

# Foreign Companies Expand Research and Development in Germany

In the course of globalisation, the integration of German companies internationally has increased strongly. It is generally assumed that a part of this trend is a one-sided transfer of German companies' research and development (R&D) activities to other countries. A new study conducted by DIW Berlin shows that this fear is unfounded.<sup>1</sup> In fact, foreign firms operating in Germany are increasing their R&D activities to approximately the same extent as German companies abroad. This shows Germany to be an attractive research location.

Multinational companies conduct R&D in different locations all over the world and organise the exchange of knowledge between their R&D and production locations internally (i.e., within the company). The application of knowledge is not a competition: it can be exploited in production at various sites at the same time without reducing its potential benefit at the point of origin. If multinational companies conduct R&D in one country this means more options for access to technological knowledge in other countries.

It is difficult to measure the internationalisation of companies and, by extension, the integration of R&D at the international level. National statistics record company activities primarily with regard to their location in a given national economy, but often provide only insufficient information on the cross-border integration of multinational companies and the internal exchange of capital, goods, services – and knowledge. Since the mid-1990s, DIW Berlin, as part of its reporting on Germany's technological performance, has examined the international integration of R&D in multinational companies.<sup>2</sup>

The internationalisation of R&D activities is considered on the basis of sector-specific data on R&D expenditure by German companies abroad and by foreign companies in Germany. Since the mid-1990s this data has been examined by the Wissenschaftsstatistik GmbH ('SV-Wissenschaftsstatistik') – the R&D statistics branch of the Donors' Association for German Research

– in special analyses of its research on R&D in business enterprises. Additional data from the OECD and the U.S. Department of Commerce permit an international comparison.<sup>3</sup>

## High degree of internationalisation

The degree of internationalisation of a production and research location, both externally and internally, is influenced decisively by a country's size, as well as by the dynamism and openness of its goods and capital markets. Small countries such as the Netherlands and Switzerland are, as a rule, more intensely internationalised than larger countries, such as the United States. Studies into the relationship between trade and foreign direct investment in industrialised countries confirm a strong positive correlation and mutually reinforcing interrelationships between the two forms of internationalisation.<sup>4</sup>

The economic significance of foreign companies in a given country can be measured by foreign direct investment as a share of gross domestic product (GDP). Countries with a high weighting of foreign direct investment often also demonstrate a high share of R&D expenditure on foreign multinational firms (cf. table 1). In the case of Germany, measured against the weighting of foreign direct investment, the share of research activities by foreign companies is relatively high.

As an indicator of the degree of internationalisation of R&D in multinational companies, it is possible to apply the share of its R&D expenditure in the country with the largest R&D volume worldwide – the United States – in relation to total R&D expenditure in the respective home country. According to this, in an international comparison German companies were found to invest the highest amount in the United States; however, the value of this indicator is only marginally higher than the average for European Union member states – which are often 'small' countries. Compared with other large

<sup>3</sup> Multinational companies are assigned to the home countries from which they are controlled. As a rule, this is also where companies' majority ownership is based. In this process, national and international statistics on foreign direct investment usually apply lower threshold values in terms of share ownership; in the case of the German Bundesbank, for example, this value stands at 10%. However, different threshold values in the statistics influence findings of analyses on the cross-border activity of multinational companies only marginally and are therefore not taken into account here.

<sup>4</sup> Cf., for example: 'Trends in Foreign Direct Investment'. *OECD Economic Outlook*, no. 73. Paris, 2003. Giuseppe Nicoletti et al.: 'Policies and International Integration: Influences on Trade and Foreign Direct Investment'. *OECD Economics Department Working Papers*, no. 359, Paris, 2003.

<sup>1</sup> Cf. Heike Belitz: 'Forschung und Entwicklung in multinationalen Unternehmen'. *Studien zum deutschen Innovationssystem*, no. 8-2004, DIW Berlin, January 2004. see also: [www.technologische-leistungsfahigkeit.de](http://www.technologische-leistungsfahigkeit.de)

<sup>2</sup> Findings from reports published in previous years can be found in the following DIW Economic Bulletins: vol. 39, no. 5, May 2002; vol. 37, no. 6, June 2000; vol. 34, no. 9, September 1997; vol. 33, no. 6, June 1996.

