B CORE TOPICS 2012

B 1 UNIVERSITY-BASED RESEARCH – CURRENT STATUS AND DEVELOPMENT PROSPECTS

B 1–1 RELEVANCE OF UNIVERSITY-BASED RESEARCH

Research is a key element in innovation processes.[58] In Germany, research is largely conducted by three groups of stakeholders: companies, non-university research institutions, and higher education institutions, i.e. universities and universities of applied sciences. The Expert Commission regularly reports on company-based research activities. In its 2010 Annual Report, the Expert Commission also provided in-depth coverage of the role of non-university research. In the 2011 Annual Report, new potentials for collaboration between non-university institutions and higher education institutions were discussed. In this current report, university-based research shall be analysed in more detail.[59] Not only the current status, but also development prospects for research in the higher education sector will be discussed.[60] One major aspect to be discussed will be the special role that university-based research takes in contributing to knowledge and technology transfer.[61]

Throughout 2010, Germany invested a total of EUR 69.8 billion in R&D. The majority of R&D expenditures – EUR 46.9 billion – is attributable to the private sector (67 percent). Higher education institutes spent EUR 12.6 billion on R&D activities (18 percent), and the R&D expenditures of non-university institutions and the federal department research institutions[62] amounted to EUR 10.2 billion (15 percent). Thus, in terms of quantitative importance, the higher education sector exceeds both the non-university sector and the federal department research institutions.

B 1–2 FEDERAL FRAMEWORK CONDITIONS

With only a few exceptions, Germany's public higher education institutions are subjected to the rights of legislative initiative and executive power of the *Länder*, i.e. Germany's federal states. In terms of education policies, the Federalism Reform I *(Föderalismusreform I)*, which was enforced in September 2006, strengthened the education-related responsibilities of the *Länder* and weakened those of the Federal Government.[63] The reform provided for an abolition of the joint tasks of "construction in the higher education sector" and "education planning", both of which had been anchored in the German Basic Law (GG).[64] Prior to the Federalism Reform I, the Federal Government had co-financed building projects in the higher education sector by covering 50 percent of construction expenses. To compensate for the increased burden on the *Länder* caused by the cancellation of these joint tasks, the Federal Government's share of contributions stipulated for university construction has been made available to the *Länder* until and including 2019, while funding is earmarked until 2013. Only construction of tertiary education research facilities and large-scale equipment are eligible for financing through the joint task of "promotion of research" which is still in place. A means of collaboration between Federal Government and *Länder* in the educational field is provided by the joint task of "promotion of research". It enables policy-makers from the federal and national levels to co-operate in financing science and research ventures of transregional importance. However, such collaboration is only possible provided that all of the federal states have given their consent. So far, only few collaboration agreements

Federalism Reform 2006, Amendment of Article 91a, Paragraph 1 and Article 91b of the German Basic Law (GG)

BOX 01

Article 91a (1) of the Basic Law[65]

Old version

The Federal Government participates in the performance of *Länder* tasks if these tasks are relevant to the public and if participation of the Federal Government is necessary for improving living conditions (joint tasks):

1. Expansion and construction of higher education institutions, including university hospitals
2. Improvement of regional economic structures
3. Improvement of agricultural structures and coastal protection.

New version

The Federal Government participates in the performance of *Länder* tasks in the following areas if these tasks are relevant to the public and if participation of the Federal Government is necessary for improving living conditions (joint tasks):

1. Improvement of regional economic structures
2. Improvement of agricultural structures and coastal protection.

Article 91b of the Basic Law GG[66]

Old version

In instances of transregional importance, the Federal and *Länder* governments may co-operate, on the basis of agreements, in education planning and the promotion of facilities and ventures of scientific research. The sharing of costs shall be specified in the agreement.

New version

(1) In instances of transregional importance, the Federal and *Länder* governments may co-operate in promoting:
   1. Facilities and ventures in scientific research outside of the higher education sector
   2. Science and research ventures in the higher education sector
   3. Research buildings at higher education institutions, including large-scale equipment.

   Agreements according to Clause 1, No. 2 require the consent of all *Länder*.

(2) Federal and *Länder* governments may co-operate, based on agreements, in monitoring the performance of education in international comparison and in preparing reports and recommendations relating to this.

(3) The bearing of costs shall be specified in the agreement.

between the Federal and *Länder* governments have been achieved, and all of these were in fact preceded by lengthy negotiations.

The Federalism Reform 2006 contributed to aggravating existing imbalances in the development prospects of higher education institutions on the one hand and non-university research institutions on the other hand. In the 1960s and 1970s, Germany's higher education institutions and non-university research institutions were still being developed in equal measures (Article 91b, Paragraph 1 (1) GG).[67] In the course of the Federalism Reform 2006, framework conditions were modified in favour of the non-university research organisations and to the significant expense of the higher education institutions. With the passing of the law on 28 August 2006, Article 91a, Paragraph 1 (1) of the Basic Law was abolished. In addition to that, Article 91b of the Basic Law was revised, which had an even greater impact on research funding.[68] Due to these new regulations, framework conditions for advancing research at higher education institutions have deteriorated considerably. According to the new regulations, the Federal Government can still use its vast financial resources to fund facilities and ventures (basic funds, infrastructure and projects) of non-university research institutions. For the higher education sector however, public funding is limited to ventures (projects) alone. This however requires the consent of each of the federal states, which is extraordinarily hard to achieve. In political practice, this may lead to flawed quid pro quo deals as in the case of the University Hospital Lübeck.[69] Since then, a number of voices from the fields of science and politics have been pleading for the necessity to further adjust Germany's federal structure,[70] arguing that the Federal Government should be re-enabled to provide long-term institutional funding for universities. The Expert Commission strongly agrees with this plea.

B 1–3 IMPORTANT REFORMS AND PROGRAMMES OF THE LAST DECADE

The last few years have seen the launch of important reforms and programmes affecting the higher education sector. Not only did this have an immediate impact on the higher education sector's contributions to knowledge and technology transfer, it also meant that Germany's higher education institutions had to cope with extensive change processes that demanded capacities in all levels of staff.

– **Bologna process:** The signing of the Bologna Declaration by the 29 European ministers of higher education marked the beginning of the Bologna process, in which 47 countries currently participate.[71] The Bologna process aims to create a European Higher Education Area that is characterised by unlimited mobility for students, graduates and lecturers. The European Higher Education Area shall be achieved on the grounds of a mutual recognition of academic achievements and degrees as well as transparency and comparability of degrees using a three-cycle degree system (Bachelor's – Master's – doctorate degree). In the history of the Federal Republic of Germany, the Bologna process is arguably the most comprehensive reform of the academic system. In the winter semester of 2009/2010, 79 percent of available study programmes had been adapted to the Bachelor's and Master's scheme. The transformation of study programmes is not yet completed in the state-regulated curricula (teacher training, law, medical), and neither is it completed in the field of fine arts and specific theological fields of study.[72]

– **G8:** In nearly all of the German federal states the mandatory period for upper secondary school has been reduced from nine to eight years (commonly referred to as G8). As a result, a double intake of drop-outs will be entering higher education in the very year the first of the G8 students have completed upper secondary school. Thus, German higher education institutions are subjected to an increase in students in the respective year and consecutive years. In the case of Bavaria, twice the amount of pupils completed their upper secondary school-leaving certificate in 2011; the same is due to happen in 2012 in Baden-Württemberg, and in North Rhine-Westphalia in 2013.[73] This reduction in the upper secondary school term, combined with a slightly earlier school enrollment and the suspension of mandatory military services, has led to the fact that today's first-year students are, on average, noticeably younger than first-year students ten years ago.

– **Abolition of the "university teachers' privilege":** For a long time, tertiary education lecturers at public universities and universities of applied sciences were entitled to freely utilise their inventions – unlike researchers in the private sector and the non-university research sector (cf. university teachers' privilege, § 42 of the Act on Employees Invention (ArbnErfG), old version). Since 7 February 2002, the university teachers' privilege has been removed from the Act on Employees Invention, which means that inventors employed in the public higher education sector have to report their job-related inventions to the respective higher education institution, which is then entitled to exploit the invention. While the higher education institution has to bear any costs involved, the inventor gets a share of the gross revenue. The aim of the abolition of the university teachers' privilege was to promote knowledge and technology transfer at universities and universities of applied sciences and strengthen innovation.[74] To achieve a more active role for higher education institutions in the field of patent application, a suitable infrastructural environment is needed.[75] In the framework of the SIGNO programme for the higher education sector, patent exploitation agencies have been established with the support of the Federal Government. The main objective of these agencies is to assess inventions in terms of their market potential and patentability and, if necessary, to provide advice and funding for the process of property right application.[76]

– **Excellence Initiative by the German federal and state governments to promote top-level research at German universities:** Launched in 2005 by the Federal and *Länder* governments, the Excellence Initiative aims to promote science and research at German higher education institutions. The initiative shall "initialise a competitive spiral that aims to promote top-level performance and to improve the overall quality of Germany as a higher education and science location".[77] Funding is allocated based on three

BOX 02

The three funding lines of the Excellence Initiative

Graduate Schools:[78] Research schools serve the purpose of promoting young academics and providing optimal conditions for doctorate research within a broad, interdisciplinary field of study. At the same time they are expected to contribute to the respective university's development of core scientific areas. During the first programme phase, the promotion of 39 research schools has been approved in the context of the Excellence Initiative.

Clusters of Excellence:[79] The aim of Clusters of Excellence is to consolidate existing research potential at German university locations. The focus is on networking and co-operations between different university facilities, and also between universities and non-university research institutions and the private sector respectively. This should result in the sharpening of university profiles and create excellent funding and career structures for young academics. In this funding line, 37 applications have been approved within the first programme phase.

Institutional strategies to promote top-level research:[80] Future concepts aim to strengthen universities institutionally and establish them in the top group in international competition. Each of the institutional strategies of those nine universities that have been funded in the first programme phase ("Elite Universities") entails a long-term strategy for sustainably developing and enhancing top-class research and for promoting young scientists. To be eligible for this funding line, a university has to have at least one research school and one Cluster of Excellence.

different funding lines: Graduate Schools, Clusters of Excellence, and institutional strategies to promote top-level research (cf. Box 2). The Excellence Initiative is divided into two programme phases that are implemented by the German Research Foundation (*Deutsche Forschungsgemeinschaft,* DFG) and the German Council of Science and Humanities *(Wissenschaftsrat)*. A total of 39 Graduate Schools, 37 Clusters of Excellence and nine institutional strategies ("Elite Universities") have been funded since 2006. 37 higher education institutions are receiving approximately EUR 1.9 billion for their projects.

In 2009, the Federal and *Länder* governments signed an agreement on the launch of the second programme phase of the Excellence Initiative, which provides for a five-year extension and a funding volume of more than EUR 2.5 billion. Funding decisions are due to be announced in June 2012.[81]

– **EU state aid framework:** The "Community framework for state aid for research, development and innovation", which came into effect on 1 January 2007, abolished the aid-related privileged treatment of not-for-profit universities that had previously been in place.[82] This resulted in the fact that, as of 2009, universities are required to provide separate costing and funding for economic and non-economic activities, i.e. costs and funding have to be reported separately, and the full costs for projects of an economic nature (e.g. R&D commissions to the business sector) have to be invoiced.

