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Weekly Report

Extensive research does not imply extensive funding

In Germany, two statistics examine the development and structure of public funding for research and development (R&D) in the private sector of the economy: the R&D statistics of the so-called "Stifterverband für die deutsche Wissenschaft - SV", a joint initiative of German industries to promote science an higher education (SV), and, secondly, the statistics of the "Bundesministerium für Bildung und Forschung, BMBF" (German Federal Ministry of Education and Research)) on "Federal Government expenditure on science, research and development to business enterprises". Based on these two sources, our weekly report provides an overview of the allocation of public R&D funding. The results highlight the fact that some research-intensive sectors—such as the manufacture of aircraft and spacecraft—benefit from disproportionately large amounts of federal state funding. Other, equally R&D-intensive business segments, such as the chemical industry receive a significantly lower proportion of public R&D grants. Generally speaking, smaller companies can expect greater support than large companies. This inequality in funding rates reflects the focus of research and innovation policy on particular company sizes or fields of technology. The second part of the report discusses the quality of the available data on the distribution of R&D funding. Considering the disparities between degree of coverage, consistency and timescale of the two statistics in question, the current state of available information remains unsatisfactory and requires further refinement.

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In view of the economic crisis, many observers expect companies to reduce their R&D spending. R&D activities, however, are especially vital in times of crisis. A marked reduction in R&D spending would endanger the companies' future potential for innovation and competitiveness. On the other hand, financing these research activities will most likely become increasingly harder, so it is justifiably doubtful if companies can maintain their current R&D levels. Against this background, the state funding of R&D efforts becomes increasingly important.

The analysis at hand provides a quantitative overview of public R&D spending by industry and company size. In addition, the report takes a critical look at the information available on public funding distribution.[1] To this end, the analysis draws on two data sources:

JEL Classification:
O32, O38

Keywords:
Research and Development, Funding

1 This report is based on the results of a short survey carried out by the Stifterverband für die Deutsche Wissenschaft and the DIW Berlin commissioned by the Expertenkommission Forschung und Innovation—EFI (Commission of Experts for Research and Innovation), Berlin, established by the German government. The underlying report Eickelpasch, A.

Table 1

Total R&D expenditure, employees, turnover and R&D employees in 2005

NACE Rev. 1.1		R&D expenditure			Employees	Turnover	R&D employees
		in million euros	*thereof*: financed by the government				
			in million euros	in percentages	in thousands	in billion euros	
	Overall economy	47 965,0	1 542,9	3,2	3 832	1 211,8	300 540
	thereof:						
D	Manufacturing	43 348,2	1 217,4	2,8	3 102	967,9	266 016
DA	Manufacture of food products, beverages and tobacco	295,4	1,9	0,6	114	44,0	2 302
DB	Manufacture of textiles and textile products	123,3	1,2	1,0	32	5,3	999
DC	Manufacture of leather and leather products	11,4	0,1	0,4	3	0,8	132
DD	Manufacture of wood and wood products	12,1	.	.	12	1,9	154
DE	Manufacture of pulp, paper and paper product; publishing and printing	112,9	1,0	0,9	36	9,3	1 008
DF	Manufacture of coke, refined petroleum products and nuclear fuel	61,9	.	.	12	42,6	342
DG	Manufacture of chemicals, chemical products and man-made fibres	7 886,4	40,9	0,5	343	172,2	39 765
24.4	Manufacture of pharmaceuticals, medical chemicals and botanical products	4 579,5	.	.	113	51,9	17 995
DH	Manufacture of rubber and plastic products	764,3	3,4	0,4	131	49,4	6 674
DI	Manufacture of other non-metallic mineral products	264,0	.	.	81	13,8	1 989
DJ	Manufacture of basic metals and fabricated metal products	944,2	17,9	1,9	296	77,0	7 615
27	Manufacture of basic metals	418,1	7,4	1,8	148	51,7	2 811
28	Manufacture of fabricated metal products, except machinery and equipment	526,1	10,5	2,0	149	25,3	4 804
DK	Manufacture of machinery and equipment n.e.c.	4 448,1	95,3	2,1	561	110,9	36 010
DL	Manufacture of electrical and optical equipment	9 635,4	248,2	2,6	618	131,3	67 399
30	Manufacture of office machinery and computers	572,3	2,2	0,4	47	18,5	4 282
31	Manufacture of electrical machinery and apparatus n.e.c.	1 260,5	21,5	1,7	163	31,3	11 532
32	Manufacture of radio, television and communication equipment and apparatus	4 366,8	112,3	2,6	189	42,9	27 419
33	Manufacture of medical, precision and optical instruments, watches and clocks	3 435,8	112,3	3,3	218	38,5	24 165
DM	Manufacture of transport equipment	18 602,2	794,7	4,3	822	302,9	99 835
34	Manufacture of motor vehicles, trailers and semi-trailers	15 751,7	.	.	717	276,7	86 929
35	Manufacture of other transport equipment	2 850,5	.	.	104	26,2	12 907
DN	Manufacture n.e.c.	186,6	3,5	1,9	41	6,6	1 790
73	Research and development	1 179,6	111,0	9,4	29	4,5	9 874
74	Other business activities	686,5	156,6	22,8	57	9,8	4 952

