Key indicators of the German equipment and supplies industry

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Abstract A framework is presented to analyse the sector of equipment and supplies in biotechnology. Unlike the much-studied sectors of agro-food and biopharmaceuticals, the biotechnology equipment and supplies industry has been little involved in ethical and social controversies. It is thus interesting to see how this sector developed in absence of ethical or cultural barriers to economic development and integration. We find that the sector in Germany is rather diverse, showing a relatively high degree of commercial development. Prospects for future growth are delineated by discussing supporting and hampering factors in the demand for equipment and supplies in biotechnology.

Keywords: biotechnology, equipment and supplies, system of innovation, Germany

Introduction

Biotechnology was first commercialised in the USA, mainly by a rapid growth of small biotechnology firms. Concern that a similar build-up was not occurring in Germany led to policies supporting the creation of a science base in biotechnology, the creation of links between that science base and industry and the formation of small firms. This has been quite successful since the mid-1990s. Policies were also directed towards the assimilation of new biotechnology knowledge by large companies in pharmaceuticals and agro-food. A key issue relating to the development of biotechnology in these sectors in Germany has been public anxiety about the ethics of research and consumer resistance to the introduction of novel biotechnology products. The equipment sector, covering such diverse businesses as laboratory reagents and production equipment, provides an important contrast since, unlike the other two sectors, it is not embedded in ethical and social issues. Our insight is based on a current research project funded by the European Commission. The study is designed to elucidate whether the driving forces within the system of innovation in three sectors of European biotechnology are mainly explained by sectoral or by national factors. In this paper, we present main characteristics of the German biotechnology equipment and supplies sector, which has been poorly studied in the past.[1]

State of the industry

Screening company databases for biotechnology firms yielded 210 companies potentially active in the German biotechnology equipment and supplies sector. Our sector definition is based on a list of products and technologies (Table 1).

Table 1 Sector definition of the biotechnology equipment and supplies sector. Only those enterprises active in at least one of the listed technologies and/or markets were included in the sample (libraries are excluded because they do not fit into the classification)

Subsector	Components
Separation technology	Centrifuges Filters
Bioreactors	Fermenters Reactors
(D)NA technology	DNA synthesis Gene transfer systems Blots Enzymes for nucleic acids Nucleic acid synthesis reagents Nucleic acids Probes Vectors
Protein technology	Protein synthesis Reagents for protein synthesis Inhibitors for protein chemistry Kits for protein chemistry Protein standards Bioactive proteins
Micro tool	Micromanipulation Microinjection appartus
Laboratory automation	Laboratory robots Automated workstations
Cell technology	Cell handling Cell breeding Kits for cell biology Reagents for cell biology Cell lines Cell stains and indicators
Kits and reagents for evolutionary biology	Antibiotics and inhibitors Kits for molecular biology Proteases Coenzymes Cofactors Cross-linkers Detergents Media
Bacteria/yeasts	Bacterial and yeast strains
Immune technology	Antibodies Control sera Hybridoma production Reagents for immunology Kits for immunology
Industrial enzymes	Industrial enzymes

A questionnaire was sent out to these companies in late 1999. Of the 210 firms, 5 per cent answered that they did not apply to our sector definition or were excluded because they were contract research organisations (CROs) or sales organisations without their own R&D. We thus estimated that there are around 200 companies in Germany that match our sector definition of the biotechnology equipment and supplies sector. The actual number could be lower, because we assumed that the rate of companies not applying to our sector definition (5 per cent) remained the same within 'respondents' and 'non-respondents'. On the other hand, the actual number of companies in this area could also be higher because we might have missed some

companies when screening the databases. However, we consider the number of 200 companies in the German equipment and supplies sector as an upper bound. In effect, data on 54 companies (26 per cent of 210) have been used to analyse the industrial equipment and supplies sector in Germany (Table 2).

The numbers on firms and industry turnover are based on data extrapolated from information of our national survey. They could be biased upward and may represent an upper bound for the actual data. The data on the annual turnover are heavily skewed to the right. We thus conclude that the mean is of low relevance in this case. Median turnover of dedicated biotechnology firms (100 per cent turnover in biotechnology) within the sector amounts to €933,000. The average share of biotechnology turnover is 48 per cent generated by selling products. The total number of employees ranges between 4,000 (lower bound) and 8,400 (upper bound) individuals.

Most of the firms (72 per cent) are small, employing 1–20 individuals. Eleven per cent employ between 21 and 50 people while only 2 per cent have 51–100 individuals on their pay-roll. Fifteen per cent of the companies have a workforce of more than 100 people.

