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**Article**

## Demand for Pharmaceuticals: Impacts on Production and Employment in Nearly Every Sector of the Economy

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## Demand for Pharmaceuticals – Impacts on Production and Employment in Nearly Every Sector of the Economy

Jörg-Peter Weiss, Stephan Raab and Joachim Schintke

The pharmaceutical industry employs around 106 000 people and produces a good 9 billion euros or 2.5% of value added in the manufacturing sector in Germany. But it contributes a bigger part to value added and employment in the economy as a whole than these figures show. Its particular role results from the fact that almost its entire output (96%) goes direct to end user (final demand), while demand for its products is subject to the special regulations in the health system.

With its purchases of intermediate products and capital goods the pharmaceutical industry gives rise to production and employment effects in nearly every area of production. That applies particularly to high quality services, like business-related services, research and development, leasing, services in the real estate and housing sector and data processing and data bank services. State regulations in the health system thus also have an effect in other sectors of the economy.

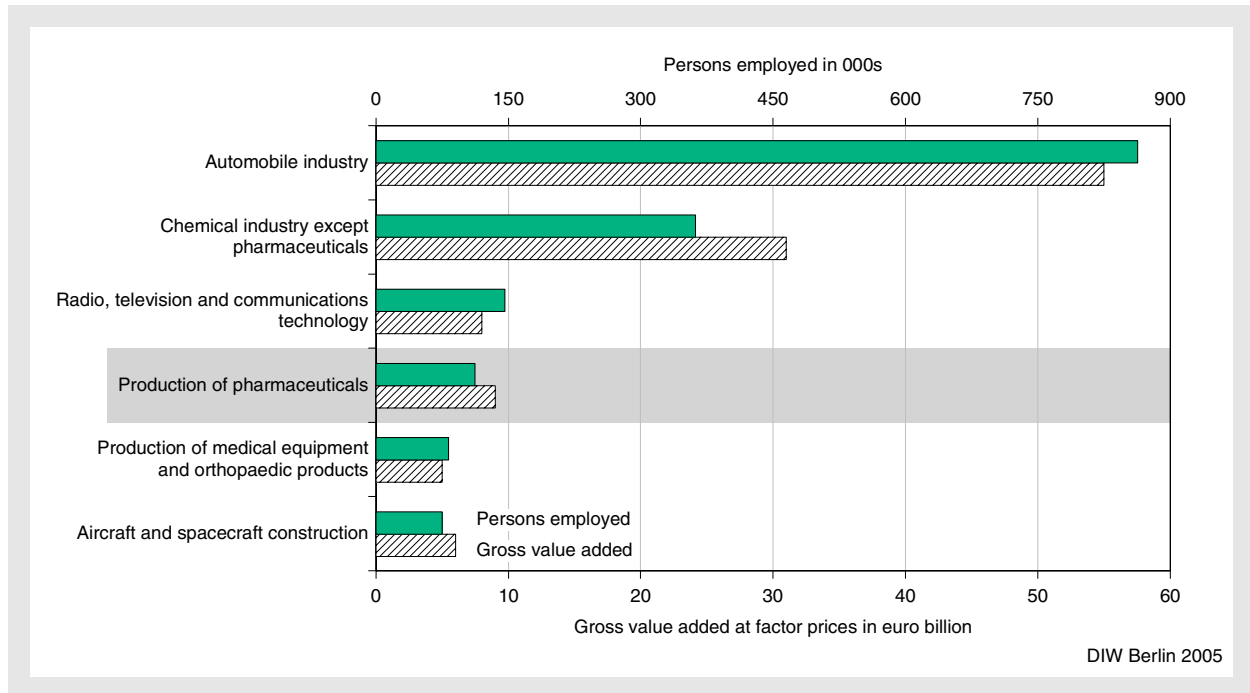
This article presents analyses by DIW Berlin of the linkages between the pharmaceutical industry and the rest of the economy.<sup>1</sup> It shows that deliveries by the pharmaceutical sector to final demand in private households and public authorities (the social insurance institutions, especially the compulsory health insurance) and abroad have considerable indirect production effects in other sectors of the economy, amounting to about 60% of the direct deliveries by the pharmaceutical industry to final demand. So for every person employed in the pharmaceutical industry one other person is employed in the rest of the economy.

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<sup>1</sup> This article gives the results of a study by DIW Berlin for the Verband Forschender Arzneimittelhersteller, cf. J.-P. Weiss, S. Raab and J. Schintke: 'Die Pharmazeutische Industrie im gesamtwirtschaftlichen Kontext: Ausstrahlung auf Produktion und Beschäftigung in den Zulieferbereichen', in: *DIW Berlin: Politikberatung kompakt*, vol. 4 ([www.diw.de/deutsch/produkte/publikationen/diwkompakt/2004/index/html](http://www.diw.de/deutsch/produkte/publikationen/diwkompakt/2004/index/html)). This article differs from the results published there in the employment effects in 2000 and 2002. This is because the Federal Statistical Office revised the employment figures for the pharmaceutical industry and the rest of the chemical industry caused by the DIW Berlin study.

Figure 1

## Gross Value Added and Employment in Selected Research-Intensive Industries in Germany in 2002



Sources: Federal Statistical Office; DIW Berlin calculations.