Table 1

## Internationalisation of R&amp;D and Production in Selected Industrialised Countries, 2001

Country	R&D expenditure				Level of foreign direct investment	
	Total	Share of foreign firms	of subsidiaries in the United States		of foreign countries	in foreign countries
	In million PPP \$	% Share	In million US \$	% Share	% of GDP	
USA	209 955	14.9	19 402 <sup>3</sup>	9.4	13.1	13.7
EU	120 127	9.4 <sup>4</sup>	17 657	14.7	—	—
Japan	76 455	3.9 <sup>1</sup>	3 474	4.5	1.2	7.2
Germany	38 036	26.5	6 010	15.8	22.3	29.8
France	21 920	16.4 <sup>2</sup>	3 215	14.7	22.0	37.3
Great Britain	19 796	39.4	4 762	24.1	38.6	63.4
Canada	10 007	31.6	2 218	22.2	29.7	34.7
Sweden	7 680	34.1 <sup>1</sup>	408	5.3	42.0	55.6
Netherlands	5 078	21.5 <sup>1</sup>	1 627	32.0	74.2	85.7
Switzerland	4 140 <sup>1</sup>	—	4 162	100.5	36.1	100.3
Finland	3 325	14.2	162	4.9	21.6	46.1

1 1999. — 2 1998. — 3 R&D expenditure of US companies abroad. — 4 U.S. companies in the EU.

Sources: OECD; UNCTAD; U.S. Department of Commerce; SV-Wissenschaftsstatistik; DIW Berlin calculations.

industrialised countries, the internationalisation of R&D in multinational companies in Germany has progressed considerably in both directions.

In Germany, approximately three-quarters of in-country R&D total spending is on companies linked into the international exchange of knowledge through capital integration (cf. table 2): on the one hand, these are R&D expenditures by foreign companies in Germany (26% of all R&D research in Germany)<sup>5</sup>; on the other, this is R&D spending by German companies also involved in R&D abroad (51%). For the most part, therefore, Germany's 'research laboratories' are to be found in multinational companies.

### R&D activity of German companies abroad

Contrary to previous expectations,<sup>6</sup> in 2001 expenditure on R&D by German companies abroad, to the tune of 11.9 billion euros, only marginally exceeded the 11.5 billion euros spent on R&D by foreign firms in Germany. R&D expenditure of German companies abroad rose by a good 130% in nominal terms from 1995 to 2001; it

<sup>5</sup> This is based on the assumption that companies with foreign majority ownership also have research locations abroad, which exchange knowledge with their plants in Germany. This does not apply, however, when, for example, foreign financial investors own an independent company in Germany that conducts research.

<sup>6</sup> Cf. Heike Belitz: 'Research and Development in Multinational Companies from a German Perspective'. In: *DIW Economic Bulletin*, vol. 34, no. 9, September 1997, pp. 13-20.

grew significantly more rapidly than total R&D expenditure in Germany (46%; cf. table 2).<sup>7</sup> This increase in foreign R&D involvement is very probably due primarily to mergers and acquisitions rather than to an expansion in R&D in existing German companies abroad.<sup>8</sup>

German companies with the largest R&D capacities abroad are to be found in vehicle construction and the chemical (including pharmaceutical) industry, and also in the areas of computer, electrical, electronic, and precision engineering (cf. table 3). In Germany, too, these sectors see the greatest R&D expenditure. The R&D intensity in Germany of German companies who are also active abroad is, on average, higher than that of those companies who have no foreign involvement (cf. figure 1).<sup>9</sup>

R&D expenditure of German companies in their most important foreign location, the United States,

<sup>7</sup> Given the relatively rough estimate for total R&D expenditure by German companies abroad, in which, in retrospect, the effects of exchange rates can no longer be evaluated, measuring medium-term change is only possible on a nominal basis. Domestically, too, given the low price dynamism, this approach seems justified.

<sup>8</sup> Between 1995 and 2001 there was a strong worldwide increase in mergers and acquisitions (M&As), which fell sharply after 2000. Between 1995 and 2001 Germany was the fourth-largest investor in cross-border M&As, after the United States, the United Kingdom and France; cf. Science, Technology and Industry Scoreboard, OECD, Paris 2003. The most prominent example of this expansion was the fusion of Daimler-Benz AG with the U.S. Chrysler Corporation, which, in 1998, became DaimlerChrysler.

<sup>9</sup> R&D intensity is measured as R&D personnel as a share of all employees, or R&D expenditure as a share of turnover.