The majority of companies (71 per cent) have been established independently compared with 17 per cent that originated from other firms or were founded as a spin-off from public sector research (PSR). Around 56 per cent of the firms are older than five years and 43 per cent were been set up between 1994 and 1998. Around 40 per cent earned between €100,000 and €1m total turnover in 1998. One-quarter earned between €1m and €5m. There are 11 per cent very small companies (turnover below €50,000). Some 21 per cent of the firms in the sample earn more than €10m per year. The

Table 2 Key indicators of the German biotechnology equipment and supplies industry (data for 1999 if not indicated otherwise)

Indicator	Value
Number of companies	200
Size distribution (no. of employees):	
1–20	72%
21–50	11%
51–100	2%
>100	15%
Agencies funding research	BMBF, DFG, AiF, Länder ministries[a]
Total public funding (1994–1998)[b]	€403m
Number of dedicated biotechnology institutes	13
Number of degrees awarded during 1994–19984[c]	
master	914
PhD	165
Total turnover (based on median)	€130m
Total biotechnology turnover (based on median)	€60m
Median turnover of dedicated firms	€933,000
Average share of biotechnology turnover	48%
$\frac{\sum(\text{biotechnology revenue}(\%)_i \quad \text{total revenue}(€)_i}{\sum\text{total revenue}(€)_i}$	
Main source of biotechnology turnover	Products
Main target markets	Domestic
Location of main PSR collaborators	Domestic
Location of main firm collaborators	Domestic

[a] BMBF Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research); DFG Deutsche Forschungsgemeinschaft (German Research Society); AiF Arbeitsgemeinschaft industrieller Forschungsvereinigungen (Association of Industrial Research Organisations).
[b] Public funding within categories B4 (industrial biotechnology: food/feed, paper, textile, and pharmaceutical and chemical production) and B7 (development of basic biotechnology) of Giessler and Reiss[2]
[c] Numbers based on official data provided by the Federal Statistical Office (1999, ordered information), covering the fields of biotechnology, chemical engineering, process engineering and micro system engineering.

median of turnover of the equipment and supplies sample was €650,000 in total and €300,000 in biotechnology.

Almost 80 per cent of the companies achieve more than half of their total annual sales in biotechnology. Remarkably 57 per cent of the firms in the sample generate 100 per cent of their turnover in biotechnology.

Nearly 50 per cent of the companies are involved in product development, 36 per cent in technology development and 14 per cent in product research. By far the majority of the firms have product sales in biotechnology (86 per cent). Almost half the firms of the sample (46 per cent) sell their goods mainly in Germany. Europe emerged as a main market by 32 per cent of the firms, whereas merely 16 per cent of the firms see their main product market in the USA. Taking into account the fact that most of the patents (55 per cent) held by the firms of the sample have national claims only, it should be reasonable to assume that the majority of the equipment and supply firms looked at focus on the domestic market solely.

In order to examine the sample for latent factors which explain correlations between observed features (variables), an unconstrained factor analysis in SPSS 8.0.0 was used. It revealed a correlation between the fact that a company belonged to the biotechnology equipment and supplies sector (factor loading 0.718) and that it is 'selling biotech products' (0.667) in 'domestic markets' (0.514). Hence, we may conclude that there is at least one large group of firms in this sector that sells products to customers located in Germany, underpinning the hypothesis of a strong cluster of domestically oriented firms.

Only 55 per cent of the firms from this sector have reported R&D collaborations either with organisations from PSR or with other companies. For both collaborative R&D with PSR (75 per cent) as well as with companies (61 per cent), the partner for the firms in our sample is located in Germany. On average, the companies established 1.3 collaborations with both public and private domestic partners.

Hence, we have evidence to believe that the commercial as well as the scientific (technological) focus of the firms from the equipment and supplies sector is located in Germany. The influence of the *national* system of innovation should thus be dominant in this sector.

Product and technology portfolios

Counting the relative occurrence of certain products or technologies in the questionnaires derives the aggregated technology portfolio of the companies of our sample, thus representing an estimation for the technologies and products most frequently applied or offered in the German equipment and supplies sector, as shown in Table 3. We have grouped the variables into eleven groups (cf. Table 1 for the composition of the subgroups). The numbers show that there is no technology that was much more often used than others. Among the most frequently applied ones are (D)NA technology, cell technology, and kits and reagents for evolutionary biology. The ones less popular mainly concern more conventional or more 'low-technology' technologies (industrial enzymes, bacteria/yeast, bioreactors). This is not to say that these would be commercially less appealing but that they are not in the centre of the business of the high-technology companies in our sample.

Micro tools and laboratory automation which are areas relevant for many 'parallel-

Table 3 Relative occurrence of products and technologies at companies of the sample by groups

Product/Technology	Occurence in the sample (%)
(D)NA technology	17
Kits and reagents for evolutionary biology	17
Cell technology	16
Protein technology	14
Immune technology	14
Separation technology	10
Bioreactors	4
Laboratory automation	3
Bacteria/yeast	3
Micro tools	1
Industrial enzymes	1

type' platform technologies (eg high-throughput sequencing, HTS), are also among the equipments that are offered only by a rather low number of companies.