### The position of the pharmaceutical industry in the German economy

Germany traditionally has a strong position in high-tech goods, but the peak technology sector is relatively weak.<sup>2</sup> The particular position of the pharmaceutical industry in the structure of German production is due to three factors. Firstly, it is distinguished by particularly high research intensity, and it is a peak technology sector. Secondly, it is one of the sources of medical progress in industry beside medical equipment, and so it contributes to the efficiency of the health system, which employs 10.5% of the total workforce. This sector, with its related industries, is the focus of public discussion at present, on account of its dynamic growth and the resultant rise in expenditure by the health insurance institutes, causing increases in their contribution rates.<sup>3</sup> Thirdly, production by the industries related to the

<sup>2</sup> Cf. Dieter Schumacher, H. Legler and B. Gehrke: 'Gute Position Deutschlands bei forschungs- und wissensintensiven Produkten gefährdet', in: *Wochenbericht des DIW Berlin*, no. 31/2003, p. 487. In this article peak technology goods are groups with a high share, more than 8.5%, of research and development in turnover, and high-tech goods are groups with an R&D share in turnover of between 3.5% and 8.5%.

<sup>3</sup> Cf. Volker Meinhardt and Erika Schulz: 'Kostenexplosion im Gesundheitswesen?' In: *Wochenbericht des DIW Berlin*, no. 7/2003, pp. 105ff.

health system is growing at an above-average rate, and they are one of the few sectors of industry that have increased the number of employed persons in the last ten years.

The pharmaceutical industry is one of the leading branches in German industry in research and development intensity, together with aircraft and spacecraft construction, and radio, television and communications technology. The share of its internal R&D expenditure in the value of production for sale was 13.7% in 2001;<sup>4</sup> the aircraft and spacecraft sector spent 13.2%, and radio, television and communications technology 10.9%.<sup>5</sup> Its contributions to gross domestic product (gross value added) and employment, however, are small compared with the high-tech sectors, like the rest of the chemical industry or automotive construction (cf. figure 1).

However, the pharmaceutical industry – like the other industry of importance for the health system, med-

<sup>4</sup> Internal R&D expenditure is expenditure within the firm on research and development.

<sup>5</sup> Cf. C. Grenzmann, R. Marquardt, H. Legler, B. Gehrke and U. Schasse, with contributions from M. Leidman: 'Forschungs- und Entwicklungsaktivitäten der deutschen Wirtschaft', in: *Studien zum deutschen Innovationssystem*, no. 10/2004, p. 26.

ical equipment – is much more expansive than the average for manufacturing or, to name one example, the chemical industry (cf. figure 2).

This brief survey of the pharmaceutical industry's position in the structure of German industry shows that its importance in the economy as a whole in Germany is only inadequately described in a comparison of economic data like turnover, value added or the number of persons employed with the corresponding macroeconomic data. Hence, this article examines another important aspect, the question what effects the pharmaceutical industry has on the rest of the economy. To answer that question the intersectoral dependencies that result from mutual deliveries and purchases are examined using an input-output analysis model.<sup>6</sup>

### The pharmaceutical industry's linkages through its purchases of intermediate products – the input structure

Purchases of intermediate products by the pharmaceutical industry amount to a good 60% of its production value and more than half of the purchases are within Germany. A consideration of the input side shows that the pharmaceutical industry has linkages with almost every area of production (cf. tables 1 and 2).

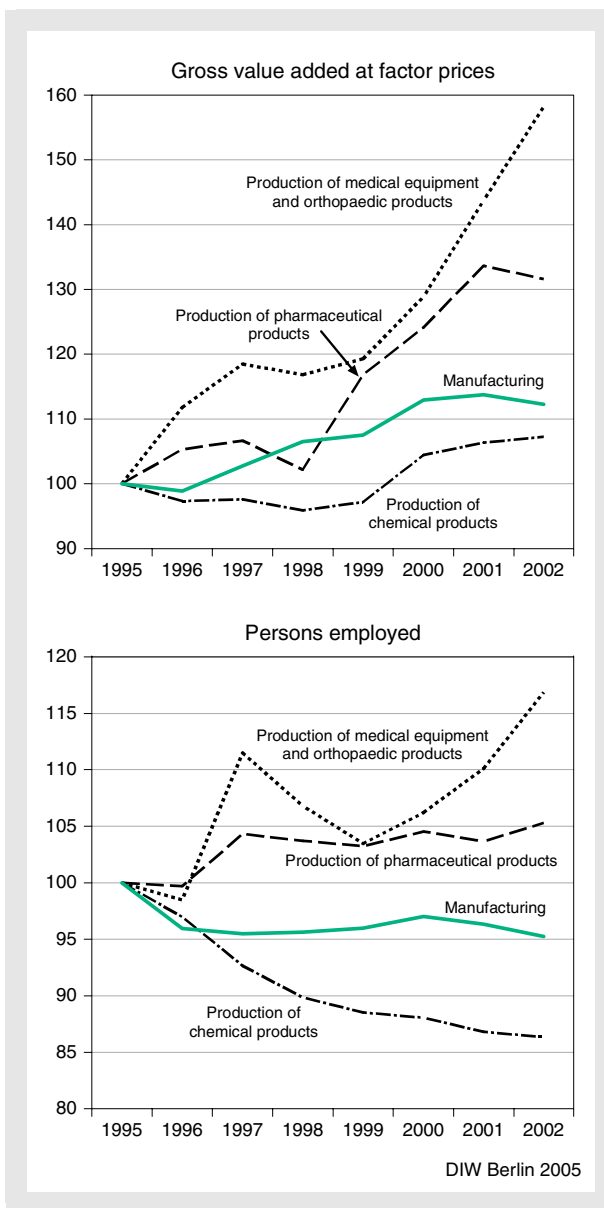
However, there are clear concentrations. A good half of the purchases of intermediate products in Germany in 2000 were in only three supplier sectors: the chemical industry, business-related services and research and development services – although the level of research and development within the pharmaceutical industry is itself high.