Table 2  
Total R&D Expenditure by Companies  
in Germany and Abroad, 1995 and 2001

	1995	2001	Change
	In billion euro		As %
In Germany	30.0	43.8	46
Foreign firms	5.0	11.5	130
German firms			
Without R&D abroad	8.0	9.8	23
With R&D abroad	17.0	22.5	32
German companies abroad	5.1	11.9	133
German companies worldwide	22.1	34.4	56
	As % of R&D in Germany		
In Germany	100	100	–
Foreign firms	17	26	–
German firms			
Without R&D abroad	27	22	–
With R&D abroad	57	51	–
	As % of German R&D worldwide		
German firms with R&D abroad	100	100	–
In Germany	77	65	–
Abroad	23	35	–

Sources: SV-Wissenschaftsstatistik; DIW Berlin calculations and estimates.

increased approximately 3.4 fold in nominal terms from 1990 to 2001, while their turnover increased only 2.9 fold. In total, foreign companies operating in the United States increased R&D spending 2.6 fold over this period, at the same time doubling their turnover.<sup>10</sup> Thus, for-

foreign companies have expanded their R&D activities in the United States more quickly than their production and sales. With their R&D expenditure standing at approximately \$ 6 billion, and with some 26 000 people employed in R&D, German companies demonstrate the largest R&D capacities of all foreign firms in the United States, followed by British, Swiss and Japanese companies. At the same time, on average German companies have the highest R&D intensity of all foreign firms in the United States.

### R&D activity of foreign firms in Germany

In 2001, every fourth euro invested in R&D in Germany was spent by foreign firms, and one-quarter of those employed in R&D were working in these companies (cf. table 4). In manufacturing industry – the area in which business R&D is concentrated – only about one-fifth of all employees were employed in foreign companies. Between 1995 and 2001, the 130% increase in R&D expenditure of foreign companies in Germany was roughly the same as that spent by German firms abroad. Mergers and acquisitions<sup>11</sup> led to a sharp increase in for-

<sup>10</sup> U.S. Department of Commerce: U.S. Affiliates of Foreign Companies, various years.

<sup>11</sup> Between 1995 and 2001 Germany was in third place in terms of the purchase of companies by foreign buyers, after the United States and the United Kingdom. Cf. Science, Technology and Industry Scoreboard, op. cit.

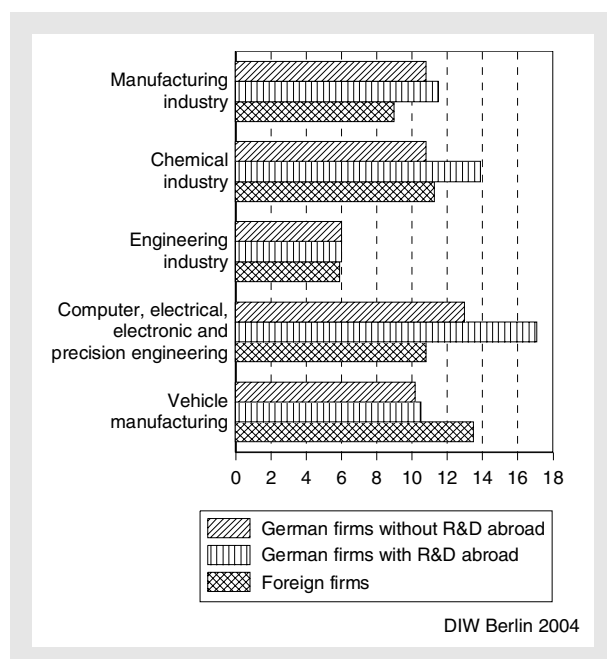
Table 3  
R&D Activities of German Firms in 2001, by Economic Sector

Economic sectors	German firms					
	Total domestic R&D expenditure <sup>1</sup>	of which: with R&D abroad				Worldwide R&D expenditure
		R&D expenditure at home		R&D expenditure abroad		
	In million euro	In million euro	As %	In million euro	As %	In million euro
Manufacturing industry	29 490	20 210	69	11 589	36	31 799
Chemical industry	5 070	3 948	78	3 649	48	7 597
Engineering industry	3 441	680	20	444	40	1 124
Computer, electrical, electronic and precision engineering	6 586	4 627	70	2 801	38	7 428
Vehicle manufacturing	12 351	10 618	86	4 568	30	15 186
Other economic sectors	3 330	2 264	68	360	14	2 624
Total	32 820	22 474	68	11 949	35	34 423

<sup>1</sup> Total domestic R&D business expenditure minus foreign firms' R&D expenditure.  
Sources: SV-Wissenschaftsstatistik; DIW Berlin calculations.