– **Higher Education Pact 2020:** In July 2007, the Federal and *Länder* governments agreed on the Higher Education Pact 2020.[83] This agreement aims to ensure the availability of study programmes corresponding with demand. In addition to that, it aims to stimulate competition for research funding via the introduction of programme allowances in the form of one-off payments. Prior to the launch of the Higher Education Pact, higher education institutions themselves had to bear the overhead costs for project implementation.

About 91,000 new places in higher education were scheduled to be created in the first programme phase of the Higher Education Pact, implemented between 2007 and 2010. To these ends, the Federal Government provided EUR 566 million, while the *Länder* committed themselves to secure the general funding. In the years leading up to 2010, an additional 182,000 new students enrolled in study programmes compared with 2005.[84] In June 2009, the Federal and *Länder* governments decided to extend the Higher Education Pact until 2015. A key objective of the second programme phase is to create 275,000 additional study places, to be funded by the Federal and *Länder* governments at an average of EUR 26,000 per place. In March 2011, it was decided to provide additional resources so as to meet the short-term increase in demand for study places caused by the suspension

of mandatory military service and civilian service. In addition to that, the Federal Government doubled their financing for students who had enrolled between 2007 and 2010. In the second phase of the programme, the Federal Government allocated a total of EUR 4.7 billion to advancing study opportunities in Germany.

The second component of the Higher Education Pact 2020 is the granting of programme allowances, i.e. one-off payments. Prior to the introduction of the Higher Education Pact it had been the responsibility of the higher education institutions themselves to bear the overhead costs of a project. Since the launch of the Pact, applicants of a research venture funded by the German Research Foundation (DFG) receive a programme allowance to cover indirect additional expenditures and variable expenditures relating to the funded project. This one-off payment serves as a lump sum compensation for infrastructure used in the context of the funded project (such as expenses for premises, maintenance costs, software costs or energy costs) and for individuals who are not on the project staff's payroll. The programme allowance amounts to 20 percent of direct project expenditures that are chargeable. Until December 2015, the programme allowance will be financed solely by the Federal Government. The future design of financing shall be decided on at a later stage, on the basis of a progress report to be submitted by the German Research Foundation by October 2013. The overall objective is to consolidate the funding scheme in the long term and have the federal states participate in the financing of the programme allowance.

– **Teaching Quality Pact:** In June 2010, the Federal and the *Länder* governments launched their "Programme for better study conditions and better quality in teaching".[85] The Higher Education Pact 2020 has thus been provided with a third component, in the context of which the Federal Government will grant approximately EUR 2 billion in total. The Teaching Quality Pact does not aim to enhance capacities of higher education institutions; the aim is to improve student assistance and the quality of teaching within the entire academic landscape.[86] One of the main objectives here is to improve staffing levels for teaching, student assistance and supervision and to continuously qualify existing academic personnel in higher education institutions. To a certain extent, this initiative can be regarded as a response to earlier criticism according to which the Higher Education Pact solely addresses quantitative measures caused by growing numbers of tertiary students, but does adequately account for the issue of teaching quality.

Within the course of only ten years, Germany's higher education institutions had to face the challenges associated with these reforms. Generally speaking, the extent of resources that have been made available for these purposes is insufficient. In the case of the Bologna reform, the transition process itself consumed working time of lecturers and academic staff that could otherwise have been dedicated to research and other specific tasks. Even more, the transformation of study programmes into Bachelor's and Master's programmes resulted in increased efforts in student assistance. Moreover, the Bologna process has also been characterised by a failure to systematically adapt existing academic structures to the requirements of the now relatively young first-year students, e.g. by means of introducing an orientation phase.[87]

FINANCIAL RESOURCES AND STAFFING IN THE GERMAN HIGHER EDUCATION SECTOR B 1–4

More academic and artistic staff employed at higher education institutions

In 2010, German higher education institutions provided employment for 324,400 individuals from the group of academic and artistic staff. This group comprised 210,600 full-time employees and 113,800 part-time employees.[88] Compared with figures from 2000, the number of academic and artistic staff had increased by 105,100 persons; albeit 84 percent of this increase was attributable to part-time positions. In only 36.4 percent of cases, financing of these additional jobs was covered by basic funds – the majority of jobs were financed via public and private third-party funding as well as tuition fees. It is for these reasons that the increase in staffing levels within this group of employees was considerably higher than that of the group of professors.

BOX 03

Empirical surveys commissioned by the Commission of Experts for Research and Innovation

Qualitative survey "Heads of Universities":[89] In 2011, the Social Science Research Center Berlin (WZB) was commissioned by the Expert Commission to conduct eight interviews with research vice presidents and vice chancellors of research. Four of these interviews were conducted at higher education institutions that had succeeded in the third funding line of the Excellence Initiative (i.e. institutional strategies), and four interviews were conducted at universities that did not have an awarded institutional strategy. The aim of the survey was to find out if the current structural and organisational framework conditions facilitate or hamper the capacity of heads of universities to influence the research-related services portfolio via structures, processes, incentive systems and priority setting as part of their research strategy.

Quantitative survey "Heads of Universities":[90] In 2011, the Donors' Association for the Promotion of Sciences and Humanities in Germany *(Stifterverband für die Deutsche Wissenschaft)* conducted a full survey in the German higher education sector *("Hochschulbarometer")*. With the exception of public administration universities of applied sciences, the presidents and rectors of all of Germany's public higher education institutions were surveyed. The gross return rate for this survey was 56 percent (n=199).

Quantitative survey "Academic Research Staff":[91] In 2011, the Centre for European Economic Research (ZEW) was commissioned by the Expert Commission to conduct a quantitative survey among university professors in order to document in detail the current research situation for academic research staff. A total of 9,400 individuals were asked to participate; the return rate was 27 percent.

Quantitative survey "Non-university Research Institutions":[92] Already in 2009, the ZEW was commissioned by the Expert Commission to interview personnel at 430 non-university research organisations by means of a written survey. The aim was to collect data for analysing the tasks and structures as well as the performance and the governance of non-university research institutions.

The results of this survey have been integrated into this chapter. A more detailed analysis of the respective data is presented in the Expert Commission's studies on the German innovation system.[93]

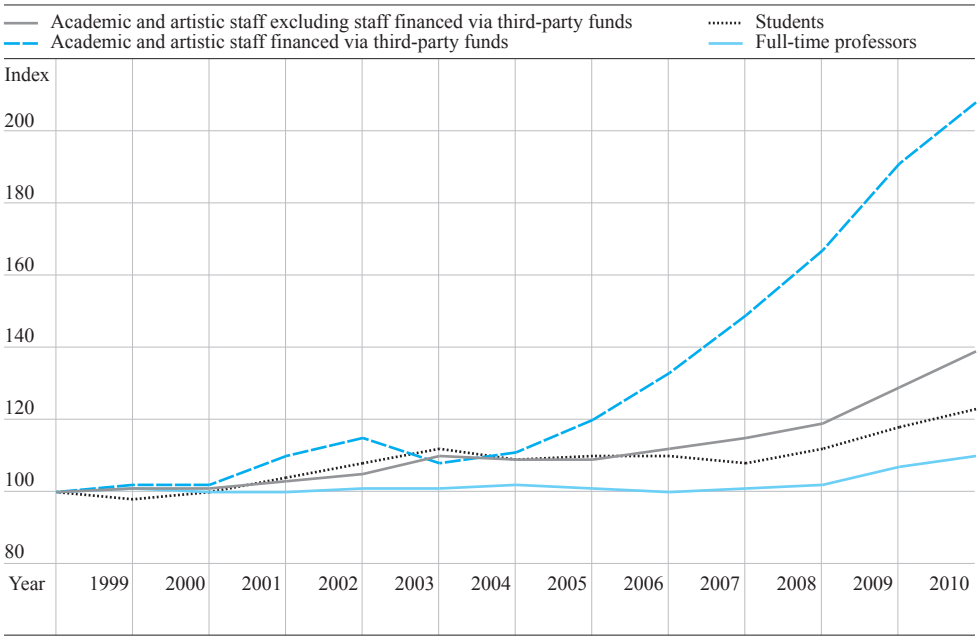
In the second half of the last decade, the increase in academic and artistic staff was significantly higher than that of the increase in student numbers. From a purely numeric point of view, the student/teacher ratio recorded by the Federal Statistical Office – i.e. the relation between the number of students and the number of academic and artistic staff – improved from 8.2 in 2000 to 6.8 in 2010. Yet, these results are misleading as improvements in staffing levels were primarily achieved via an increase in employees who were financed by third-party funding. While these employees take on research tasks, they usually refrain from teaching assignments. When deducting the personnel financed by third-party funding, it turns out that the student/teacher ratio only improved from 9.8 to 8.8 between 2000 and 2010. What is more, the student/full-time professor ratio deteriorated from 47.6 to 53.5 since the number of professors increased at a lower rate than the number of students (cf. Figure 1).

Basic funds for 2009 back to 2002 levels

In 2009, the revenue of German higher education institutions amounted to a total of EUR 38.9 billion. Of this amount, EUR 12 billion are attributable to administrative revenue from the higher education sector's medical facilities.[94] When deducting this administrative revenue derived from medical facilities, financing of higher education institutions for 2009 was composed of 73 percent basic funds, 20 percent third-party funds, and 7 percent administrative revenue.