Source: Stifterverband für die Deutsche Wissenschaft. **DIW** Berlin 2009

The R&D statistics of the "Stifterverband für die deutsche Wissenschaft" which explores R&D funding from the recipient's perspective ("recipient statistics").

The statistics of the German Federal Ministry of Education and Research (BMBF) on "Federal Government expenditure on science, research and development to business enterprises" which documents R&D funding from the donor's perspective ("donor statistics").

Unequal funding for different industries

The R&D statistics of the "Stifterverband für die deutsche Wissenschaft" are based on regular surveys of companies that are assumed to pursue R&D activities. In addition, the SV consults joint research institutions. The survey concept conforms to the internationally binding definitions and delinea-

and C. Grenzmann: Kurzexpertise zur Inanspruchnahme der Förderung von Forschung und Entwicklung Studien zum deutschen Innovationssystem, No. 16-2009,EFI (ed.) is available at http://www.e-fi.de/studien2009.html.

tions documented in the OECD Frascati manual.[2] Furthermore, the SV also collects information on the different sources of R&D funding, e.g. the company or corporation itself, other companies or government authorities (federal government, Länder, and local authorities). This data is collected every two years. It is available for the period from 1981 to 2005; results for manufacturing cover the period from 1993 to 2005.[3]

According to the SV's R&D statistics, in 2005 companies in the business sector spent nearly 48 billions euros on R&D. Of this, 1.5 billion euros (3.2 percent) could be attributed to public funding (table 1). The state's co-financing share has steadily decreased since 1981, when public contributions still amounted to 12.3 percent of R&D spending (table 2). The prime reason for this decrease: While the companies continued to expand their own R&D efforts, public spending took a less coherent development.

In manufacturing, the decrease of public funding proceeded more or less as in the economy as a whole. Here, the state's co-financing share continued to drop over the years: from 6.2 percent in 1993 to a mere 2.8 percent (or 1.2 of 43.3 billion euros) in 2005.

Table 2

Total R&D expenditure, employees, turnover and R&D employees

	R&D expenditure			Employees	Turnover	R&D employees
	in million euros	*thereof*: financed by the government				
		in million euros	in percentages	in thousands	in billion euros	
2005	47 965.0	1 542.9	3.2	3 832	1 211.8	300 540
2003	46 069.9	1 589.5	3.5	3 819	1 045.3	294 377
2001	43 239.2	1 543.4	3.6	4 225	1 042.3	302 519
1999	39 255.4	2 482.7	6.3	4 407	939.9	302 609
1997	33 029.1	2 586.5	7.8	4 413	843.4	282 431
1995	29 571.2	2 085.5	7.1	4 833	793.5	279 351
1993	29 158.7	1 968.9	6.8	5 253	736.2	289 168
1991	28 807.2	2 395.0	8.3	6 305	759.0	316 775
1989	25 647.2	2 484.6	9.7	5 446	660.2	292 590
1987	22 640.5	2 180.2	9.6	5 621	598.6	291 364
1985	19 897.1	2 360.1	11.9	5 667	619.2	271 453
1983	16 620.8	2 044.5	12.3	5 622	552.6	245 795
1981	13 962.1	1 719.4	12.3	5 730	506.6	238 848

Source: Stifterverband für die Deutsche Wissenschaft. **DIW** Berlin 2009

In 2005, the lion's share of state funding (795 million euros or 65.3 percent) fell upon the sector of "Manufacture of transport equipment". Although the data for the year 2005 does not show any further subdivision, the results of previous periods would suggest that most of these subsidies were earmarked for the business line "Manufacture of other transport equipment" and within this sector the "Manufacture of aircraft and spacecraft".[4] Other in-

2 OECD (ed.): Frascati Manual 2002—The Measurement of Scientific and Technological Activities, Proposed Standard Practice for Surveys of Research and Experimental Development. Paris 2002.