Figure 1  
R&D Personnel Intensity<sup>1</sup> in Germany in 2001,  
by Economic Sector

As %



<sup>1</sup> R&D personnel intensity is measured as R&D personnel as a share of all employees.

Sources: SV-Wissenschaftsstatistik; DIW Berlin calculations.

foreign firms' share of total German R&D capacity, increasing it from one-sixth to one-quarter (cf. table 2). This expansion of R&D activity was stronger than the

increase in the turnover of foreign companies conducting R&D.<sup>12</sup> Just as in the United States, foreign companies in Germany expanded their R&D activities more quickly than sales and production. In Germany, western European and U.S. companies are involved in R&D to more or less the same extent; for German firms the most important foreign research location is the United States. The cross-border integration of companies' R&D locations and knowledge exchange occurs primarily within and between the knowledge-intensive regions of the United States and western Europe. The role of Japan, China and other East Asian countries in this context is low – although, given the combined potential of their markets and skilled workforce, there is scope for expansion.

### Prevalence of horizontal multinationals

More recent theoretical and empirical studies on the internationalisation of multinational firms in the industrialised countries assume the dominance of the horizontal model of international division of labour, in which companies conduct similar activities and produce similar products in different locations with the same factor

<sup>12</sup> The increase in turnover between 1995 and 2001 was 83% in companies with majority foreign ownership conducting R&D (calculated on the basis of SV-Wissenschaftsstatistik data), or 58% in all companies, in which foreign firms had a share of at least 10% in terms of voting rights/capital (calculated on the basis of data from the German Bundesbank on international capital integration, various years).

Table 4  
Total R&D Expenditure and R&D Employees in Foreign Firms in Germany in 2001,  
by Economic Sector<sup>1</sup>

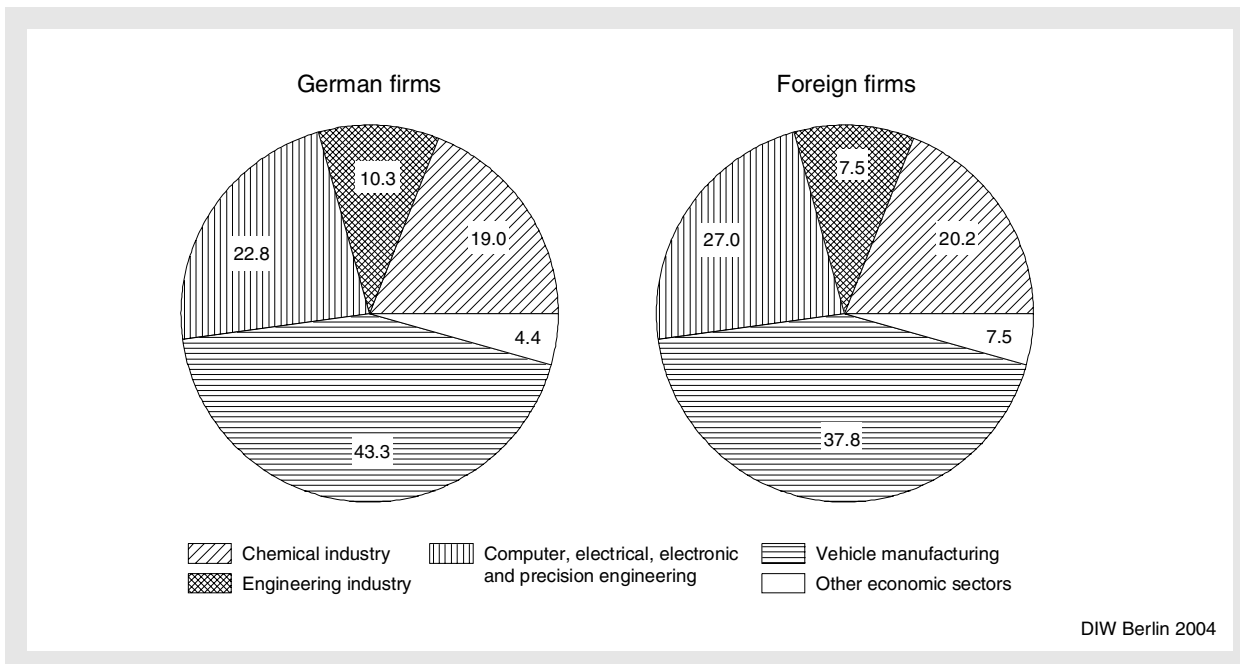
Economic Sectors	Total R&D expenditure			R&D staff		
	All firms	Foreign firms		All firms	Foreign firms	
	In million euros	As %		In full-time equivalents	As %	
Economy, total	43 239	11 478	26.5	302 519	73 173	24.2
Of which:						
Manufacturing industry	39 326	10 744	27.3	270 546	68 279	25.2
Of which:						
Chemical industry	7 029	2 037	29.0	42 001	11 254	26.8
Engineering industry	4 058	817	20.1	36 730	7 499	20.4
Computer, electrical, electronic and precision engineering	8 837	2 540	28.7	79 651	20 325	25.5
Vehicle manufacturing	16 750	4 438	26.5	88 272	21 720	24.6
Services for firms	2 361	550	23.3	20 277	4 177	20.6