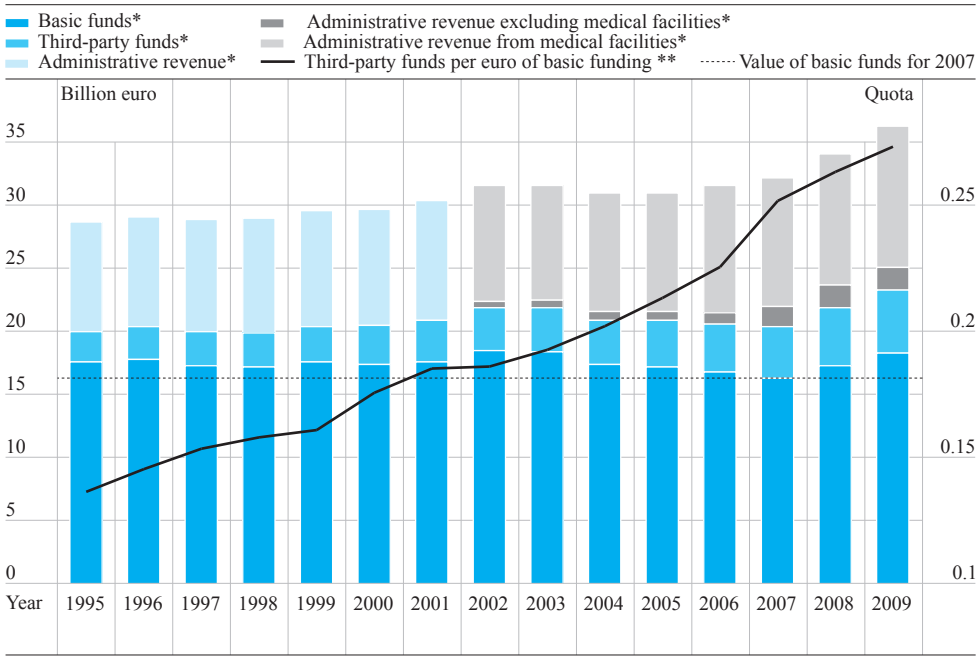
Over the last decade, the amount of basic funds was subjected to considerable fluctuations (cf. Figure 2). In 2002 for instance, extra funds from the proceeds of the sale of UMTS mobile phone licences had been made available. In the consecutive years, basic funds decreased, and in 2007 they reached their lowest point of the entire recorded period. It was only in 2009 that the level of 2002 and 2003 was reached again. The increase that has been recorded

FIG 01 **Development in the number of academic and artistic staff and students at German higher education institutions**

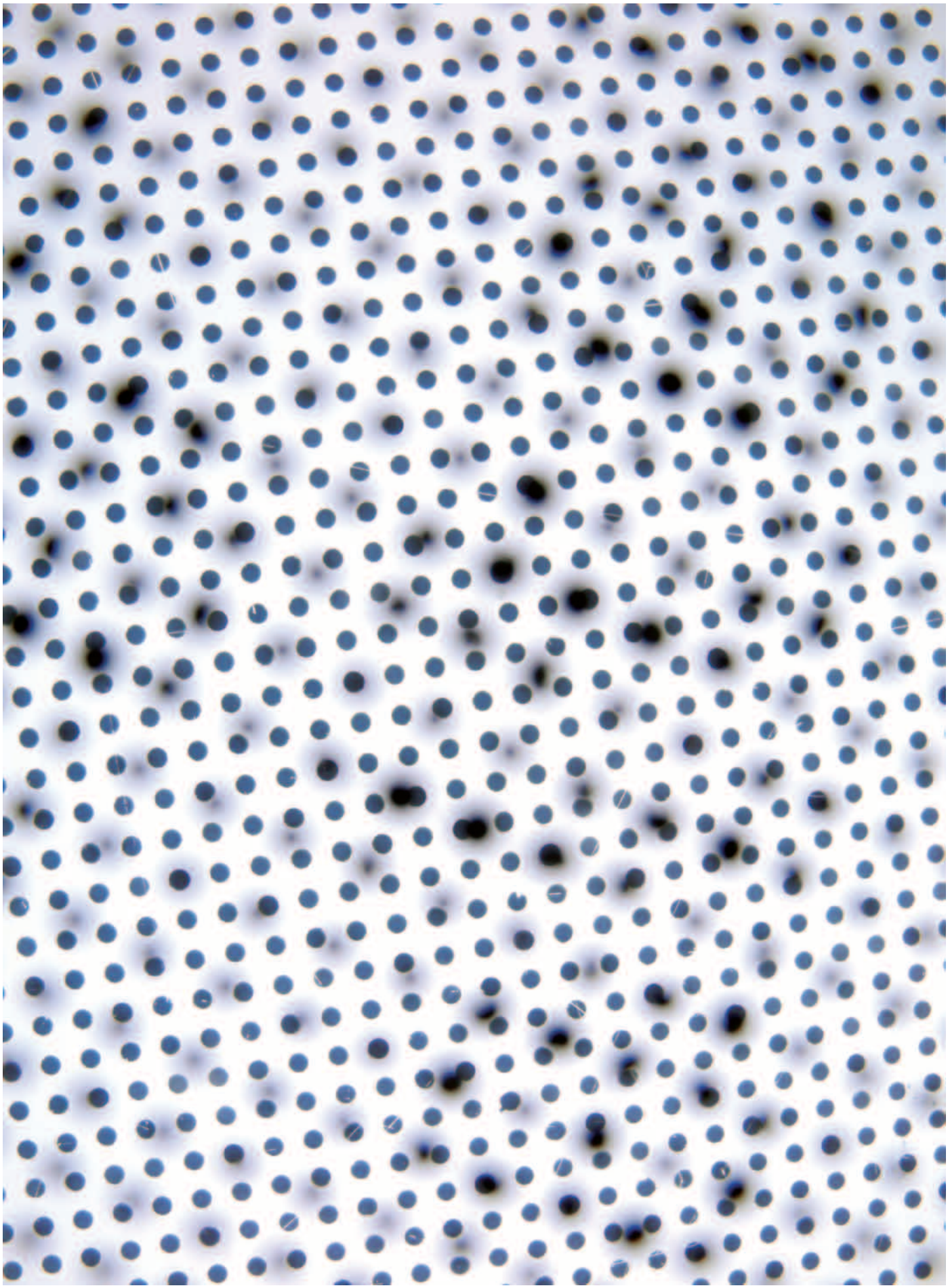


Index: 1998 = 100.
Source: Federal Statistical Office *(Statistisches Bundesamt, Fachserie 11, Reihe 4.4 und 4.1)*. Own calculations.

FIG 02 **Financing of higher education institutions in Germany**



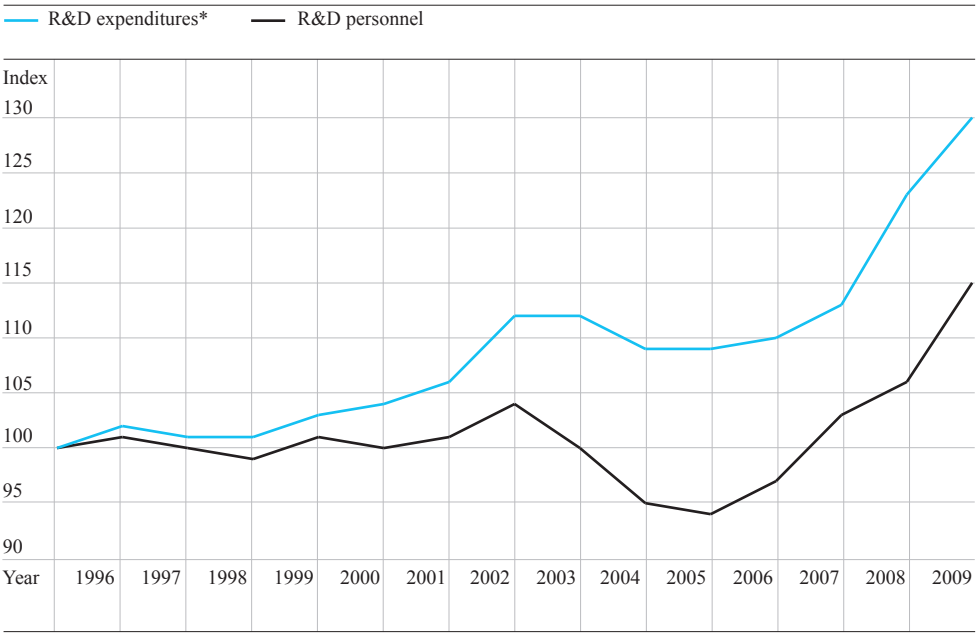
* in billion euro at 2005 prices (left scale); ** quota (right scale).
Up until 2002, administrative revenue could not be broken down into revenue from medical facilities and revenue from other academic facilities. Revenue figures are deflated using the consumer price index. Revenue includes income from tuition fees.
Source: Federal Statistical Office *(Statistisches Bundesamt, Fachserie 11, Reihe 4.5.)* Calculations by ZEW and own calculations.



3/10 Moiré effect: dot pattern

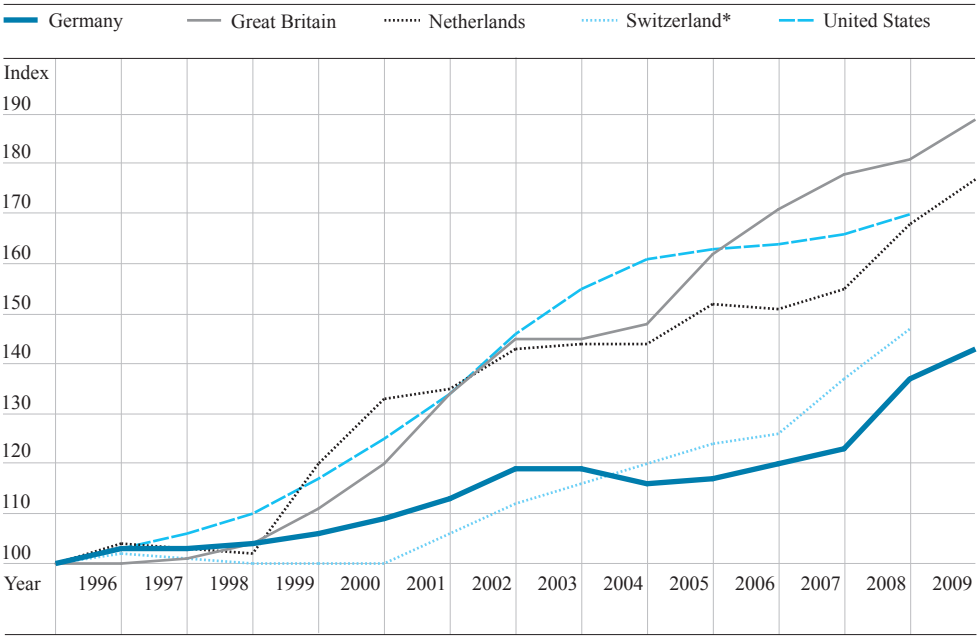
4/10 Moiré effect: dot and line pattern

Development of R&D expenditures and R&D personnel (full-time equivalents) at higher education institutions in Germany FIG 03



* at 2005 prices. Index: 1995 = 100.
Source: Federal Statistical Office *(Statistisches Bundesamt, Fachserie 11, Reihe 4.3.2.)* Calculations by ZEW.

Development of R&D expenditures (at 2000 prices) of higher education institutions 1995–2009 in international comparison FIG 04



* Values are interpolated for odd years. R&D expenditures are deflated by applying the implicit price index of GDP (at 2000 prices). Index: 1995 = 100.
Source: OECD – MSTI 1/2011.

since 2007 is largely attributable to the launch of the Higher Education Pact in 2007.[95] At the same time, the number of students enrolled in the winter semester of 2009/2010 was 14 percent higher than in the winter semester of 2002/2003.

Overall, third-party funding has become more and more relevant when compared with basic funding. In 1995, German higher education institutions received EUR 0.14 of third-party funds per euro of basic funds. In 2009, third-party funds increased to EUR 0.27 per euro of basic funds. It is worth considering here that third-party funds can be used for financing research but not for financing teaching assignments; teaching assignments still have to be financed through the higher education institutions' basic funds.