3 See Stifterverband für die Deutsche Wissenschaft (ed.): FuE-Datenreport 2007. Tabellen und Daten, Essen 2007 and Stifterverband für die Deutsche Wissenschaft (ed.): FuE-Datenreport 2008. Analysen und Vergleiche, Essen 2008.

4 See Rammer, C. and H. Binz: Zur Förderung der FuE in der Wirtschaft durch den Staat. In: Legler, H. and Ch. Grenzmann: FuE-Aktivitäten der deutschen Wirtschaft. Analysen auf der Basis von FuE-Erhebungen, Essen 2006, 131-141.

Table 3

Total R&D expenditure, employees, turnover and R&D employees in 2005 by size

	R&D expenditure			Employees	Turnover	R&D employees
	in million euros	*thereof*: financed by the government				
		in million euros	in percentages	in thousands	in billion euros	
Overall economy	47 965.0	1 542.9	3.2	3 832	1 211.8	300 540
Size class by employees						
less than 20 employees	266.9	25.3	9.5	14	1.7	3 402
20 to 49 employees	613.3	52.1	8.5	51	7.4	7 259
50 to 99 employees	846.9	63.0	7.4	96	15.9	8 360
100 to 249 employees	2 205.3	141.3	6.4	292	56.5	20 491
250 to 499 employees	2 306.1	48.9	2.1	335	77.8	20 096
500 to 999 employees	2 658.4	38.7	1.5	326	79.4	20 658
1 000 to 1 999 employees	4 365.0	261.1	6.0	411	115.9	30 814
2 000 to 4 999 employees	6 676.4	202.2	3.0	557	212.6	40 984
5 000 to 9 999 employees	5 243.9	55.6	1.1	299	185.5	27 346
10 000 and more employees	22 782.8	654.7	2.9	1 450	459.1	121 131

Source: Stifterverband für die Deutsche Wissenschaft. **DIW** Berlin 2009

Table 4

R&D funding by the federal government, R&D intensity and R&D funding intensity in 2007

NACE Rev. 1.1		R&D funding by the federal government		Expenditure for in-firm R&D		
		in million euros	structure in percentages	structure in percentages	in percentages of the gross production value	funding share in percentages
D	Manufacturing	1611.4	100.0	100.0	2.7	3.4
	thereof:					
DG	Manufacture of chemicals, chemical products and man-made fibres	85.9	5.3	14.4	3.9	1.3
DJ	Manufacture of basic metals and fabricated metal products	53.3	3.3	2.7	0.6	4.2
DK	Manufacture of machinery and equipment n.e.c.	175.1	10.9	11.6	2.5	3.2
DL	Manufacture of electrical and optical equipment	516.4	32.0	25.8	5.7	4.2
30	Manufacture of office machinery and computers	*12.5*	*0.9*	1.0	2.7	*2.7*
31	Manufacture of electrical machinery and apparatus n.e.c.	*118.1*	*8.5*	9.8	4.7	*1.8*
32	Manufacture of radio, television and communication equipment and apparatus	*165.0*	*11.9*	10.2	9.1	*5.2*
33	Manufacture of medical, precision and optical instruments, watches and clocks	*171.3*	*12.4*	4.7	5.2	*8.2*
DM	Manufacture of transport equipment	629.3	39.1	41.6	5.0	3.2
34	Manufacture of motor vehicles, trailers and semi trailers	*116.4*	*8.4*	36.8	4.8	*0.7*
35	Manufacture of other transport equipment	*414.1*	*29.9*	4.8	6.3	*19.5*
351	Building and repairing of ships and boats	*123.8*	*8.9*	.	.	.
352	Manufacture of railways and tramway locomotives and rolling stock	*2.1*	*0.2*	.	.	.
353	Manufacture of aircraft and spacecraft	*286.0*	*20.7*	.	.	.
359	Manufacture of other transport equipment	*2.2*	*0.2*	.	.	.