The pharmaceutical industry influences production activity in the rest of the economy not only through its purchases of intermediate products but also through its investment activity. In the period considered here, 1995 to 2000, purchases of capital goods grew relatively much more strongly, from around 1 billion euros to just under 1.7 billion euros (cf. table 3), than purchases of intermediate products, which rose from 10.2 billion euros to 12.7 billion euros.

The value of purchases of intermediate products and of capital goods is by no means the end of the pharmaceutical industry's influence on the economy. On the contrary, the chemical industry, for instance, in turn needs intermediate products from crude oil processing, the electricity industry or manufacturers of foodstuffs, beverages and tobacco in order to make its deliveries to

<sup>6</sup> On the data base and methodology see *DIW Berlin: Politikberatung kompakt*, vol. 4, pp. 20ff.

Figure 2  
Value Added and Employment in Manufacturing in Germany 1995 to 2002  
1995 = 100



Sources: Federal Statistical Office; DIW Berlin calculations.

the pharmaceutical industry, and these in turn require intermediate products, e.g. from mining and agriculture and the manufacturers of metal products.

An input-output analysis, and especially the static open input-output model, offers a method to answer the question of to what extent the pharmaceutical industry causes production effects in its suppliers through its purchases of intermediate products and capital goods, and – again along the chain of intermediate products – in

Table 1  
 Input of Production Sector (CPA 24.4): Pharmaceutical Products by Commodity Groups,<sup>1</sup> 1995 and 2000  
 In million euros

No.	CPA <sup>2</sup>	Groups of goods	1995			2000		
			Domestic	Imported	Total	Domestic	Imported	Total
1	01 to 05	Agriculture, forestry and fishing	3	-	3	3	-	3
2	10 to 14	Mining and quarrying	6	8	14	7	19	26
3	15	Food products and beverages	95	96	191	93	123	216
4	16	Tobacco products	-	-	-	-	-	-
5	17	Textiles	22	69	91	24	64	88
6	18	Wearing appare; furs	-	-	-	-	-	-
7	19	Leather and leather products	-	-	-	-	-	-
8	20	Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	5	-	5	5	-	5
9	21	Pulp, paper and paper products	140	48	188	166	46	212
10	22	Publishing, printing and recorded media	44	-	44	45	1	46
11	23	Coke, refined petroleum products and nuclear fuel	8	2	10	20	2	22
12	24.4	Pharmaceutical products	184	738	922	58	754	812
13	24 (exc. 24.4)	Chemicals and chemical products, except pharmaceutical products	1 939	1 586	3 525	1 890	1 632	3 522
14	25	Rubber and plastic products	272	67	339	240	101	341
15	26	Glass and other non-metallic mineral products	62	7	69	63	10	73
16	27	Basic metals	9	11	20	7	12	19
17	28	Fabricated metal products, except machinery and equipment	208	19	227	184	37	221
18	29	Machinery and equipment	26	6	32	25	7	32
19	30	Office machinery and computers	29	8	37	22	14	36
20	31	Electrical machinery and apparatus, etc.	7	2	9	3	7	10
21	32	Radio, television and communication equipment and apparatus	-	-	-	-	-	-
22	33	Medical, precision and optical instruments, watches and clocks	30	9	39	30	16	46
23	34	Motor vehicles, trailers and semi-trailers	2	1	3	2	-	2
24	35	Other transport equipment	-	-	-	-	-	-
25	36	Furniture, other manufactured goods, etc.	4	2	6	2	1	3
26	37	Material recycling	-	-	-	-	-	-
27	40	Electrical energy, gas, steam and hot water and distribution of gas	55	1	56	81	1	82
28	41	Water supply	10	-	10	13	-	13
29	45	Construction; civil engineering and building completion	217	2	219	186	2	188
30	50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	16	-	16	19	-	19
31	51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	167	-	167	157	-	157
32	52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	40	-	40	35	-	35
33	55	Hotel and restaurant services	16	2	18	16	1	17

Table 1 (continued)