University-based research increasingly financed via third-party funds

In 2009, German universities and universities of applied sciences invested EUR 11.8 billion in R&D and had a staffing level of 115,400 in full-time equivalents. Following a decrease between 2003 and 2005 in R&D expenditures and R&D personnel at higher education institutions, an upward trend could only be observed since 2006. This progress accelerated in 2008 and 2009: thus, in 2008 and 2009 the real growth rate for R&D expenditures of the higher education sector amounted to 9 and 6 percent respectively. Based on full-time equivalents, the higher education sector's R&D staffing level increased by 2.7 percent in 2008, and it even increased by 8.2 percent in 2009.

The proportion of third-party funded personnel of the total R&D personnel increased from 50.2 percent in 2005 to 59.2 percent in 2009. Over the same period, the proportion of third-party funded R&D expenditures increased from 41.6 percent to 46.2 percent. This increase in external funding was derived from several sources. Within this specified period, third-party funding from the Federal Government and the German Research Foundation (DFG) increased by 60 and 71 percent respectively.[96] Two factors in particular are worth mentioning here: first, the Federal Government's increase in project funding within the framework of its High-Tech Strategy, and second the Central Innovation Programme *Mittelstand* (ZIM) that was launched as part of the Federal Government's 2009 stimulus package *(Konjunkturpaket II)*. The ZIM programme aimed to promote co-operation projects between R&D facilities and the private sector. Another aspect to be taken into account was the launch of the Excellence Initiative in 2007. Between 2006 and 2009, the amount of third-party funds acquired via EU programmes increased by 29 percent.[97]

The increase in third-party funding of research has the advantage of allowing for an expansion of university-based research activities. What is more, the allocation of research funds in the context of application or competition procedures can focus to a higher degree on current quality criteria[98] – which is not necessarily the case when basic funds are allocated. Yet, the increase in third-party funding also bears risks as it limits the freedom of the researcher to a considerable extent; both in terms of time and in terms of research contents. The preparation of research proposals is very time-consuming, and proposals are reviewed by other academic staff, which means that even more time is taken up. Moreover, third-party funding is not always open to all research topics, which means that researchers have an incentive to adapt their research topics according to the funding opportunities available. As a result, research programmes with relatively low external funding prospects may not be pursued. This means that unconventional ideas may lose out, and the higher education sector is being deprived of range and diversity. These are risks that should be taken into account by political decision-makers involved. Research and teaching in the higher education sector are in need of sustainable financing structures; in the long run, too high a proportion of third-party funding will jeopardise the contributions of higher education institutions to basic research.

Progress in financing of university-based research only since 2008

Research funding at German tertiary institutions can be assessed by comparing it with the current status and development of countries that are in the forefront of higher education performance (e.g. Great Britain, the Netherlands, Switzerland, and the United States). In 2009, Germany spent 0.49 percent of GDP on university-based R&D. This value is much lower than that of the Netherlands (0.73 percent)

and that of Switzerland (0.72 percent in 2008), at approximately the same level as that of Great Britain (0.52 percent) and higher than that of the United States (0.36 percent in 2008).

Between 1995 and 2009, Germany's average annual growth rate for R&D expenditures was 2.6 percent. This is lower than that of Switzerland (3 percent), the Netherlands (4.1 percent), the United States (4.2 percent) and Great Britain (4.7 percent). While higher education institutions in the compared countries further increased their R&D expenditures in the middle of the last decade, real R&D expenditures in the German higher education sector stagnated (2003, 2005) and decreased (2004). This resulted in a relative deterioration of Germany's position. It is only since 2008 that the real R&D expenditures of German higher education institutions have increased markedly.

In terms of the public financing of university-based research, Continental Europe and the Anglo-Saxon countries display different levels of participation. In Germany, the Netherlands and Switzerland the public sector provided for approximately 80 percent of research expenditures in 2008. In Great Britain and the United States, only two thirds of research activities were financed by the public sector.

Between 2001 and 2008, the proportion of publicly funded research in the higher education sector in Great Britain, Switzerland and the United States remained largely unchanged, while in Germany and the Netherlands the proportion in fact decreased. In numerous countries – Great Britain and the United States in particular – a considerable part of funding is provided by foundations, which is notably the case with the countries' leading private universities. In Germany, this funding model is also gaining more relevance, although it applies to non-university research institutions rather than higher education institutions. Compared with higher education institutions in other countries, many of the institutions in Germany are lagging behind considerably when it comes to professionalising this funding approach.[99] In Germany, there are indeed individuals with substantial private assets; assets which could be used to support science and research. Yet, the use of this source of financing is hampered by unfavourable legal framework conditions and an insufficient degree of professional fundraising structures in the German higher education sector.

SCOPE OF RESEARCH SERVICES AT UNIVERSITIES AND NON-UNIVERSITY RESEARCH INSTITUTIONS

B 1–5

To record the scope of research activities in the higher education sector, data relating to university[100] publication and patent activities have been compared with corresponding data from the four main non-university research institutions. These non-university research institutions are: the Helmholtz Association of German Research Centres (HGF), the Max Planck Society (MPG), the Gottfried Wilhelm Leibniz Science Association (WGL), and the Fraunhofer-Gesellschaft (FhG).[101] For certain subject domains, publication performance can only be quantified with a high degree of difficulty. Hence, the current analysis shall only integrate data from natural sciences, engineering sciences, medical sciences and agricultural sciences. The findings are as follows:

– The Max Planck (MPG) institutes are well positioned in the field of basic research. This is reflected in extensive publication activities and a relatively low level of patent activities.

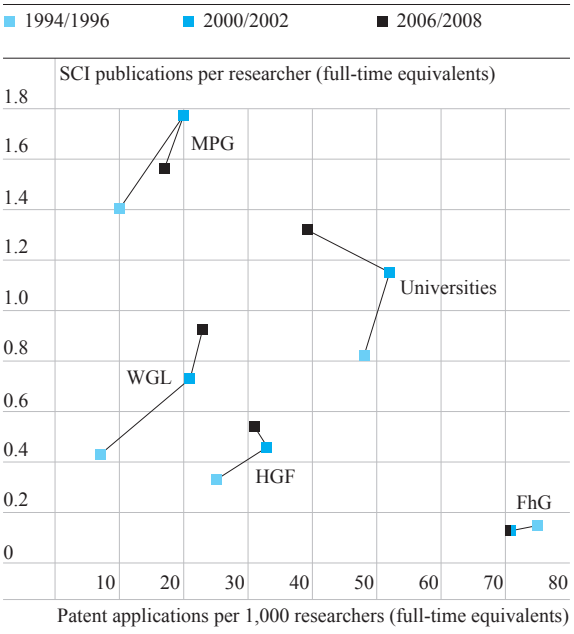
– The universities managed to significantly increase their publication activities over the last few years. In terms of publication intensity they have currently reached a level that almost corresponds with that of the MPG. Taking into account the limited resources available at universities, this is an impressive result.

– The Fraunhofer-Gesellschaft is primarily dedicated to applied research and technology transfer. This is reflected in a relatively high level of patent intensity and a relatively low level of publication intensity.

– Facilities of the Helmholtz Association (HGF) have the task of bridging the gap between basic research and applied research. Moreover, the original HGF mission is directed at research on systems based on large-scale facilities and comprehensive scientific infrastructure. In the surveyed subject domains, HGF institutes display a slightly lower publication and patent intensity than the surveyed universities.

– The Leibniz Association (WGL) is an umbrella organisation that comprises legally independent facilities. In addition to basic research and applied research, WGL facilities are active in the

FIG 05 **Patent and publications intensity of German higher education institutions and non-university research institutions in natural sciences, engineering, medical sciences and agriculture**



Figures on publications and researchers are each relating to natural sciences, engineering, medical sciences and agriculture; figures on patent applications at universities, including academic inventors of private and corporate patents, are based on estimates.
Sources: EPA: Patstat; Thomson Reuters: SCIE; Federal Statistical Office *(Statistisches Bundesamt: Fachserie 11, Reihe 4.3.2, Fachserie 14, Reihe 6)*. Calculations and estimates by ISI and ZEW.

field of information and documentation, knowledge transfer, training and continuing education, as well as advisory services to the public sector. In the surveyed subject domains, both the universities' publication intensity and the universities' patent intensity are higher than that of WGL facilities. At the same time, both the surveyed universities and the WGL facilities displayed a significant increase in publication intensity over the last 15 years.

The Expert Commission is aware of several weaknesses associated with the measures employed to assess performance.[102] Moreover, the average view provided in this analysis may serve to identify tendencies but does not allow for an assessment of individual research facilities. Thus there are indeed Fraunhofer institutes that are active in the field of basic research.[103] Similarly, the Max Planck Society has over the last few years undertaken important initiatives for the transfer of results from basic research.[104] In spite of the weaknesses of the metrics employed, Figure 5 still illustrates quite clearly the distinct profiles of non-university research institutions and universities. Moreover, it also provides evidence for the significant improvement of the universities' position.

Regardless of these positive tendencies, it is still obvious that German universities are not yet among the world's leading research universities. In terms of the number and quality of publications, German universities are still lagging behind when compared on an international scale. Thus, according to OECD, the ranking of the top 50 universities with the largest scholarly impact does not include any of the German facilities.[105] German universities have been listed in only six out of 17 academic subject domains in the respective top 50 ranking. Similarly, the Times Ranking and the Shanghai Ranking have included only one German university in their ranking of the 50 leading universities.[106] Although there are good reasons for questioning the value of such rankings, they still display a high degree of international visibility, and talented young academics and eminent scientists alike use these rankings as orientation marks. In the long term, German higher education institutions cannot afford to linger in mediocrity. In view of these considerations, the positive trend that was triggered by the launch of the Excellence Initiative should be actively continued.

AUTONOMY, GOVERNANCE AND PROFILE-BUILDING

B 1–6

Increased autonomy of higher education institutions – strengthened position of heads of universities

Since the 1990s, the co-ordination of higher education institutions has been increasingly shifted from the respective federal ministries to the head offices of the higher education institutions. By and large, the hierarchical governance and the co-ordination structures of ministerial bureaucracy have been replaced by contractual agreements. Yet, depending on the respective federal state, there continue to be differences regarding the extent to which objectives are developed in collaboration with the Federal Government or indeed pre-established by state regulations.

A survey among heads of universities and universities of applied sciences, conducted by the

Stifterverband für die Deutsche Wissenschaft[107], shows that more than half of the respondents (55 percent) would regard the degree of autonomy of German higher education institutions as "high" or "rather high". Only 5 percent of respondents felt that the degree of autonomy was "rather low". About three quarters of respondents felt that the higher education institutions' autonomy was higher today than it had been five years ago. The degree of autonomy as perceived by the interviewees varies depending on the federal state, which corresponds with earlier studies on the same topic.[108]

The implementation of new models of governance has led to major changes not only in the relationship between higher education institutions and the responsible federal ministries; it has also affected decision-making processes within the higher education sector. With respect to internal governance of higher education institutions, two distinct changes have become evident. First, the legal status of presidents and rectors as opposed to academic senates and faculties has been strengthened over the last decade; the power of governing bodies has been enhanced while academic self-government has lost some of its influence.