<sup>1</sup> Extrapolated on the basis of a company panel that comprises 91% of total domestic R&D expenditure and 85% of companies' R&D staff.  
Sources: SV-Wissenschaftsstatistik; DIW Berlin calculations.

Figure 2

### Share of the R&D Expenditures of the Manufacturing Industry in Germany in 2001

As %



Sources: SV-Wissenschaftsstatistik; DIW Berlin calculations.

endowment.<sup>13</sup> Research findings on the internationalisation of R&D in multinational firms support this theory. This also shows the growing international integration of national research potential in increasing shares of the respective foreign firms in terms of R&D expenditure in industrialised countries such as the United States, the United Kingdom, Germany, Sweden and Japan.<sup>14</sup> In the case of Germany and the United States the approximation of R&D intensity in domestically owned and foreign-owned companies conducting research can be shown, with the latter on average still demonstrating slightly lower R&D intensity. In 2001, research by foreign firms in Germany was more intensive than that of their domestic competitors in the vehicle-manufacturing and nutrition sectors, and equally intensive in mechanical engineering. In earlier years, for which more detailed sector-specific data is available, foreign companies also demonstrated a slightly higher R&D intensity in measurement and control engineering.<sup>15</sup>

<sup>13</sup> Cf., for example, James R. Markusen: 'Integrating Multinational Firms into International Economics'. In: NBER Reporter, Winter 2001/2002, pp. 5-7, and the literature cited there; Bruce A. Blonigen, Ronald B. Davis, and Keith Head: 'Estimating the Knowledge-Capital Model of the Multinational Enterprise: Comment'. NBER Working Paper, no. 8929. Cambridge, MA, 2002.

<sup>14</sup> Cf.: *Main Science and Technology Indicators*, vol. 2003/1. OECD. Paris, 2003, table 64.

With the expansion of R&D by foreign companies in Germany the sector-specific structures of R&D expenditure in domestic and foreign firms have become more closely aligned (cf. figure 2): foreign firms are increasingly prioritising the same key areas as their German competitors in their R&D activities. This is in line with the theoretical expectation in the horizontal model of internationalisation, namely that competitors in the same location demonstrate similar R&D traits. Accordingly, the innovation impulses generated by the market in particular determine companies' R&D.

### Conclusion

The fear that the importance of Germany as an R&D and innovation location is becoming undermined, given the expansion of German companies' R&D capacities abroad, is unfounded. On the contrary, foreign firms are demonstrating their interest in qualified production and R&D in Germany. In Germany, foreign companies are involved in R&D – just as their domestic competitors are

<sup>15</sup> Cf. Heike Belitz: 'German Companies Intensify their Research and Development Activities Abroad'. In: *DIW Economic Bulletin*, vol. 37, no. 6, June 2000, pp.175-182.

– particularly in those business areas that they consider to provide new market opportunities in the medium term, based on the competitive advantages still prevalent in their home countries.

The progressive internationalisation of R&D in Germany, both externally and internally, is an expression of the increasing overall commercial internationalisation, as a result of which knowledge also has become 'more international'. This is linked to the danger of companies' R&D moving abroad. While this has occurred in individual cases, foreign companies have increased their R&D activities in Germany in ways similar to those of German companies abroad. If we look only at the transfer of German companies' R&D to other countries, we cannot take account of the fact that Germany itself is a highly attractive research location for foreign companies.

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