No.	CPA <sup>2</sup>	Groups of goods	1995			2000		
			Domestic	Imported	Total	Domestic	Imported	Total
34	60	Land transport; transport via pipelines	94	12	106	98	19	117
35	61	Water transport services	5	2	7	4	1	5
36	62	Air transport services	33	11	44	63	16	79
37	63	Supporting and auxiliary transport activities; activities of travel agencies	53	-	53	71	-	71
38	64	Post and telecommunications	138	8	146	154	5	159
39	65	Financial intermediation services, except insurance and pension funding services	40	1	41	49	2	51
40	66	Insurance and pension funding services, except compulsory social security	36	-	36	38	-	38
41	67	Activities auxiliary to financial intermediation	-	-	-	-	-	-
42	70	Real estate activities	299	-	299	288	7	295
43	71	Renting of machinery and equipment without operator and of personal and household goods	299	-	299	396	-	396
44	72	Computer and related services	131	5	136	193	19	212
45	73	Research and development services	169	993	1 162	587	2 573	3 160
46	74	Other business services	1 259	30	1 289	1 573	39	1 612
47	75	Public administration and defence, compulsory social security services	124	-	124	124	-	124
48	80	Education	-	-	-	-	-	-
49	85	Health and social work services	-	-	-	-	-	-
50	90	Sewage and refuse disposal, sanitation and similar activities	55	-	55	55	-	55
51	91	Membership organisation services, etc.	25	-	25	31	-	31
52	92	Recreational, cultural and sporting services	17	-	17	17	-	17
53	93	Other services	37	-	37	43	-	43
54	95	Private households	-	-	-	-	-	-
55		Input of intermediate products by all production sectors	6 430	3 746	10 176	7 180	5 531	12 711
56		Intermediate products from imports	3 746	-	-	5 531	-	-
57		Taxes on goods minus subsidies on goods	60	-	60	58	-	58
58		Intermediate products by production sectors at purchase prices	10 236	-	10 236	12 769	-	12 769
59		Other production charges minus other subsidies	160	-	160	131	-	131
60		Compensation of employees in Germany	5 399	-	5 399	8 309	-	8 309
61		Depreciation	815	-	815	828	-	828
62		Net operating surplus	1 361	-	1 361	-1 605	-	-1 605
63		Gross value added	7 735	-	7 735	7 663	-	7 663
64		Total inputs	17 971	-	17 971	20 432	-	20 432

1 At current production or cif prices. — 2 Statistical classification of goods related to economic sectors in the European Union.  
Sources: Federal Statistical Office; DIW Berlin calculations.

Table 2  
**Input Coefficients of Production Sector (CPA 24.4): Pharmaceutical Products by Commodity Groups,<sup>1</sup> 1995 and 2000**  
 As % of production

No.	CPA <sup>2</sup>	Groups of goods	1995			2000		
			Domestic	Imported	Total	Domestic	Imported	Total
1	01 to 05	Agriculture, forestry and fishing	0.02	0.00	0.02	0.01	0.00	0.01
2	10 to 14	Mining and quarrying	0.03	0.04	0.08	0.03	0.09	0.13
3	15	Food products and beverages	0.53	0.53	1.06	0.46	0.60	1.06
4	16	Tobacco products	—	—	—	—	—	—
5	17	Textiles	0.12	0.38	0.51	0.12	0.31	0.43
6	18	Wearing apparel; furs	—	—	—	—	—	—
7	19	Leather and leather products	—	—	—	—	—	—
8	20	Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	0.03	—	0.03	0.02	—	0.02
9	21	Pulp, paper and paper products	0.78	0.27	1.05	0.81	0.23	1.04
10	22	Publishing, printing and recorded media	0.24	0.00	0.24	0.22	0.00	0.23
11	23	Coke, refined petroleum products and nuclear fuel	0.04	0.01	0.06	0.10	0.01	0.11
12	24.4	Pharmaceutical products	1.02	4.11	5.13	0.28	3.69	3.97
13	24 (exc. 24.4)	Chemicals and chemical products, except pharmaceutical products	10.79	8.83	19.61	9.25	7.99	17.24
14	25	Rubber and plastic products	1.51	0.37	1.89	1.17	0.49	1.67
15	26	Glass and other non-metallic mineral products	0.35	0.04	0.38	0.31	0.05	0.36
16	27	Basic metals	0.05	0.06	0.11	0.03	0.06	0.09
17	28	Fabricated metal products, except machinery and equipment	1.16	0.11	1.26	0.90	0.18	1.08
18	29	Machinery and equipment	0.14	0.03	0.18	0.12	0.03	0.16
19	30	Office machinery and computers	0.16	0.04	0.21	0.11	0.07	0.18
20	31	Electrical machinery and apparatus, etc.	0.04	0.01	0.05	0.01	0.03	0.05
21	32	Radio, television and communication equipment and apparatus	—	—	—	—	—	—
22	33	Medical, precision and optical instruments, watches and clocks	0.17	0.05	0.22	0.15	0.08	0.23
23	34	Motor vehicles, trailers and semi-trailers	0.01	0.01	0.02	0.01	0.00	0.01
24	35	Other transport equipment	—	—	—	—	—	—
25	36	Furniture, other manufactured goods, etc.	0.02	0.01	0.03	0.01	0.00	0.01
26	37	Material recycling	—	—	—	—	—	—
27	40	Electrical energy, gas, steam and hot water and distribution of gas	0.31	0.01	0.31	0.40	0.00	0.40
28	41	Water supply	0.06	—	0.06	0.06	—	0.06
29	45	Construction; civil engineering and building completion	1.21	0.01	1.22	0.91	0.01	0.92
30	50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	0.09	—	0.09	0.09	—	0.09
31	51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.93	—	0.93	0.77	—	0.77
32	52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	0.22	—	0.22	0.17	—	0.17
33	55	Hotel and restaurant services	0.09	0.01	0.10	0.08	0.00	0.08

Table 2 (continued)