Second, heads of higher education institutions in nearly all of the *Länder* have been provided with university councils that take the role of supervisory and advisory bodies. Yet, in terms of decision-making structures, there are vast differences between the individual federal states (cf. Box 4): the extent to which major staffing and policy decisions are made by heads of universities, academic self-governments or ministries varies considerably as the federal states have each established different forms of academic governance.

In the higher education sector, structure and development plans are employed to establish an organisational framework and to map out the future shape of research. At those federal states that follow a hierarchical model, a hierarchical/council model or a hierarchical/council/collegiate model of governance, the heads of universities have substantial leeway in designing these structure and development plans. Interviews with heads of universities suggest that these seek collaboration with and the consent of academic staff in order to support their decisions.[110] In this respect, respondents regarded the respective dean of the university as their most important partner. In those federal states that have embarked on the hierarchical/collegiate model or the collegiate model, the academic senate has, with few exceptions, significant participation rights. At the same time, the interviews with heads of more hierarchical universities have shown that they, too, integrate the faculties into their decision-making processes so as to make use of expert knowledge and achieve consent among staff.[111] In addition to this, some of the higher education institutions are also establishing strategic advisory boards that comprise selected and often eminent academics. These committees are designed to consolidate specialist knowledge while at the same time legitimising management decisions within the larger institution.[112]

These new models of governance have led to major changes in the relationship between higher education institutions and the respective federal ministries, and also in the field of internal decision-making. The functioning and impact of the different models will

BOX 04

Types of governance in the higher education sector[109]

- **Hierarchical model** (Hessen and Saarland): The university management possesses at least veto rights regarding essential personnel and policy decisions; in most cases the final decision is theirs.
- **Hierarchical/council model** (Bavaria and North Rhine-Westphalia): The university management is provided with a university council as the decision-making entity.
- **Hierarchical/council/collegiate model** (Baden-Württemberg, Hamburg and Thuringia): Overall, academic self-government has the same or comparable influence as the university management and the university council.
- **Hierarchical/collegiate model** (Brandenburg, Lower Saxony and Schleswig-Holstein): The university council has only marginal powers compared with that of the university management and academic self-government. The academic senate has a considerable say in decision-making.
- **Collegiate model** (Berlin, Bremen, Mecklenburg-Western Pomerania, Rhineland-Palatinate, and Saxony-Anhalt): Governance is largely dominated by university committee structures. The academic senate has a considerable say in decision-making.

now have to be assessed on the basis of a comparative evaluation. Ideally, such a survey should be co-ordinated on a national level; it should be based on internationally recognised criteria, and, finally, it should allow for both international and cross-regional comparison.

Enhancing profile-building and competition via the Excellence Initiative[113]

The Excellence Initiative has triggered and enhanced profile-building processes in the higher education sector. Those heads of universities who had been successful in the context of the Excellence Initiative stressed that the initiative had caused a debate on the strengths and weaknesses of the respective institution. They further stated that the initiative had led to attempts to strengthen individual faculties in the course of their application.[114] Yet, also structural strains could be observed since universities had to enter into long-term financial commitments that took up resources beyond the funding period, thereby limiting their future scope for action. For instance, this is the case if new academic staff of a Cluster of Excellence or members of a new administrative unit have been hired on the basis of open-ended contracts.[115] In the context of the Excellence Initiative, the funded Graduate Schools have also sharpened their profiles. Thus the thematic priorities of these schools have been integrated into existing research areas, or indeed serve as a solid basis for the development of a research focus.

Heads of universities of institutions that did not, or only partially, succeed within the Excellence Initiative often stated that they would motivate the academic staff that had been involved in the application to further pursue the planned ventures. Often it is the case that new funding opportunities are jointly sought, and in some of these cases the application for the Excellence Initiative even provided for a "plan B". Thus the impact of the Excellence Initiative is not limited to those universities that have succeeded in the competition; the consequences of the initiative reach far beyond the scope of participating universities.

The critical debate on excellence and competition, which has been triggered by the Excellence Initiative, has multiple effects on the character of research. In the view of the professors who were interviewed in the course of the survey commissioned by the Expert Commission, the most crucial consequences of the Excellence Initiative are as follows: research is more and more oriented towards its potential for third-party funding; interdisciplinary research topics are gaining more relevance; and, finally, there is a recent tendency for large-scale research projects.

The Excellence Initiative has forced vertical and horizontal differentiation of the German academic landscape.[116] The awarding of "seals of excellence" has led to an increased visibility of selected universities, which has a positive effect e.g. on attracting prominent scholars. But the Excellence Initiative has also initiated thematic specialisation and horizontal differentiation among universities by promoting Graduate Schools and Clusters of Excellence. In the view of the Expert Commission, both developments are crucial steps on the way to a higher education system that is internationally competitive.

Profile-building through institutional metastructures

According to the respondents, profile-building and profile-enhancing processes have been initiated in the course of the last few years. This has been done with a view to increasing the prospects for acquiring funds within the framework of the Excellence Initiative and other promotional schemes. According to the interviewed heads of universities, another reason for profile-building measures has been the need to adapt to upcoming budgetary constraints.[117] The ultimate aim of profile-building is to identify the unique characteristics and specialisations of research topics and approaches, thereby positioning oneself within the research landscape.[118] The surveys commissioned by the Expert Commission (cf. Box 3) provide an interesting insight into the ways in which profile building works. In the majority of cases, these processes are initiated by the heads of universities.[119] At the core of any profile-building process lies an analysis of the strengths and weaknesses of the respective institution. Yet, bottom-up processes have also been put in place e.g. by inviting academic staff to contribute their own ideas. The surveys also revealed that, besides health sciences, it is primarily the MINT subjects group that is gaining more and more relevance in establishing

an academic profile.[120] The reason for this may be a priority treatment of this subjects group on the part of education policy-makers, but also incentive structures in third-party funding.

Profile building usually manifests itself in the identification of research focuses. This is followed by the process of defining thematic specifications that are thought to represent the individual research and competence portfolio. This means that research focuses can be regarded as institutional metastructures which span across faculties and departments and are designed in an interdisciplinary way. The university's underlying organisational structure, i.e. its division into academic disciplines, remains unaffected by this; a clear division into academic disciplines is still regarded as a necessary prerequisite for successful interdisciplinary work.[122] Irrespective of an institution's thematic focus, basic research is an extraordinarily important factor in profile-building processes.

Often enough, the defined research focuses are allocated with additional financial resources that serve as a type of "initial funding", both for internal use (development of new research topics within the research focus) and external use (development of research focuses within the higher education institution). Once this consolidation period has been completed, in many cases the aim is to finance the research focus via third-party sources alone. Some of the higher education institutions have already evaluated their research focuses on an internal basis; others have not been active in this regard yet. Preliminary findings suggest that the development of research focuses as a means of profile building and attracting eminent researchers is showing its effect even at this stage. In many cases research focuses have only been defined in the course of the last few years. Hence, it remains to be seen if the newly created structures can stand the test of time and sustainably shape the profile of the higher education institutions involved.

BOX 05

Institutional metastructures: an example

The Centre for Renewable Energy (ZEE) at the Albert Ludwigs University of Freiburg:[121] The ZEE is a key research institute of the University of Freiburg that brings together all those academic entities that conduct research and teaching on issues relating to renewable energy; with a special focus on solar technologies, biomass production, biomass utilisation, geothermal energy, energy systems, and energy efficiency. The aim is to illuminate the technological, economic and social implications of renewable energy. To date, seven out of eleven faculties are participating in ZEE activities. On the basis of co-operation agreements, the ZEE closely collaborates with non-university research institutions. ZEE partners are the *Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg* (FVA), the Fraunhofer Institute for Solar Energy Systems (ISE), the Offenburg University of Applied Sciences, and the *Öko-Institut e.V.*

The winter semester of 2008/2009 saw the launch of the new international Master's programme "Renewable Energy Management", in collaboration with the Faculty of Forest and Environmental Sciences of the University of Freiburg. In addition to that, "Photovoltaics", a Master's programme for working professionals, was introduced in co-operation with the Faculty of Engineering of the University of Freiburg and the Fraunhofer Institute for Solar Energy Systems.

APPOINTMENT POLICIES, REMUNERATION AND RESEARCH CAREERS

B 1–7

Enhancing flexibility in appointment policies

In 2009, a total of 22,109 university professors were employed in the German higher education sector, while the number of published vacancies amounted to 1,856 positions. The average annual renewal rate for 2009 was thus 8.4 percent.[123] The appointment of professors can have a major impact on a university's profile building in research and teaching. Meanwhile, in eleven of the German federal states, the right to appoint professors has been transferred from the respective *Länder* authorities to the heads of the higher education institutions; this was achieved by amending the state laws for higher education. Only in Baden-Württemberg, Bavaria, Berlin, Bremen and Rhineland-Palatinate are professors still largely appointed by the respective federal ministry. Heads of higher education institutions who are entitled to appoint professors can sharpen the profile of their institution via strategic appointment policies. Only occasionally do heads of universities make use of this right in order to strategically strengthen certain

departments through their appointment decisions, sometimes at the expense of other departments. Some of Germany's higher education institutions feed a fixed quota of vacant professorship positions into a university-wide pool of vacancies, which are then redistributed via an internal competition as a means of strengthening their profile.[124]

Appointment procedures in the German higher education sector can develop into rather lengthy procedures that are often perceived as non-transparent. One distinct feature of universities that are particularly successful on an international scale is their more centralised, professionalised approach to appointment procedures. Nowadays, the German higher education sector also provides for more active approaches to appointing professors.[125] These are search processes that are employed to identify and address individuals that seem suitable for the position. The Expert Commission is generally in favour of applying such search processes. However, when attempting to shorten these processes, suitable methods should be employed to avoid that an accelerated process results in a further decrease in transparency or jeopardises international academic quality standards.

Remuneration and performance-related benefits

In the past, university professors in Germany had been paid according to the "C remuneration" scheme, a model that provides for different salaries depending on a person's years of service to the state. In 2005, this model was replaced by the "W remuneration" scheme, a system that allows for variable performance-related benefits for W2 and W3 professors, in addition to their fixed basic salary.[126] In North Rhine-Westphalia for example, the monthly basic salary of a professor amounts to EUR 5,279.[127] Among the different federal states, vast differences can be observed: thus a W3 professor in Baden-Württemberg receives a monthly basic salary of EUR 5,529, while a W3 professor in Berlin receives EUR 4,890.[128]

Performance-related benefits according to the W3 scheme can be divided into three categories: recruitment and retention awards, special performance-based benefits, and additional service compensation.