Cursive numbers: data for 2006, since no data is available for 2007.

Source: Federal Ministry of Education and Research; Federal Statistic Office; DIW Berlin. **DIW** Berlin 2009

dustries that received significant amounts of public funding include ”Manufacture of radio, television and communication equipment”, “Manufacture of medical, precision and optical instruments” (9.2 percent of state funding in manufacturing each) and “Manufacture of machinery and equipment” (7.8 percent). The chemical industry, on the other hand, only obtained 3.4 percent of public funding. While small and medium-sized companies (SME) with fewer than 250 employees claimed more than a fifth of the available financing, larger corporations with more than 10,000 employees received two fifth of the public R&D contributions (table 3).

The state’s co-financing quota varies in line with industry-specific differences in corporate R&D expenditure. In 2005, the share of public funding on R&D expenditure was above average in the sector of “Manufacture of transport equipment” (at 4.3 percent). However, a closer look reveals substantial variance within this line of business. While the “Manufacture of motor vehicles, trailers and semi-trailers” received just 0.4 percent of co-financing, the segment of “Manufacture of other transport equipment” including the “Manufacture of aircraft and spacecraft” and “Manufacture of railways and tramway locomotives and rolling stock” enjoyed more than 30 percent of state funding[5] —a quota that used to be even higher in the past (46 percent in 1995). Another industry with an above average share of co financing is the “Manufacture of medical, precision and optical instruments” (3.3 percent). Its public co-financing rate has remained relatively high over recent years. The manufacturing of telecommunication equipment, on the other hand, reaches the industry average (2.6 percent), while manufacturing of machinery (2.1 percent) and the chemical industry (0.5 percent) receive substantially lower rates of public R&D funding—a trend that has not changed over the years.

The R&D statistics provided by the SV also allow for differentiation by company size. According to this statistic, the co-financing quota for small and medium-sized companies (SME) with fewer than 250 employees is significantly higher than that for larger corporations. Within the group of the SME the very small companies receive more funding than

5 The referenced data is from 2003. More up-to-date figures are not yet available.

the small or medium-sized companies. Despite some temporary fluctuations, there have been no major changes to the overall SME co-financing rate over the past few years, while larger corporations have experienced a decline in their public co-financing quota.

Research funding does not necessarily correlate to research intensity

A further data source for the investigation of the distribution of public funding of R&D is the annual report on "Federal Government expenditure on science, research and development to business enterprises" provided by the BMBF. These statistics contain data on total federal funding and, as a portion, on the so-called "direct project funding".[6] Available data cover the period from 1998 to 2007. Unlike the SV's R&D statistics, these statistics do not cover funding by the German Länder and other authorities.[7] Also, the data do not allow classifications by company size.

In order to contrast overall R&D intensity with federal R&D funding, this "donor statistics" was cross-referenced with the cost structure statistics of the Federal Statistical Office.[8]

In 2007, the federal government supported business-related R&D activities with almost 2.2 billion euros. The largest contributions were made by the "Bundesministerium der Verteidigung—BMVg" (Federal Ministry of Defence—865 million euros), the "Bundesministerium für Wirtschaft und Technologie - BMWi" (Federal Ministry of Economics and Technology—689 million euros) and the BMBF (507 million euros). Together, these three ministries accounted for 94 percent of the registered funding volume. Most of these funds (1.6 billion euros) went to the manufacturing industries (tables 4 and 5). Within this sector, direct project support accounted for the bulk of the funding (88.2 percent).

Table 5

R&D funding by the federal government and R&D funding intensity in manufacturing

	R&D funding by the federal government	Expenditure for in-firm R&D		
	in million euros		in percentages of the gross production value	funding share in percentages
2007	1 611.4	47 767.2	2.7	3.4
2006	1 383.3	45 801.8	2.7	3.0
2005	1 209.8	43 520.8	2.8	2.8
2004	1 118.6	41 265.7	2.8	2.7
2003	1 166.5	41 837.3	3.0	2.8
2002	1 124.5	38 444.9	2.8	2.9
2001	1 325.9	.	.	.
2000	1 495.3	.	.	.
1999	1 553.5	.	.	.
1998	1 735.1	.	.	.