No.	CPA <sup>2</sup>	Groups of goods	1995			2000		
			Domestic	Imported	Total	Domestic	Imported	Total
34	60	Land transport; transport via pipelines	0.52	0.07	0.59	0.48	0.09	0.57
35	61	Water transport services	0.03	0.01	0.04	0.02	0.00	0.02
36	62	Air transport services	0.18	0.06	0.24	0.31	0.08	0.39
37	63	Supporting and auxiliary transport activities; activities of travel agencies	0.29	0.00	0.29	0.35	0.00	0.35
38	64	Post and telecommunications	0.77	0.04	0.81	0.75	0.02	0.78
39	65	Financial intermediation services, except insurance and pension funding services	0.22	0.01	0.23	0.24	0.01	0.25
40	66	Insurance and pension funding services, except compulsory social security	0.20	—	0.20	0.19	—	0.19
41	67	Activities auxiliary to financial intermediation	0.00	—	0.00	0.00	—	0.00
42	70	Real estate activities	1.66	—	1.66	1.41	0.03	1.44
43	71	Renting of machinery and equipment without operator and of personal and household goods	1.66	—	1.66	1.94	—	1.94
44	72	Computer and related services	0.73	0.03	0.76	0.94	0.09	1.04
45	73	Research and development services	0.94	5.53	6.47	2.87	12.59	15.47
46	74	Other business services	7.01	0.17	7.17	7.70	0.19	7.89
47	75	Public administration and defence, compulsory social security services	0.69	—	0.69	0.61	—	0.61
48	80	Education	—	—	—	—	—	—
49	85	Health and social work services	—	—	—	—	—	—
50	90	Sewage and refuse disposal, sanitation and similar activities	0.31	—	0.31	0.27	—	0.27
51	91	Membership organisation services, etc.	0.14	—	0.14	0.15	—	0.15
52	92	Recreational, cultural and sporting services	0.09	—	0.09	0.08	—	0.08
53	93	Other services	0.21	—	0.21	0.21	—	0.21
54	95	Private households	—	—	—	—	—	—
55		Input of intermediate products by all production sectors	35.78	20.84	56.62	35.14	27.07	62.21
56		Intermediate products from imports	20.84			27.07		
57		Taxes on goods minus subsidies on goods	0.33		0.33	0.28		0.28
58		Intermediate products by production sectors at purchase prices	56.96		56.96	62.50		62.50
59		Other production charges minus other subsidies	0.89		0.89	0.64		0.64
60		Compensation of employees in Germany	30.04		30.04	40.67		40.67
61		Depreciation	4.54		4.54	4.05		4.05
62		Net operating surplus	7.57		7.57	-7.86		-7.86
63		Gross value added	43.04		43.04	37.50		37.50
64		Total inputs	100.00		100.00	100.00		100.00

1 At current production or cif prices. — 2 Statistical classification of goods related to economic sectors in the European Union.  
Sources: Federal Statistical Office; DIW Berlin calculations.



Table 3

### The Effects of Investment in Plant and Equipment by the Pharmaceutical Industry on Production, Value Added and Employment in All Production Sectors

Year	Investment in plant and equipment by the pharmaceutical industry	Induced effects in the economy as a whole		
		Production	Gross value added	Employment
		In million euros at current prices		
1995	963	1 667	795	16 893
2000	1 661	2 804	1 288	24 455
2002	1 526	2 572	1 180	21 910

Sources: Federal Statistical Office; DIW Berlin calculations.

their suppliers, so contributing to value added (income) and employment in a large number of production sectors.

This model also forms the basis for the calculation of the effects that are *indirectly* induced in the individual production sectors of the German economy through the chain of suppliers of intermediate products by this industry's *direct* deliveries of pharmaceutical products to final demand.

The input-output model enables the share of production or gross value added and employment in these production sectors to be calculated for 1995 and 2000 that is caused by demand for capital goods in the pharmaceutical industry and its deliveries to final demand.

The calculations for 2002 are approximations. They are based on the assumption that the production coefficients calculated from the input-output table for 2000 are also valid for the year 2002. This table is used to determine the production figures of the sectors that depend on the end-user deliveries regarded as exogenous in the model. Moreover, the input-output calculation for 2002 contains no figures for final demand and no data on the number of persons employed, and so these figures had to be estimated.

Hence some unclarity has to be taken into account in considering the model calculations for 2002 as these contain estimated data. The year 2002 was chosen as the latest for the calculations because, as well as the production statistics with the statistics on cost structures and the national accounts, at least some indications were available for the extrapolation of final demand for pharmaceuticals and for the estimate of labour coefficients.

Moreover, it is also assumed that the application of the coefficient matrix for 2000 also provides an acceptable approximation for 2002.

### The effects of the pharmaceutical industry on production and employment in production sectors

The following section gives the results of the model calculations.

#### The effects of investment activity by the pharmaceutical industry

Investment in fixed capital formation by the pharmaceutical industry induces production in the economy as a whole to a value around 1.7 times the volume of investment in the pharmaceutical sector. In 2002 the sector invested 1.5 billion euros, and this corresponded to production in the economy as a whole of 2.6 billion euros. An estimated 22 000 persons were employed on this production and the gross value added amounted to 1.2 billion euros.

A glance at table 5 shows that production, value added and employment are also induced in production sectors that are not directly affected by demand for investment in the pharmaceutical industry. They include the chemical industry, energy and water supplies and transport and other services.<sup>7</sup>

#### The effects of deliveries by the pharmaceutical industry to final demand

Direct deliveries by the pharmaceutical industry to final demand amounted to 22.1 billion euros in 2002, and the model calculations show that output of intermediate products was induced in the producing sectors (*indirect* production effects) to the amount of 12.5 billion euros. That was 56.7% of the value of the direct deliveries. So deliveries by the pharmaceutical industry to final demand resulted in a production value totalling 34.6 billion euros (cf. table 4). Total production induced by the pharmaceutical industry's deliveries to final demand amounted to 157% of direct deliveries to final demand.