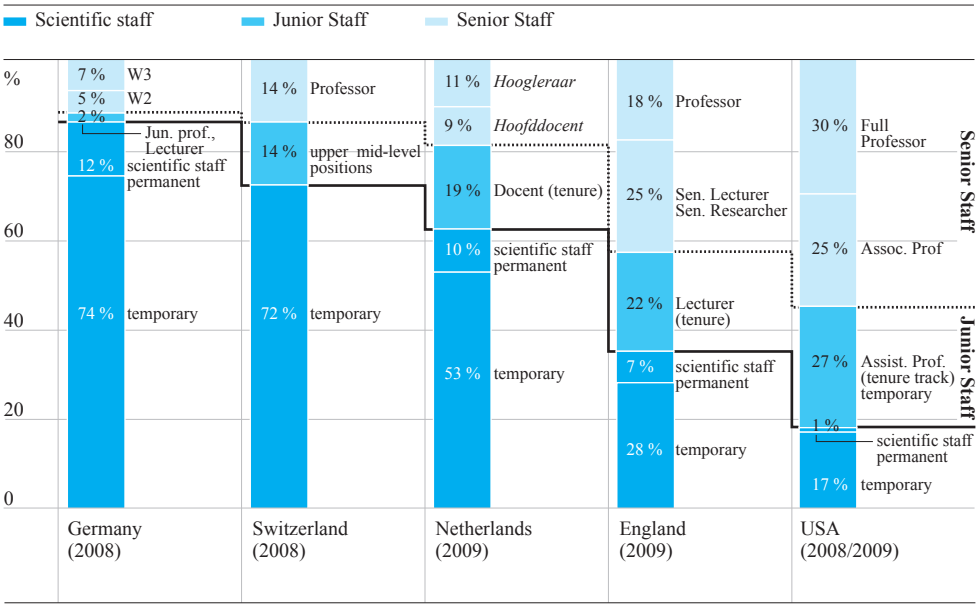
– Recruitment and retention awards can be used by higher education institutions as a means of attracting exceptional scientists and artists, or, respectively, as an incentive for them to remain at the university. Higher education institutions are thus provided with a tool that enables them to force appointments that are regarded as particularly valuable in terms of profile building.

– Special performance-based benefits and additional service compensation provide incentives for professors to excel in the fields of research, teaching, further training, arts, and the recruitment of young academics, and to take on roles in academic self-government.

The criteria according to which performance-related benefits are granted are at the discretion of the federal states and the higher education institutions. In many cases, a phased model has been put in place.

The W remuneration model cannot compete on an international level.[129] The annual basic salary of a W3 professor in North Rhine-Westphalia is EUR 68,627 (based on a 13 month salary, excluding performance-related benefits). In the United States, a university professor receives an average annual salary of USD 110,488 (approx. EUR 84,200). At private higher education institutions, the average salary even amounts to USD 131,589 (approx. EUR 100,300), and professors employed at high-ranking universities such as Harvard or Stanford can earn as much as USD 240,000 (approx. EUR 182,800).[130] This goes to show that universities can only attract internationally renowned academics and artists if they are able to grant them substantial bonuses. The basic salary in combination with performance-related benefits will have to compete with salaries granted at world-class universities – and not with average salaries. In Germany, the Federal Pay Act (BBesG) specifies an upper limit for performance-related benefits. This ceiling is defined by the difference in basic salary between the W3 remuneration group and the B10 remuneration group. In North Rhine-Westphalia, this difference amounts to approximately EUR 6,246 per month.[131] Performance-related benefits may exceed this amount particularly in cases where this is deemed necessary for attracting a professor from outside the German higher education system, or for the purpose of averting the outmigration of a professor from the German higher education sector.[132] Yet, due to the requirement of budget neutrality,[133] higher education institutions may grant high

Full-time academic personnel in universities FIG 06
(figures in percent)



Rounding errors Netherlands
Source: Kreckel (2008; revised); Kreckel (2010): 38 f.

Relevance of different modes of collaboration according to university professors and heads of non-university research institutions TAB 03
(multiple answers were allowed; figures in percent)

	Higher education institutions	Non-university research institutions
Joint research	43	66
Staff from non-university research institutions holding a professorship	17	41
Joint academic events	16	23
Joint student mentoring	15	44
Staff from non-university research institutions holding academic events	15	37
Joint doctoral programmes	14	32
Participation in committees of non-university research institutions	9	–

Proportion of interviewees who allocated highest relevance to the respective modes of collaboration
Sources: *ZEW-Hochschulforscherbefragung 2011; ZEW-AUF-Befragung 2009.*

BOX 06

Junior professorships and tenure track careers

2002 saw the launch of junior professorships in Germany, a title that can be granted provided that a doctoral thesis has been completed. The aim is to provide young academic talents with more flexibility and responsibility at an earlier stage in their career as this would be the case when pursuing the regular path of a post-doctoral academic career. At this stage in time, both models, i.e. junior professorships and W professorships, are still applied in parallel.

Tenure track refers to academic careers that are offered to young scholars following successful evaluation. The candidate is then supplied with a permanent position at the respective higher education institution. As part of the tenure track model, academic achievements of the candidate are evaluated twice. The first evaluation usually takes place after approximately three years into the person's tenure track career, and the second after approximately six years, i.e. at the end of the temporary contract.

performance-related benefits only within the limits of the resources at their disposal: if a professor is granted a particularly high remuneration, this will narrow the scope of action regarding further appointments and the granting of performance-related benefits to other academic staff.

Obviously an international comparison of the remuneration of professors is not without problems. Factors such as differences in the social system – particularly with regard to health insurance and old age pensions – as well as differences in tax levels and income-related purchasing power have to be taken into account. Yet, when refining the method of comparison, it still leads to the result that salaries of professors in Germany are lower than those of analogue countries such as the Netherlands, Switzerland, the United States or Great Britain.[134]

Limited career options for young academics

In the German higher education sector, only a small part of the academic mid-level positions can be attributed to junior staff, i.e. full-time professional teaching staff situated below the peak group of professors. Only 2 percent of personnel in the German higher education sector are junior professors or lecturers, while the proportion of junior staff in the United States' higher education sector amounts to 27 percent. While these positions in the United States are temporary posts, continued career options are made available in the form of tenure track careers (cf. Box 6), provided that the candidate has proven successful in his or her job. In Germany, the tenure track model has only been rarely applied to date.[135]

Over the last few years, the number of temporary mid-level positions in the German higher education sector has been increased – this however was done without increasing the number of W3 and C4 professorships to the same extent. This means that, from the perspective of young academics, the prospects of getting a permanent position in Germany are rather low. In international comparison, German universities have only insufficient means of attracting and keeping young academic talents as tenure track models are not widely offered in Germany. As a prerequisite for establishing a broad-based tenure track system in Germany, a sufficient number of vacancies have to be available; this is currently not the case. Furthermore, academic labour markets would have to develop in order to cater for post-doctoral candidates who have entered tenure procedures, and for those who did not succeed in the tenure procedures. In Germany, such labour markets still only exist in underdeveloped form.

CO-OPERATION AND COMPETITION WITH NON-UNIVERSITY RESEARCH INSTITUTIONS

B 1–8

Co-operation with non-university institutions are becoming more and more important

In the view of the heads of universities surveyed, collaborations between higher education institutions and other stakeholders have become more important over the last few years. Particularly relevant in this regard are collaborations with non-university research institutions.[136] Heads of universities feel that co-operations with Max Planck institutes and Leibniz institutes are especially important. The reason for this is that the universities' research programmes are primarily focussed on basic research, a field that is highly compatible with those of the institutes mentioned above. According to the interviewees,

Institutionalised forms of collaboration between higher education institutions and non-university research institutions

BOX 07

Göttingen Research Council (GRC): By launching the GRC in 2006, the University of Göttingen and seven non-university research institutions – the Göttingen Academy of Sciences and Humanities, five Max Planck institutes and one Leibniz institute – institutionalised their history of collaboration. GRC is a co-ordinating body and a platform for achieving decisions by consensus. On central issues with transorganisational relevance, the different facilities co-operate while maintaining their institutional independence and internal governance structures.

Karlsruhe Institute of Technology (KIT): The KIT is a merger of the University of Karlsruhe and the Karlsruhe Research Centre (FZK), a research body that is a member of the Helmholtz Association. In July 2009, the state parliament of Baden-Württemberg passed the "KIT Merger Act", thereby sealing Germany's first institutional merger of a university and a non-university research institution. On the basis of an elaborate legal framework, the formerly independent entities are now part of joint governance structures. The funding structures of these two former entities had been very different; not least due to the fact that the Karlsruhe Research Centre had been receiving considerable funding from the Federal Government. The KIT will be maintaining its internal division between a university sector a nd a large-scale research sector. These two areas are closely linked via joint fields of expertise, joint centres and thematic focal points.

Jülich-Aachen Research Alliance (JARA): JARA is a joint venture between RWTH Aachen University and the Jülich Research Centre, which is a member of the Helmholtz Association. In JARA, no attempts were made to fully merge the university and the non-university research institution. The "JARA agreement" merely provides a formal framework for establishing joint topic-related sections. Each of these "JARA sections" is jointly managed by a director from the Aachen side and a director from the Jülich side. The four research areas that are currently in place within this framework represent the heart of the co-operation between the two institutions. In addition, the management levels of the RWTH Aachen and the Jülich Research Centre have also been integrated further.

The Charité University Hospital Berlin and the Max Delbrück Center for Molecular Medicine (MDC): The Charité and the MDC at Berlin-Buch, a research centre belonging to the Helmholtz Association, are planning to expand their collaboration, which includes, among other things, a closer organisational integration. In their coalition agreement for the federal state of Berlin, the Social Democrats (SPD) and the Christian Democrats (CDU) state the following: "The coalition intends to enter negotiations with the Federal Government, based on exploratory talks between the Berlin Senate and the Federal Government, with the aim of launching a pilot project before the year 2018. This pilot project comprises the merging of the research areas of the Charité University Hospital and the Max Delbrück Center for Molecular Medicine Berlin-Buch (MDC) under the umbrella of the Helmholtz Association."[137]

co-operations with Helmholtz institutes primarily enable higher education institutions to make use of costly research infrastructures. With the exception of the universities of applied sciences, collaboration with Fraunhofer institutes seems to be considered less relevant for the strategic focus of the higher education institutions.

For the higher education institutions, the key rationale for collaborating with non-university research institutions lies in the research itself and in the opportunity to obtain reputable third-party funding. In addition to that, close collaboration with regional facilities is regarded as crucial for reaching a critical mass in the context of the Excellence Initiative.[138] Thus, collaboration at a regional level leads to an expansion of research fields, creates opportunities for recruiting top scientists, improves a university's research infrastructure through the use of non-university facilities, and, finally, provides a basis for improved teaching and theses supervision.