Future prospects

Considerations about future perspectives of the sector must reflect the expectations regarding the development of the business of the customers of the equipment and supplies companies as well as trends in public funding programmes. Regarding the latter, an important trend on the technology policy side with relevance to the equipment and supplies is that the research in basic biotechnologies[2] should be strengthened in future by federal R&D programmes. Additionally, the sector will benefit from plans to increase funding for research on the (human and plant) genome. The scientific community has claimed that the current resources must be increased at least tenfold if Germany wants to reach its competitors from the USA, the UK and continental Europe. In November 2000 the Federal Ministry of Education and Research (BMBF) concluded to increase funding for genome research substantially to about €150m during 2001 and 2003. This initiative will also boost demand for equipment and supplies products as their share of total expenses is normally rather high in sequencing activities (up to 50 per cent). Future prospects also depend on the performance of the programme to analyse the plant genome (*Genomanalyse im biologischen System Pflanze*, GABI). It started in late 1998 and has a duration of eight years. The aims are to support basic research on *Arabidopsis*, barley and other crops (step 1), and applied research in companies (step 2) to exploit the results of the first step. In particular, the demand for proteome analysis equipment will increase. In addition to the general increase in public funding for genome research in Germany we expect a certain shift of attention from structural to functional genomics approaches. This tendency will have an impact on the types of equipment demanded.

The customers of the companies in the equipment and supplies sector are mainly

- hospitals;
- physicians;
- the biotechnology industry;
- the pharmaceutical industry;
- the agro-food industry;
- the fine chemical industry.

Hospitals and practices face cost containment pressure. Owing to the strict employment laws in Germany and the high unemployment rate it is unlikely that this pressure can be reduced by decreasing personnel cost. It is henceforth arguable that they may try to save money spent for equipment. This particularly applies for larger investments of €500,000 or more. Thus, it should only be possible to increase the turnover from sales to those institutions by replacing conventional equipment and supplies products. Taking all this into account, we estimate flat growth rates for the business with the first two customer groups.

Growth is more likely to come from the business to business field (biotechnology, pharmaceutical and agro-food customers). The biotechnology industry as a whole experienced a steep rise in Germany during the 1990s. Figure 1 depicts this trend by summarising several earlier studies[3]. Many new companies have been established, providing a high demand potential on the one hand, but often facing budget constraints on the other, so that the actual buying power might not be too high. Growth rates are nevertheless appealing for this industry.

Biotechnology is increasingly pervading the German pharmaceutical industry not only as a research tool but also as a production technology. Future growth in turnover from this industry will again depend on the ability of the equipment and supplies companies to replace conventional products and keep up with the needs of their customers. The firms investigated in our study are likely to succeed in this as

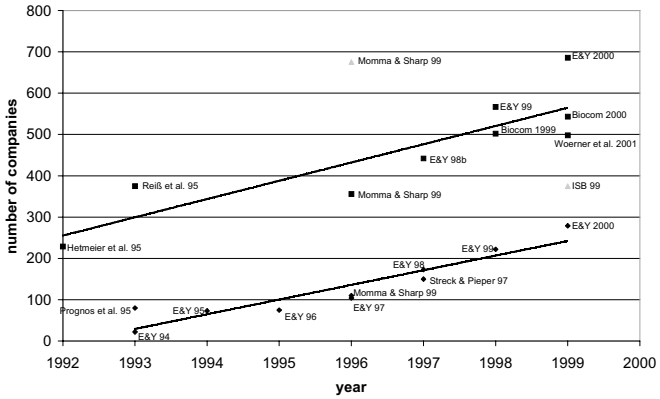

Fig. 1 German biotechnology companies 1992–1999[3]

they meet the requirements of modern approaches pursued in pharmaceutical R&D. We expect over-proportional growth rates in the equipment and supplies sector relative to the pharmaceutical industry in mid-term because more and more companies (have to) introduce modern biotechnological approaches in their R&D efforts.

Although biotechnologically derived agro-food products lack in consumer acceptance, equipment such as bio-reactors, separation technologies or cell technology and supplies such as bacteria, yeast or industrial enzymes are used in both production and R&D. As most of these tools are already introduced as standard equipment of laboratories and plants respectively, we do not expect exceptionally high growth rates from this area. Growth might be more likely to arise by sales of detection systems for material contaminated with genetically modified organisms.

The chemical industry uses supplies like industrial enzymes in a wide variety of areas. It has been predicted that the global market will have a 6.5 per cent growth rate per annum. The industrial enzyme sector is an example of the seamless transition from traditional biochemical methods to the use of genetic engineering and recombinant production. German companies only operate in niche sectors of the enzyme market but hold significant shares in them.

We argue that the market of the equipment and supplies sector is stable and robust because its products are used in a number of industries and by several institutions. However, we do not consider this business as a growth industry (such as the biopharmaceutical or the IT sector). Growth rates should be in the range of 5 per cent per year for the industry average. We conclude that future prospects will mainly depend on replacing conventional technologies and setting and meeting of standards across industries.

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