<sup>7</sup> As a rule negative value added amounts are shown for the banks in tables 4 and 5. This is only a correction to the national accounts to balance the assumed charges for banking services, which should actually be included in the purchases of intermediate products by the other producing sectors, so reducing their value added; however, in the method of accounting used hitherto they have not been included.

Table 4

### Production, Value Added and Employment Induced in Production Sectors by Final Demand for Pharmaceutical Products in 2002

No.	CPA <sup>1</sup>	Groups of goods	Production	Gross value added	Employment <sup>2</sup>
			In million euros at current prices		No. of persons
			Directly induced effects		
12	24.4	Pharmaceutical products	22 094	8 286	101 836
			Indirectly induced effects		
1	01 to 05	Agriculture, forestry and fishing	54	25	1 084
2	10 to 14	Mining and quarrying	40	13	623
3	15	Food products and beverages	176	47	1 235
4	16	Tobacco products	0	0	0
5	17	Textiles	32	11	317
6	18	Wearing apparel; furs	1	0	6
7	19	Leather and leather products	0	0	3
8	20	Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	35	12	298
9	21	Pulp, paper and paper products	280	86	1 442
10	22	Publishing, printing and recorded media	147	67	1 146
11	23	Coke, refined petroleum products and nuclear fuel	130	14	87
12	24.4	Pharmaceutical products	63	24	291
13	24 (ex. 24.4)	Chemicals and chemical products, except pharmaceutical products	2 306	644	7 756
14	25	Rubber and plastic products	348	130	2 626
15	26	Glass and other non-metallic mineral products	129	57	1 112
16	27	Basic metals	61	13	300
17	28	Fabricated metal products, except machinery and equipment	358	150	3 306
18	29	Machinery and equipment	98	39	691
19	30	Office machinery and computers	43	9	126
20	31	Electrical machinery and apparatus, etc.	59	24	400
21	32	Radio, television and communication equipment and apparatus	11	3	66
22	33	Medical, precision and optical instruments, watches and clocks	49	23	425
23	34	Motor vehicles, trailers and semi-trailers	11	2	38
24	35	Other transport equipment	3	1	17
25	36	Furniture, other manufactured goods, etc.	5	2	50
26	37	Material recycling	9	2	40
27	40	Electrical energy, gas, steam and hot water and distribution of gas	228	107	815
28	41	Water supply	31	21	157
29	45	Construction; civil engineering and building completion	318	139	4 186
30	50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	64	34	1 053
31	51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	375	227	3 986
32	52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	70	44	1 767
33	55	Hotel and restaurant services	44	19	1 386
34	60	Land transport; transport via pipelines	168	83	2 879
35	61	Water transport services	10	3	18
36	62	Air transport services	99	47	242
37	63	Supporting and auxiliary transport activities; activities of travel agencies	241	80	1 830
38	64	Post and telecommunications	309	190	1 904
39	65	Financial intermediation services, except insurance and pension funding services	380	-27	2 960
40	66	Insurance and pension funding services, except compulsory social security	102	24	423
41	67	Activities auxiliary to financial intermediation	47	25	546
42	70	Real estate activities	588	459	748
43	71	Renting of machinery and equipment without operator and of personal and household goods	696	494	1 232
44	72	Computer and related services	356	264	3 071
45	73	Research and development services	699	348	5 849
46	74	Other business services	2 607	1 838	33 983
47	75	Public administration and defence, compulsory social security services	189	138	3 089
48	80	Education	64	53	1 331
49	85	Health and social work services	2	1	43
50	90	Sewage and refuse disposal, sanitation and similar activities	102	48	542
51	91	Membership organisation services, etc.	59	43	1 322
52	92	Recreational, cultural and sporting services	129	77	1 296
53	93	Other services	104	79	1 873
54	95	Private households	0	0	0
55		All production sectors	12 532	6 258	102 016
			Total induced effects		
All production sectors			34 626	14 545	203 853

1 Statistical classification of goods related to economic sectors in the European Union. — 2 Calculated using labour coefficients, estimated on the basis of the national accounts and surveys on cost structures.

Sources: Federal Statistical Office; DIW Berlin calculations.

Table 5

### Production, Value Added and Employment Induced in Production Sectors by Investment in Fixed Capital Formation by the Pharmaceutical Industry in 2002

