Contents

Introduction......................................................................................................................................................... 1

1 Organizational structures and characteristic features of the German PSR system ........................................................................................................................................................................ 3

2 Historical development of German PSR ........................................................................................................ 16
  2.1 The development of the PSR system until 1945 ...................................................................................... 16
  2.2 The development of the PSR system in the Federal Republic............................................................... 19
    2.2.1 From 1945 to the early 1960s ............................................................................................................ 20
    2.2.2 From the mid 60s to the late 70s: expansion, institutional consolidation and stagnation of the German PSR system ......................................................................................... 40
      2.2.2.1 Cooperative federalism and the consolidation of the German research system ................................. 40
      2.2.2.2 The Federal Ministry for Research and Technology .................................................................... 49
      2.2.2.3 Programmatic expansion: the transition from a “passive” to an “active” research policy .......... 48
      2.2.2.4 From expansion to stagnation: public sector research in the seventies ...................................... 55

3 The situation of German PSR in the mid 1990s ...................................................................................... 87
  3.1 Research capacities ................................................................................................................................. 87
  3.2 The position of PSR in the overall research system .............................................................................. 93
  3.3 Challenges for German PSR in the eighties and nineties .................................................................... 99

4 Political regulation and guidance .............................................................................................................. 105
  4.1 PSR functions and research policy objectives ....................................................................................... 105
  4.2 Guidance of PSR .................................................................................................................................... 121

5 Government and funding arrangements for PSR ....................................................................................... 123
  5.1 The Federal Government (Bund) .......................................................................................................... 126
  5.2 The States (Länder) .............................................................................................................................. 138
    5.2.1 The regional distribution of PSR capacities ...................................................................................... 138
    5.2.2 The “regionalization” of research policy ......................................................................................... 150
5.2.3 Horizontal Self-Coordination: The Standing Conference of Ministers of Education and Cultural Affairs of the Länder ................................................................. 155

5.3 Vertical cooperation and government-science coordination: The BLK and the Science Council ........................................................................................................... 161

5.3.1 The Bund-Länder-Commission for Research Promotion (BLK) ................................................................................................................................. 161

5.3.2 Self-regulation of science and the Science Council ................................................................................................................................. 163

5.4 The European Union (EU) ........................................................................................................................................................................ 172

5.4.1 Importance and impact of the EU on German PSR and research policy in the 1980s ........................................................................................................... 172

5.4.2 The German research system between reunification and Europeanisation: the 1990s ........................................................................................................... 189

5.5 Reunification and the reconstruction of an all-German research system .................................................................................................................. 193

5.6 The DFG ........................................................................................................................................................................................................... 204

6 Sub-sectors ........................................................................................................................................................................................................ 209

6.1 Universities ........................................................................................................................................................................................................... 209

6.1.1 Funding arrangements for university research and the marginalization of research by teaching ........................................................................................................... 214

6.1.2 University reform: the never-ending story .............................................................................................................................................................................. 220

6.2 The relationship between university and non-university research ........................................................................................................................................... 240

6.3 Extra-university state-financed research institutes .............................................................................................................................................................. 245

6.3.1 MPG .................................................................................................................................................................................................................. 256

6.3.2 FhG .................................................................................................................................................................................................................. 261

6.3.3 Federal Research Establishments .................................................................................................................................................................................. 267

6.3.4 National Research Centers .................................................................................................................................................................................. 270

6.3.5 Bund-Länder-Institutes .................................................................................................................................................................................. 275

Literature .................................................................................................................................................................................................................. 279

Appendix .................................................................................................................................................................................................................. 299
Glossary

AGF/HGF  Arbeitsgemeinschaft / Helmholtzgemeinschaft Deutscher Forschungszentren
(Helmholtz-)Association of National Research Centers

BFA  Bundesforschungsanstalten
Federal Research Establishments

BLI  Bund-Länder-/Blaue-Liste-Institute
Bund-Länder-/Blue-List-Institutes

BLK  Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung
Bund-Länder-Commission for Educational Planning and Research Promotion

BMAf  Bundesministerium für Atomfragen
Federal Ministry for Nuclear Affairs

BMBF  Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie
Federal Ministry for Education, Science, Research and Technology

BMBW  Bundesministerium für Bildung und Wissenschaft
Federal Ministry for Education and Science

BMFT  Bundesministerium für Forschung und Technologie
Federal Ministry for Research and Technology

BMwF  Bundesministerium für wissenschaftliche Forschung
Federal Ministry for Scientific Research

DFG  Deutsche Forschungsgemeinschaft
German Research Society

FH  Fachhochschule
College for Advanced Professional Training

FHG  Fraunhofer-Gesellschaft
Fraunhofer-Society

GFE  Großforschungseinrichtungen
National Research Centers

HBFG  Hochschulbauförderungsgesetz
Act for the Support of University Construction

HRG  Hochschulrahmengesetz
Framework Act on Higher Education

KMK  Ständige Konferenz der Kultusminister der Länder
Standing Conference of Ministers of Education and Cultural Affairs of the Länder

KWG  Kaiser-Wilhelm-Gesellschaft
Kaiser-Wilhelm-Society

MPG  Max-Planck-Gesellschaft
Max-Planck-Society

RV-Fo  Rahmenvereinbarung Forschungsförderung
Framework Agreement on Research Promotion

SFB  Sonderforschungsbereich
Collaborative Research Center
WBL  
*Wissenschaftsgemeinschaft Blaue Liste*
Science Association Blue List

WR  
*Wissenschaftsrat*
Science Council

WRK/HRK  
*Westdeutsche Rektorenkonferenz/Hochschulrektorenkonferenz*
West German Conference of Rectors / Conference of University Rectors
**Introduction**

This report tries to capture the major dynamics and challenges facing public sector research (PSR) in the Federal Republic of Germany. However, no comprehensive description and overview of the German public research system (PRS) is intended which would go beyond the scope of the report. Instead, crucial developments concerning its organizational structures and thematic orientation, which have taken place since the beginning of the eighties, will be highlighted as well as the areas in which reforms have been waited for or attempted without success.