Source: Federal Ministry of Education and Research; Federal Statistic Office; DIW Berlin. **DIW** Berlin 2009

The largest recipient—at 39.1 percent of total funding expenditure—is the "Manufacture of transport equipment", up from 32.1 percent in 1998. Nevertheless, the statistical data highlight the uneven distribution of funds within this sector: A fifth of all funding goes to the "Manufacture of aircraft and spacecraft"—substantially more than to the automotive manufacturers (8.4 percent) or the shipbuilding industry (8.9 percent). However, the statistics also register a strong decrease in the percentage received by the manufacture of aircraft and spacecraft over the past few years, accompanied by a concomitant increase of funds for the automotive and shipbuilding industries.

According to the "donor statistics," the "Manufacture of other transport equipment" remains the largest beneficiary by far, with a federal R&D co-financing quota of 19.5 percent. This elevated quota is most likely due to high aerospace subsidies. Unfortunately, the cost structure statistics do not identify R&D spending for this particular line of industry. "Manufacture of electrical and optical equipment" enjoys above-average funding, too, with a co-financing rate of 4.2 percent. In this sector "Manufacture of medical, precision and optical instruments" receive especially high levels of public spending with a co-financing rate of 8.2 percent, closely followed by "Manufacture of radio, television and communication equipment" (5.2 percent). Manufacture of machinery, on the other hand, re-

6 BMBF (Ed.): Forschung und Innovation in Deutschland 2008—Im Spiegel der Statistik. Berlin 2008. Ministries that have contributed data to the statistics include the BMBF (Federal Ministry of Education and Research), the BMWi (Federal Ministry of Economics and Technology, the BMVg (Federal Ministry of Defence), the BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) and the BMELV (Federal Ministry for Food, Agriculture and Consumer Protection).

7 Information on the overall amount of Länder funding from a donor's perspective is not available. However, a recent ZEW study suggests that funding by the Länder should be substantial according to the sheer number of companies involved. For comparison: Between 2004 and 2006, almost two thirds of researching companies in the manufacturing industries received federal funding, almost half of them benefited from Länder funding and a little less than a quarter obtained an EU grant. See Rammer, Ch. and G. Licht (2009): Inanspruchnahme von Forschungs- und Innovationsfördermittel durch FuE betreibende Unternehmen in Deutschland. Auswertung aus der Innovationserhebung 2007 des ZEW. Mannheim 2009.

8 Federal Statistical Office (Ed.): Fachserie 4 Reihe 4.3. Kostenstruktur der Unternehmen des Verarbeitenden Gewerbes sowie des Bergbaus und der Gewinnung von Steinen und Erden. 2007. Wiesbaden 2009. Here, funding intensity is measured as R&D funding as a percentage of overall R&D spending, and R&D intensity as a percentage of gross value added.

ceives the industry average co-financing quota of 3.1 percent, while numbers for the chemical industry barely reach 1.2 percent.

In 2007, the federal government co-financed 3.4 percent of the R&D activities undertaken by manufacturing, a slight increase on the previous years' co-financing rate of 2.7 to 3.0 percent of R&D spending.

In order to investigate whether funding focus on R&D intensive industries in particular, this report compares R&D intensities with R&D funding rates. In manufacturing industry, 2007 figures show that R&D spending amounted to 2.7 of gross value added (R&D intensity), while the federal government co-financed 3.4 percent of R&D activities (R&D funding intensity). According to this approach the seven major industries that receive almost 90 percent of all public R&D funding can be divided into three distinct categories (see figure).