No.	CPA <sup>1</sup>	Groups of Goods	Capital goods purchases by the pharmaceutical industry <sup>2</sup>	Induced by investment		
				Production	Gross value added	Employment <sup>3</sup>
				In million euros at current prices		No. of persons
1	01 to 05	Agriculture, forestry and fishing	2	3	2	69
2	10 to 14	Mining and quarrying	0	6	2	61
3	15	Food products and beverages	0	2	1	14
4	16	Tobacco products	0	0	0	0
5	17	Textiles	2	3	1	34
6	18	Wearing apparel; furs	0	0	0	2
7	19	Leather and leather products	0	0	0	3
8	20	Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	4	20	7	171
9	21	Pulp, paper and paper products	0	8	2	42
10	22	Publishing, printing and recorded media	11	28	12	218
11	23	Coke, refined petroleum products and nuclear fuel	0	10	1	7
12	24.4	Pharmaceutical products	0	0	0	0
13	24 (ex. 24.4)	Chemicals and chemical products, except pharmaceutical products	0	17	5	58
14	25	Rubber and plastic products	2	34	13	257
15	26	Glass and other non-metallic mineral products	1	27	11	237
16	27	Basic metals	3	44	11	214
17	28	Fabricated metal products, except machinery and equipment	44	123	52	1 137
18	29	Machinery and equipment	368	426	169	2 991
19	30	Office machinery and computers	36	41	9	119
20	31	Electrical machinery and apparatus, etc.	70	126	51	849
21	32	Radio, television and communication equipment and apparatus	75	88	24	538
22	33	Medical, precision and optical instruments, watches and clocks	83	90	42	775
23	34	Motor vehicles, trailers and semi-trailers	136	185	40	612
24	35	Other transport equipment	57	57	16	289
25	36	Furniture, other manufactured goods, etc.	50	55	20	555
26	37	Material recycling	0	1	0	6
27	40	Electrical energy, gas, steam and hot water and distribution of gas	0	20	9	70
28	41	Water supply	0	2	1	11
29	45	Construction; civil engineering and building completion	171	189	82	2 492
30	50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	48	59	31	977
31	51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	92	170	103	1 806
32	52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	14	21	13	532
33	55	Hotel and restaurant services	0	5	2	168
34	60	Land transport; transport via pipelines	37	51	25	876
35	61	Water transport services	0	1	0	2
36	62	Air transport services	0	8	4	19
37	63	Supporting and auxiliary transport activities; activities of travel agencies	0	32	11	240
38	64	Post and telecommunications	0	23	14	145
39	65	Financial intermediation services, except insurance and pension funding services	0	39	-3	303
40	66	Insurance and pension funding services, except compulsory social security	0	7	2	29
41	67	Activities auxiliary to financial intermediation	0	4	2	51
42	70	Real estate activities	4	67	52	85
43	71	Renting of machinery and equipment without operator and of personal and household goods	0	35	25	61
44	72	Computer and related services	169	203	151	1 752
45	73	Research and development services	0	1	1	10
46	74	Other business services	19	172	121	2 240
47	75	Public administration and defence, compulsory social security services	1	8	6	124
48	80	Education	0	0	0	9
49	85	Health and social work services	0	0	0	3
50	90	Sewage and refuse disposal, sanitation and similar activities	0	5	2	26
51	91	Membership organisation services, etc.	0	4	3	80
52	92	Recreational, cultural and sporting services	28	42	25	417
53	93	Other services	0	7	6	131
54	95	Private households	0	0	0	0
55		All production sectors	1 526	2 572	1 180	21 910

1 Statistical classification of goods related to economic sectors in the European Union. — 2 Estimated using the structure of goods in the economy as a whole; totals are from the investment surveys of companies by the Federal Statistical Office. — 3 Calculated using labour coefficients, estimated on the basis of the national accounts and the surveys of cost structures.

Sources: Federal Statistical Office; DIW Berlin calculations.

Direct deliveries to final demand corresponded to value added of just under 8.3 billion euros. The indirect value added effects amounted to 6.3 billion euros or 75.7% of direct value added. Hence value added in the economy as a whole induced by deliveries by the pharmaceutical industry to final demand in 2002 can be held to amount to 14.5 billion euros.

102 000 people were employed in the pharmaceutical industry on the direct deliveries to final demand. A further 102 000 were employed on the production induced by these indirect effects. The distribution of these indirect effects on the producing sectors can be seen in table 4. So the total employment induced by pharmaceutical deliveries to final demand was twice as high as the direct employment.

The relation between the macroeconomic effects that can be attributed to deliveries by the pharmaceutical sector to final demand and the direct effects was of a comparable order in all the three years considered (cf. figure 3). In 1995 the macroeconomic effects amounted to 60% of direct production to meet final demand for pharmaceutical products, to 70% of the gross value added they induced and 90% of the employment that can be directly attributed to them. In 2002 the corresponding relations were 56.7% for production, 75.7% for gross value added and 100.2% for employment.

### The effects by economic sector

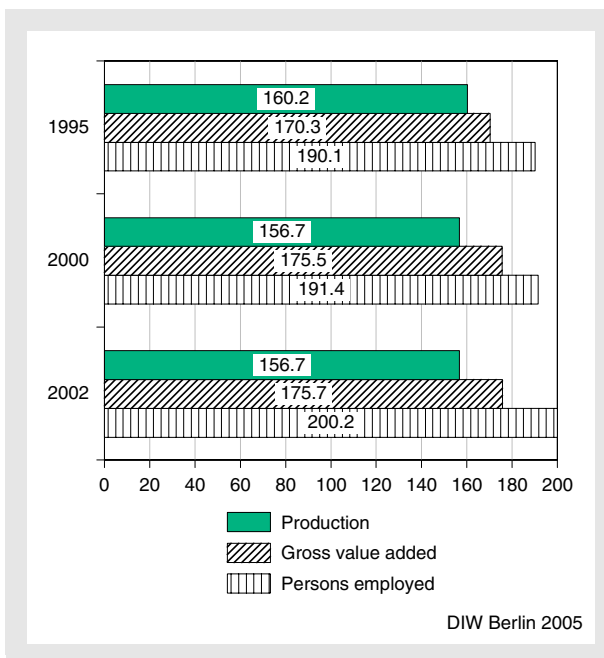
Effects caused by the pharmaceutical industry on production, value added and employment can be observed in almost every area of production in the economy. But considerable differences are evident in the extent of the indirect effects and these are shown in detail in table 4.