When engaging in collaborations, the primary focus for both university professors and heads of non-university research institutions are joint research ventures (cf. Table 3).[139] For the heads of

BOX 08

Freedom of Science Act[140]

Key improvements brought about by the Freedom of Science Act comprise the following:

1. The introduction of global budgets and more flexible budgetary framework conditions: e.g. abolition of staff plans, the expansion of defined areas to which the organisations may allocate funding (staffing, material, and investment), as well as a substantial expansion of the proportion of funding amounts that the organisations manage under their own responsibility, with the aim of carrying over budgets into the consecutive year.
2. Improved conditions for attracting the best minds: a step-by-step abolition of the assignment framework *("Vergaberahmen")*, abolition of approval requirements for W professorship positions, as well as further developments in the terms of employment.
3. Simplified conditions regarding stakes in undertakings, collaborative projects and the launch of spin-offs in Germany and abroad.
4. Simplified construction of facilities for the science sector; science organisations have been given more responsibility in the field of construction. Regulations for simplified, modernised construction procedures for FhG and HGF will be adapted to the regulations that apply to MPG building procedures.
5. Facilitation in the regulation for procurement of goods and services: removal of administrative barriers; free choice in terms of procurement procedures for all suppliers and service providers.

non-university research institutions, other aspects are also highly relevant: these include the joint mentoring of students and doctoral candidates as well as joint appointment procedures and co-operations in the area of lectures and seminars. Thus it appears that for scientists at non-university research institutions there are more incentives to co-operate than for academic staff at higher education institutions.

In its Annual Report 2011, the Expert Commission expressed the view that a stronger integration of university-based and non-university research could improve Germany's competitive edge as a science location. Over the last few years, a number of promising types of institutionalised collaboration between higher education institutions and non-university research institutions have been established (cf. Box 7). Yet, the development of efficient co-operation models is currently being hampered by differences in funding formulas employed by non-university research institutions.[141]

The Expert Commission expressly welcomes these forms of collaboration as they can be regarded as promising experiments for integrating complementary elements of university-based and non-university research. At the same time, one might assume that in some cases these models are used as vehicles for bypassing restrictions for Federal/*Länder* joint research funding; restrictions that had been established by the Federalism Reform I. To achieve sustainable solutions, comprehensive policy measures are needed. Therefore the Expert Commission reiterates that the Federal Government should be re-enabled to engage in regular institutional funding of higher education institutions.

Creating comparable conditions for higher education institutions and non-university research institutions

Germany's higher education institutions do not solely engage in collaborations with non-university research institutions; in some cases, these two types of research entities do in fact compete with each other. However, this competition is characterised by distorted competitive conditions. The Federal Government has initiated the "Freedom of Science Act" initiative, a scheme that seeks to improve the framework conditions of the science system while also improving Germany's attractiveness in the international competition for science and innovation locations (cf. Box 8). The Expert Commission is very much in favour of this initiative. Currently, the "Freedom of Science Act" only applies to non-university research institutions (FhG, MPG, HGF, and WGL) as well as the German Research Foundation (DFG).[142] Due to the fact that the federal states are largely responsible for research in the higher education sector, university-based research has been virtually exempted from these improvements. In the view of the Expert Commission, these limitations should be lifted as soon as possible.

B 1–9 KNOWLEDGE AND TECHNOLOGY TRANSFER; PATENTING IN THE HIGHER EDUCATION SECTOR

Minor role of knowledge and technology transfer to date

In its earlier reports, the Expert Commission already stressed that the transfer of findings plays an increasingly important role in knowledge-based economies. The transfer to relevant groups of society and the transfer to companies are particularly relevant here. Yet, only a small proportion of interviewed university professors perceived the transfer of knowledge to the private sector as a substantial part of their academic work.[143] According to the interviewees, scholarly research is primarily directed at the respective academic community of the researcher. Scientific publications, academic lectures and collaborative projects are regarded as the key transfer channels to the private sector. Other forms of transfer such as advanced training, advisory services or the launch of spin-offs are regarded as key channels by only a small number of interviewees. The findings of the survey confirm the notion that university professors regard transfer activities as very important only if they are accompanied by research activities. Yet, there is a notable exception to this pattern: academic staff from universities of applied sciences frequently stated that companies were indeed important addressees of their research findings.[144] The surveyed heads of selected higher education institutions largely confirmed the views expressed by the interviewed university professors. Nonetheless, higher education institutions with a technical focus regard technology transfer and collaborations with the private sector as relatively important.[145]

Mixed results for the work of patent exploitation agencies

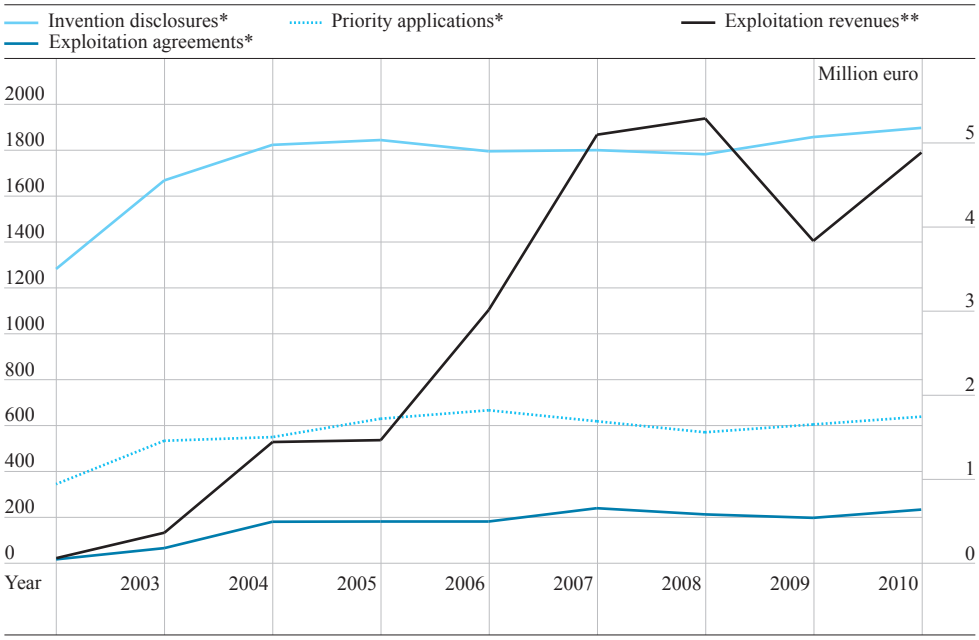
Following the abolition of the university teachers' privilege, agencies for patent exploitation were established in Germany's federal states. These patent exploitation agencies operate as external, largely independent service providers and usually work for only one regional higher education network *(Hochschulverbund)*, without any overlapping. Due to this, agencies have adapted their thematic specialisation to the services portfolio of the higher education institutions they are in charge of. Given these organisational structures, there is no direct competition between the individual patent exploitation agencies.[146]

Whether or not Germany's patent exploitation agencies have a positive impact on the higher education sector's overall exploitation activities is yet unclear. Figure 7 shows the development of inventions documented by the agencies and patent applications and exploitation cases managed by the agencies. About one out of three registered inventions documented by an agency leads to a patent application. Unsurprisingly, the number of invention disclosures and patent applications by higher education institutions has substantially increased since 2002, while the first three years after the abolition of the university teachers' privilege were especially dynamic. Since 2005, the number of patent applications has largely consolidated, having reached a consistent level of approximately 600 priority applications per year. A similar trend could be observed for the number of exploitation agreements, albeit with more fluctuations over the years when compared with the development of patent applications. Following a moderate increase in the starting phase, the patent exploitation agencies managed to significantly increase their exploitation revenues after 2005. In 2010, exploitation revenues amounted to EUR 4.9 million.

In spite of this increase, Germany's patent exploitation agencies do by no means operate on a cost-covering basis; and it is highly likely that also in the future they will still be dependent on public basic funding.[148] When looking at comparable models in other countries, it appears that even long-established exploitation systems such as those that can be found in Great Britain or the United States are still making a loss after 15 or even 30 years. Nevertheless, both countries still hold on to their systems as the long-term macroeconomic welfare effects are perceived as higher than the costs incurred by the transfer agencies.[149]

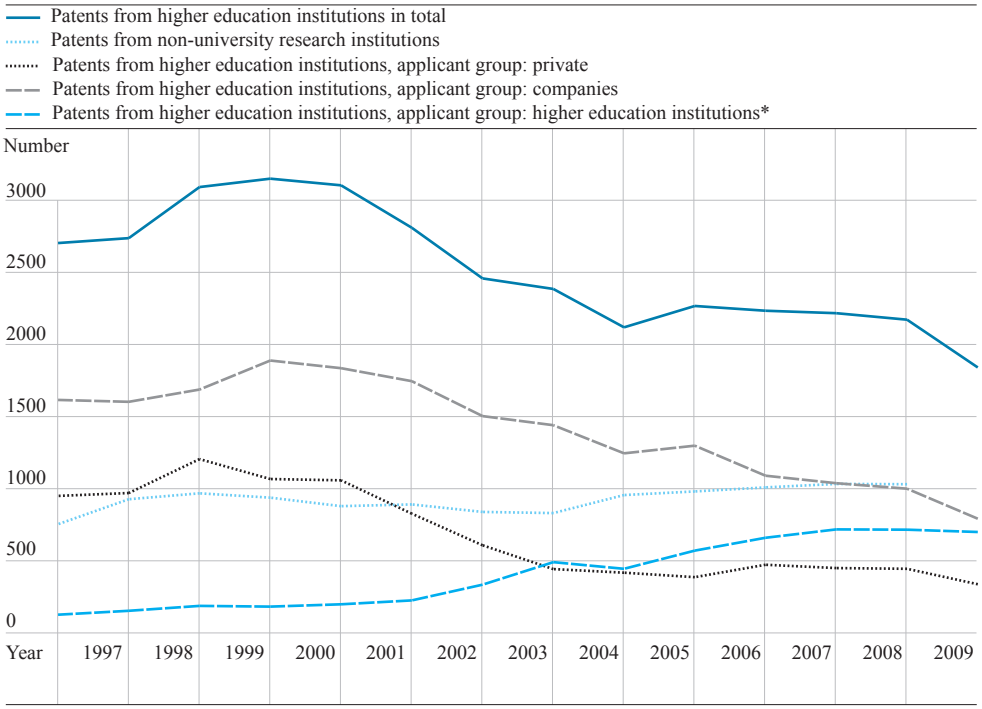
But not only the patent agency system as a whole is difficult to assess; a comparative assessment of German patent exploitation agencies is also difficult to conduct per se. This is due to the fact that (regional) higher education networks have different organisational structures, which is partly owing to their individual thematic specialisation. What is more, there are also substantial differences in terms of an agency's geographical and thematic proximity

FIG 07 **Invention disclosures, priority applications and exploitation relating to patent exploitation agencies**



* Number (left scale); ** in million euro (right scale).
Source: Project Management Jülich (PTJ). Own calculations.

FIG 08 **Published patent applications from higher education institutions in total and according to applicant groups; patent applications from non-university research institutions**[147]



Assumptions: 40 percent of inventors of patents within applicant group "private" or "company" are higher education staff other than professors; 20 percent withdrawal rate before disclosure.
* Due to differences in parent populations, annual figures slightly deviate from the values displayed in Figure 7.
Source: PATDPA. Research, calculations and estimates by Fraunhofer ISI.

to the higher education institution it is in charge of. Finally, the financial returns from patent exploitation are often only partially attributable to the agency's work and that of the inventor; they are also resulting from market developments, a factor that is generally difficult to predict.