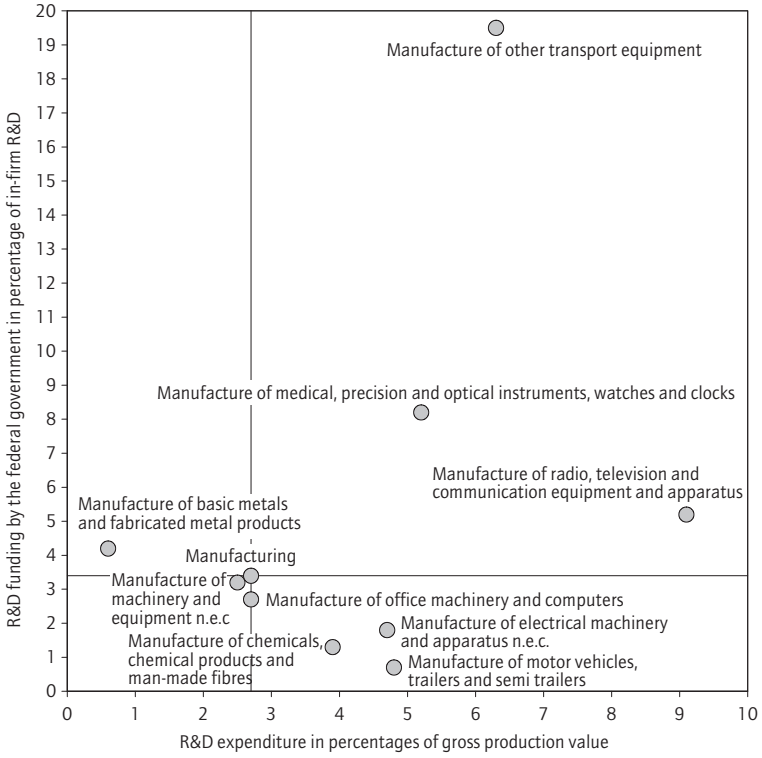
High R&D intensity and high R&D funding intensity: In "Manufacture of other transport equipment" (including the rail and aerospace industries), a sector that receives almost 30 percent of all federal funding, R&D intensity (6.3 percent) is more than twice the industry average (2.7 percent). At 19.5 percent, this segment's R&D funding intensity outstrip the average (3.4 percent) by a factor of six. Other industries with above-average R&D intensity and R&D funding intensity include the "Manufacture of radio, television and communication equipment" and "Manufacture of electrical and optical equipment".

Average R&D intensity and average R&D funding intensity: In "Manufacture of machinery and equipment" which accounts for almost 11 percent of all federal funding R&D intensity and R&D funding intensity roughly correspond to the average in manufacturing.

Above-average R&D intensity and below-average R&D funding intensity: Industries with above-average R&D intensity, but below-average funding intensity include the "Manufacture of motor vehicles, trailers and semi-trailers", the "Manufacture of electrical machinery and apparatus" as well as the chemical industry.

Figure

R&D intensity and R&D funding intensity



Source: Federal Ministry of Education and Research; Federal Statistic Office; DIW Berlin. **DIW** Berlin 2009

dustries and according to the size of the companies. While some of the more research-intensive industries receive above-average funding—for example, the manufacturing of other transport equipment—other equally R&D-intensive segments like the chemical industry achieve markedly lower funding quotas. On average, smaller companies benefit from higher funding rates than large corporations. While funding intensity has remained relatively stable in small companies, it has decreased for large corporations. One main reason for this development is the focus of the federal R&D and innovation policy on particular company sizes or fields of technology.

Disparities between the federal ministries funding statistics ("donor statistics") and the "recipient statistics" provided by the SV are not only due to the above-mentioned differences in timeliness or coverage, but also due to differences in the allocation of funding to different lines of business. In some cases, funding for a particular company might be attributed to another industry line if the parent corporation pursues a different business focus. Another underlying reason for diverging classification would be the attribution of some funded co-operative projects to

Conclusion: further refinement of data necessary

Overall, the analyses of the available data on the distribution of public R&D funding reveals significant disparities in funding intensity between different in-

the industry of the consortium leader, while others are attributed to the industries of the consortium's acting members. Furthermore, it is conceivable that companies listed in the "recipient statistics" involved in R&D projects that last several years might not report their funding on an accrual basis. Further discrepancies could arise from the fact that federal funding provided by research institutions, i.e. not directly spent by the federal government, might not be considered public funding by the beneficiary. Finally, it should be noted that the "recipient statistics" do not define grants from so called "indirect-specific programmes" (such as personnel cost subsidies) as public funding.

Due to the unsatisfactory value of information of the available data, it is vital to refine and redevelop the reporting systems in terms of coverage, consistency and topicality. Although some efforts have been made towards a harmonisation of these reporting systems, they only constitute a first step. For one, they would benefit from the inclusion of reporting systems by the Länder and further federal ministries. In addition, the reports should reflect the growing significance of the funding by the European Union.

Building on the existing information systems, the aim should be to create a comprehensive, regular and up-to-date overview of public spending on R&D activities and innovation.

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