In 2002 75% of the indirect production effects were concentrated in only twelve sectors, as were 78% of the sectoral value added effects and 70% of the indirect employment effects.

Of the production sectors most strongly 'affected' by the pharmaceutical industry (cf. figure 4) eight are in the services sector, and with the exception of the banks they show above-average value added ratios. This explains the higher share of these twelve sectors in the gross value added induced by the pharmaceutical industry compared with the indirect production effects.

Admittedly, on average for the services sector the labour input per output unit is higher than the labour intensity on average for the economy as a whole, but that does not apply to most of the services sectors strongly used by the pharmaceutical industry. The chemical industry (without pharmaceuticals) is second in importance among these, and here, too, the labour intensity is considerably below the average for the econ-

Figure 3  
Macroeconomic Effects of the Production of Pharmaceuticals in Relation to the Direct Effects (%)



Sources: Federal Statistical Office; DIW Berlin calculations.

omy as a whole. So – in deviation from the macroeconomic effects – the share of the employment indirectly induced by the pharmaceutical industry in the twelve most strongly affected supplier branches is lower than the share of production.

Of the services sectors listed here only business-related services and the wholesale trade and commission trade show the sequence of above-average labour coefficients and value added ratios typical of services. In the manufacturing sectors chemical products (without pharmaceuticals) show the pattern of the various effects that is typical of the manufacturing sector.

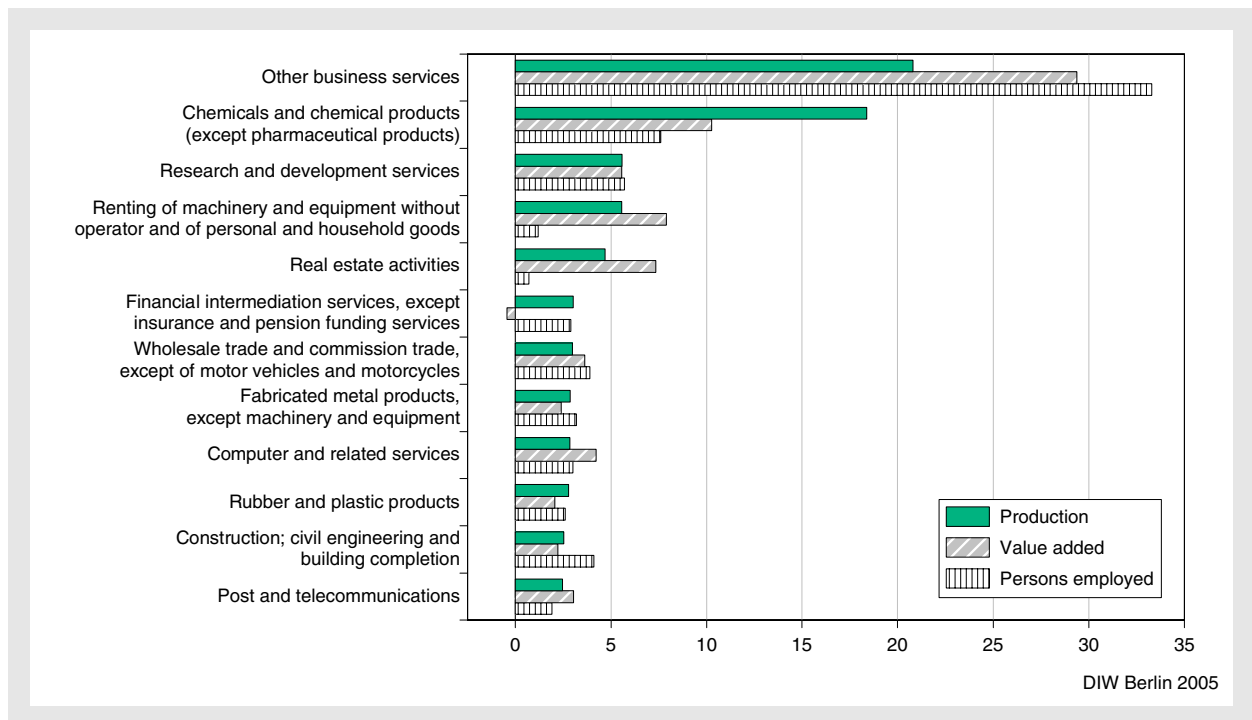
### Conclusion

In 2000 106 000 people were employed to produce pharmaceuticals. The analyses of the linkages between the manufacture of pharmaceuticals and the rest of the economy show, however, that the activities of the pharmaceutical industry cause considerable employment in the other production sectors. For every person employed in the pharmaceutical industry another is employed in the rest of the economy. So the macroeconomic impor-

Figure 4

### The Supplier Sectors most Stimulated by the Pharmaceutical Industry in 2002

Shares of indirect sectoral effects of deliveries to final demand by the pharmaceutical industry in total indirect effects (%)



Sources: Federal Statistical Office; DIW Berlin calculations.

tance of the pharmaceutical industry is therefore greater than its direct contributions to the gross domestic product and employment show.

As a country poor in raw materials Germany is dependent on production that can hold a position on the world market. That requires a high level of education,

knowledge and research. The pharmaceutical industry contributes to this, not only by employing highly skilled personnel and with its own R&D, but also by inducing additional employment and value added in high-quality services sectors. State regulation of the health system must take these strong effects into account.