Decreasing number of patent applications from university-based inventions

Not all of the patents that inventors from the higher education sector participate in are filed by the higher education institution itself.[150] Depending on circumstances, the patent may also be filed by the inventor or by a collaborating company. The inventor is entitled to file a patent in their own name provided that the higher education institution has released the employee's invention.[151]

Patents from the higher education sector that are filed by companies may emerge from different types of collaboration between a higher education institution and a company:

– The company has commissioned the higher education institution with an R&D project. In such a case, the company has borne all the costs associated with the development of the invention and is the owner of the intellectual property rights.
– The higher education institution has transferred their rights in the invention to the company, against payment of a fee (at the market rate).[152]
– The inventor is a full-time employee at the company that filed the patent and at the same time an honorary professor at a higher education institution.[153]

To monitor the frequency of these different scenarios, several assumptions and estimations will have to be made first. The results of these estimations are shown in Figure 8.[154] Following the abolition of the university teachers' privilege, the annual number of filed patents increased. However, during the same period, the number of patents filed by private persons or companies but originating in the higher education sector decreased. The university professors now had to report their inventions to their higher education institution and could not file a patent individually, as had been the case prior to the new legislation. Hence, a decrease in patents filed by private persons was to be expected; potential patent applications would now be filed by the university or the respective patent exploitation agency. Still, the decrease in applications of higher education patents by companies should be investigated in more detail. The question is whether a causal link exists between said decrease and the abolition of the university teachers' privilege and the establishment of patent exploitation agencies; or indeed, if other factors appear to be relevant here.

Overall, the number of patent applications from higher education institutions has decreased after the abolition of the university teachers' privilege. Yet, it should be noted that the decrease in applications had started much earlier than 2002. This does not apply to the four large non-university research institutions, which have been recording relatively stable numbers since the mid-1990s. Based on this observation, it could be presumed that the exploitation of inventions from the higher education sector is based on mechanisms that fail to lead to optimum results. In any event, it seems obvious that to date the 2002 reform has not resulted in increased patent activities in the higher education sector. Neither has the qualitative progress of patents been investigated – an aspect that is quite important as the commercial and technical relevance of intellectual property rights may vary significantly.

RECOMMENDATIONS OF THE EXPERT COMMISSION

B 1–10

The Federal Government should re-enable institutional funding of higher education institutions

The expansion of Germany's innovation system is largely dependent on a highly developed academic research landscape. While important progress has been achieved, Germany's higher education institutions are still disadvantaged – not only compared with leading international competitors, but also compared with German non-university research institutions. These impediments to the higher education sector will have to be overcome as soon as possible. Considerable improvements could be achieved by amending and simplifying Article 91b (1) of the German Basic Law, which should stipulate the option of funding "facilities and ventures".[155] In the history of the Federal Republic of Germany, a total of

58 amending statutes to the Basic Law have been adopted to date. The proposed modification of Article 91b would be an extremely useful measure that would lead to substantial improvements for Germany as a science location. Against this background, the Expert Commission is in favour of modifying the Basic Law and re-introducing regular institutional funding in the higher education sector.

Expanding the "Freedom of Science Act" initiative to the higher education sector

The Federal Government has launched the "Freedom of Science Act" initiative, and the Expert Commission welcomes this move. To strengthen university-based research in international competition and to avoid higher education institutions being disadvantaged compared with non-university research institutions, the Expert Commission recommends expanding the provisions of the "Freedom of Science Act" to the higher education sector. The initiative should be adopted step by step and in close collaboration with the federal states.

Scopes for development within the science sector should be expanded continuously, and the deregulation process that has been put in motion should be continued in all relevant fields of higher education. The long-term objective should be to create full financial autonomy for higher education institutions, with follow-up accountability. Global budgets should become the norm.

Strengthening autonomy in the higher education sector while advancing competition and differentiation

In spite of considerable progress, higher education planning in Germany is still based on a largely hierarchical pattern. For many years, competition and differentiation had played only a marginal role in this. The Excellence Initiative and other political reforms have guided the higher education sector towards a more competitive, profile-oriented system. These adjustments deserve continuous support from the political stakeholders. There is still a long way to go to achieve a diverse, heterogeneous academic landscape. Besides, Germany's higher education institutions will have to take on a more active role in the field of further training (cf. Chapter B2), an important new area of responsibility for higher education institutions.

Strengthening basic funding of the higher education sector

The Expert Commission welcomes the improvements that have been achieved in the financing basis of Germany's higher education institutions since 2006. However, the fact that these improvements are largely based on an increase in third-party funding entails certain threats to the system. University-based research should be enabled to regain its long-term orientation. This is one of the main reasons why institutional funding by Federal and *Länder* governments should be re-introduced as this would provide for a balance between project-based and institutional research. Furthermore, foundations could take on a more prominent role for the higher education sector than has been the case in the past. Here, the Federal Government should strengthen the legal position of foundations and introduce tax concessions for foundations. This would include improved options for ploughing foundation assets back into the higher education sector, and improved tax credits for endowments.[156]

Enhancing professionalisation of research organisations

Higher education institutions have an obligation to make use of their autonomy and financial scope. The German higher education sector is still characterised by a high degree of bureaucracy and a lack in professionalised administrative structures. The results of the surveys clearly demonstrate that a surplus of administrative activities undermines the advance of research. A stronger professionalisation of the higher education sector is currently being hampered by a faulty salary scheme for administrative staff and leading university management. Furthermore, the extent of available training for careers in higher education management is still insufficient.[157]

In this context it is also worth discussing the internal organisational structure of the higher education institutions' faculties. If one disregards the exception of Switzerland, it can be observed that none of the

compared countries, i.e. the Netherlands, the United States and Great Britain, have embarked on the chair principle. Instead, the higher education sectors of these countries are based on a departmental structure. As a result, research teams are not centred on chairs but are assembled especially for academic research projects (often with a long-term outlook). Due to this, the creation of new professorships is usually less expensive than it is in Germany, and the creation of tenure track positions is also associated with smaller follow-up costs. German higher education institutions should enhance their efforts in testing models like these. This does not mean however that organisational structures should be prescribed – instead, independent higher education institutions should be given the opportunity to find organisational structures that best fit their scope of services.

Improving the attractiveness of research careers in German higher education

The growth pattern of Germany's higher education institutions is lacking in balance and sustainability. From a careers perspective, financing of higher education institutions must be reconsidered: any university that is competing for the best talents has to be able to offer attractive research careers. The Excellence Initiative has indeed managed to advance Germany's position in direct competition with universities in other countries. Despite this progress, Germany is still lagging behind: research careers at German higher education institutions are difficult to plan, and opportunities for permanent employment in research are lower than in international comparison. In many other countries, the prospects of obtaining an open-ended contract that entails a high degree of research autonomy are better than those in Germany. To complement the junior professorship model, Germany should test tenure track models to a much larger extent. In addition to this, the number of W2 and W3 professorships should be increased as this would make it more realistic for talented academics to obtain an attractive position in an ever more competitive environment.

The Expert Commission believes that academic careers should not be planned around one and the same higher education institution, from the doctoral phase to professorship. Yet, a strict ban on internal appointments of post-doctoral candidates who completed their doctoral thesis at another institution does not seem to lead to the desired results, and it also hampers the introduction of tenure track models. It would make sense indeed to require at least one change of institution on the way from doctoral thesis to post-doctoral thesis; yet the actual time of transfer should be kept flexible.

Increasing the higher education sector's contributions to innovation

Higher education institutions can provide important contributions to the transfer of findings. The transfer of knowledge and technology, which is particularly relevant for innovations, can be achieved in different ways, e.g. via spin-offs, via the licencing of patents, or via private-public research partnerships. At the moment, all of these three options remain somewhat underused. Regardless of its positive impact, the Excellence Initiative has in fact led to a reverse development: instead of integrating aspects of knowledge and technology transfer into their scheme, Germany's policy-makers have launched parallel promotional tools such as the "leading-edge clusters" and the "research campus" programmes.

Universities have the privilege and the task to engage in research that is unrelated to concrete practical application. Yet, as soon as opportunities for practical application emerge, higher education institutions should make an effort to strategically promote these opportunities. This may require elaborate political skills on the part of the university management – in some fields of research more than in others. While scientists in engineering consider knowledge transfer as an almost natural aspect of their research activities, other fields of study are characterised by a more reluctant attitude. In some of the academic fields, the idea of closely collaborating with external partners and businesses in particular is often met with strong concerns. These reservations will have to be overcome.

The German legislator has the responsibility to promote the innovative impact of findings derived from basic research. The Federal Ministry of Education and Research (BMBF) and the German Research Foundation (DFG) have created instruments to achieve this. Thus, the BMBF "research campus" programme has received numerous applications, a fact that is

welcomed. On the part of the DFG, funding opportunities for information transfer have also been established, and the Federal Ministry of Economics and Technology (BMWi) has created incentives for supporting the launch of spin-offs via its promotional programme "EXIST". These measures demonstrate that Germany is moving in the right direction. Taking into account the diversity of instruments available, it now seems necessary to conduct a system evaluation of this area. In the context of such assessment, it should also be investigated why the abolition of the university teachers' privilege has yet failed to produce the positive impact envisaged by the political stakeholders involved.

Swiftly paving the way beyond the Excellence Initiative

The expiry of the Excellence Initiative is due to create major challenges for Germany's higher education institutions. Major research programmes and newly established research bodies should be maintained to guarantee the long-term success of measures. That said, political concepts that would cater for the period following the termination of the Excellence Initiative are not in place. The emergence of several new types of co-operation (e.g. in Karlsruhe, Aachen, Göttingen, and, more recently, in Berlin) should be generally appreciated. Yet, it seems that these have been established against the background of historical co-locations of higher education institutions and (mostly) Helmholtz facilities, or on the basis of rather coincidental political constellations.

In the medium term, the Federal Government will have to go back to systematically and sustainably supporting research in the higher education sector. While support can be granted via several different channels, one crucial point of departure would be to further strengthen higher education institutions in implementing research projects. The programme allowance that is currently in place does not suffice to cover the indirect costs incurred by DFG-funded research projects. Increasing the allowance appears to be a useful measure that could be financed by the Federal Government. Still, an increased programme allowance alone does not provide a solution to the problem of an overly strong focus on third-party funding for research in the higher education sector. To overcome this issue, the Federal Government itself will have to provide funding for research facilities.

Provided that the political stakeholders manage to facilitate co-operation between the Federal and *Länder* governments in the field of higher education, the actual structure of such extended collaboration will have to be decided on. Recent tentative approaches to discussing the idea of federal universities have not led very far. The notion of the Federal Government "taking on" individual higher education institutions and positioning them as high-level institutions for research and teaching is often regarded as a utopian vision or even a threat. Regardless of these reservations, the idea of federal universities should be taken into account as a serious policy option that should be given due consideration. The federal states however should not withdraw from financing as soon as the Federal Government extends its supportive measures.