU Labour Markets and Immigration Connected to Enlargement. 28.02.2002. 18 p.

No 792 JYRKI ALI-YRKKÖ, Mergers and Acquisitions – Reasons and Results. 05.03.2002. 32 p.

No 793 ANTTI KAUHANEN – HANNU PIEKKOLA, Rent Sharing as Part of Incentive Payments and Recruitment. 20.03.2002. 26 p.

No 794 HANNU PIEKKOLA, Transferability of Human Capital and Job Switches. 20.03.2002. 22 p.

No 795 MIKA MALIRANTA, From R&D to Productivity Through Micro Level Restructuring. 18.03.2002. 39 p.

No 796 MIKA MALIRANTA, Factor Income Shares and Micro-Level Restructuring. An analysis of Finnish Manufacturing. 18.03.2002. 23 p.

No 797 LAURA EHRLICH, The EU Single Market and Customs Policy: Impact on Estonian Foreign Trade. 19.03.2002. 24 p.

No 798 PETRI BÖCKERMAN, Understanding Regional Productivity in a Nordic Welfare State: Does ICT Matter? 22.03.2002. 20 p.

No 799 JYRKI ALI-YRKKÖ – RAINE HERMANS, Nokia Suomen innovaatiojärjestelmässä. 11.04.2002. 35 S.

No 800 JUHA FORSSTRÖM – JUHA HONKATUKIA, Energiaverotuksen kehittämistarpeet Kioton pöytäkirjan toteuttamiseksi. 26.03.2002. 31 s.

No 801 JUHA FORSSTRÖM – JUHA HONKATUKIA – ANTTI LEHTILÄ, Maakaasun hinnan vaikutukset ilmastopolitiikan kustannuksiin. 27.03.2002. 26 s.

No 802 ELINA RISSANEN, Reflections of Globalisation – The Influence of Economic Factors on the International Development Assistance Allocations. 09.04.2002. 19 p.

No 803 ELINA RISSANEN, Foreign Aid Policies – Comparing Finland and Ireland. 09.04.2002. 22 p.

No 804 RAIMO LOVIO, Suomalaisten monikansallisten yritysten T&K-toiminnan kansainvälistyminen – perustietoja ja kysymyksenasetteluja. 11.04.2002. 22 s.

No 805 ARI HYYTINEN – MIKA PAJARINEN, External Finance, Firm Growth and The Benefits of Information Disclosure: Evidence from Finland. 24.04.2002. 40 p.

No 806 MATTI LAMPINEN, Uusi talous – tapaustutkimuksia suomalaisyrityksissä. 25.04.2002. 13 s.

No 807 OLAVI RANTALA, Kansantalouden ja toimialojen pitkän ajan kasvu – Vertailua ilmastostrategian BAU-skenaarioon. 06.05.2002. 11 s.

No 808 JUSSI V. KOIVISTO – MATTI LAMPINEN, Comparative Analysis of Finno-Sinic Management: In-Depth Study of the Dimensions of Cross-Cultural Friction and Synergy in Management of Finnish Firms in Hong Kong. 22.05.2002. 18 p.

No 809 JUKKA LIIKANEN – PAUL STONEMAN – OTTO TOIVANEN, Intergenerational Effects in the Diffusion of New Technology: The Case of Mobile Phones. 22.05.2002. 16 p.

No 810 TIMO KAISANLAHTI, Minority Shareholders in the Finnish System of Corporate Governance. 10.06.2002. 71 p.

No 811 JYRKI ALI-YRKKÖ – RAINE HERMANS, Nokia in the Finnish Innovation System. 19.06.2002. 35 p.

No 812 ARI HYYTINEN – MIKA PAJARINEN, Small Business Finance in Finland. A Descriptive Study. 25.06.2002. 59 p.

No 813 ARI HYYTINEN – MIKA PAJARINEN, Financing of Technology-Intensive Small Businesses: Some Evidence on the Uniqueness of the ICT Industry. 29.07.2002. 22 p.

No 814 ARI HYYTINEN – OTTO TOIVANEN, Does Distance Matter in Deposit Supply? A Bank-level Study. 30.07.2002. 14 p.

No 815 ERKKI KOSKELA – MARKKU OLLIKAINEN, Optimal Forest Taxation under Private and Social Amenity Valuation. 13.08.2002. 23 p.

No 816 TARMO VALKONEN, Demographic Uncertainty and Taxes. 21.08.2002. 20 p.

No 817 ANTTI KAUHANEN – HANNU PIEKKOLA, Profit Sharing in Finland: Earnings and Productivity Effects. 03.09.2002. 18 p.

No 818 ISMO LINNOSMAA – RAINE HERMANS – TARU KARHUNEN, Price-Cost Margin in the Pharmaceutical Industry: Empirical Evidence from Finland. 03.09.2002. 20 p.

No 819 RAINE HERMANS – TERTTU LUUKKONEN, Findings of the ETLA Survey on Finnish Biotechnology Firms. 10.09.2002. 30 p.

Elinkeinoelämän Tutkimuslaitoksen julkaisemat "Keskusteluaiheet" ovat raportteja alustavista tutkimustuloksista ja väliraportteja tekeillä olevista tutkimuksista. Tässä sarjassa julkaistuja monisteita on mahdollista ostaa Taloustieto Oy:stä kopiointi- ja toimituskuluja vastaavaan hintaan.

Papers in this series are reports on preliminary research results and on studies in progress. They are sold by Taloustieto Oy for a nominal fee covering copying and postage costs.