The first chapter gives a brief and condensed outline of the main organizational features and government arrangements of German PSR. Chapter two follows with an overview on the historical development of the research system into the 1980s and highlights some of the central institutional and political events in this process. In this context, special emphasis is laid on the structural features and government and funding arrangements of the public research system. A change of perspective is made in chapter three to five where the historical is replaced by an analytical approach describing in broad lines the present situation of PSR and its main challenges in the mid 1990s. A second objective is to sketch the response of research policy towards these challenges and structural problems in the research system. For this purpose we turn to research policy objectives and instruments and explore significant changes and non-changes since 1980. In a sense, this is the view “from above” on our topic. The sixth chapter then shifts to the view “from below”. Basically the same phenomena are dealt with as they manifest themselves in the different sub-sectors of PSR. Accordingly, the top-down and bottom-up view on German PSR which form the main body of the report are strictly complementary as two equally important perspectives on the same issues.
1 Organizational structures and characteristic features of the German PSR system

The history of German Public Sector Research (PSR) goes back to the 19th century (see chapter 2). Over time a “differentiated, pluralistic and decentralized” (BMBF 1996) system has developed. Its institutional structures and organizational arrangements follow not a comprehensive research policy planning, but show a high level of historical path-dependency (Wissenschaftsrat 1988: 31-32). Accordingly, research policy-making and public sector research take place in a highly differentiated structure both at the policy as well as at the performing level. In a macro perspective two first general features characterize the present institutional arrangements.

A first one is institutional differentiation at the performing level. Since the middle of the 19th century universities have gradually lost their near monopoly on PSR to a multiplicity of state-financed extra-university research institutions for specific missions and types of research. Here, a first major gap between rhetoric and reality in German research policy shows. In official documents universities are still regarded as the “most important places of research” and “fundament of the overall research system” (Wissenschaftsrat 1988: 29). Especially the “unity of research and teaching” as the constitutive principle of German universities is responsible for this. Teaching and research are equally important tasks. There is no priority of one of both – which could only be teaching to the disadvantage of research under the conditions of mass higher education (see below). In contrast, teaching is expected to flow from and to be oriented towards research. Moreover, the principle implies that no differentiation of research universities and teaching-oriented universities exists and that both tasks are not strictly separated within universities by roles or organizational units but coupled. But at least with regard to research capacities reality does not longer correspond to this prominent role assigned to universities. Instead the non-university sector has caught up with them (Figure 1-2). An reason for this is the high institutional continuity of German research institutions. New tasks and functions of PSR were either integrated into existing research organizations or assigned to newly founded functionally specialized research institutes.
Organizational structures and characteristic features of the German PSR system

Figure 1: PSR expenditure in the FRG by performing sector in 1995

Universities: 54%
GFE: 15%
MPG: 6%
FhG: 5%
BLI: 5%
Others: 11%
BFA: 4%

Source: for data see Table 9A; for acronyms see glossary.

Figure 2: R&D personnel by employing public sector in 1995

Both sectors together employ two fifths of total R&D personnel, and spend one third of overall R&D expenditure. While a shift of weight from the former to the latter occurred between 1975 and 1989,
this trend has reversed since reunification. In 1995 the university (non-university) sector accounted for 54% (46%) of R&D expenditure in the public sector (Table 9A). ¹ Concerning R&D personnel the overweight of universities (57%) is slightly more pronounced (Table 7A), but even here it is not the case that one of both sub-sectors is dominant, the other marginal. Within the higher education system one can distinguish two broad institutional sectors with different missions: 89 (1995) universities which are research and teaching institutions and 138 Fachhochschulen or polytechnics concentrating on short-term vocational undergraduate programs. They receive almost no institutional research funding and their contribution to PSR is marginal.² The non-university sector largely is composed of five groups of research organizations and institutes:

- the Max-Planck-Society (Max-Planck-Gesellschaft (MPG)) operating 66 research institutes in 1995 (Table 2.2). The task MPG complements universities in areas of basic research that are particularly promising and innovative for scientific advancement or require a concentration of resources and level of interdisciplinarity not available at universities.

- the Fraunhofer-Society (Fraunhofer-Gesellschaft (FhG)) with 41 institutes and 3 service institutions in 1995. It is the counterpart to the Max-Planck-Society for applied contract research and technology transfer in the service of industry and state.

- the 16 national research centers (Großforschungseinrichtungen (GFE)) working with a particular concentration of infrastructure, staff and financial means on selected fields of complex scientific and technological research which are perceived to be of special importance to the economy like aeronautics or the society like public health and the environment.

- 56 federal research institutes (Bundesforschungsanstalten (BFA)) performing commissioned research and scientific services supporting ministries and other government agencies in carrying out their policy responsibilities;

- more than so-called 80 Bund-Länder-/Blue-List-Institutes (Bund-Länder-/Blaue-Liste-Institute (BLI)). These are independent research institutes of supra-regional importance financed jointly by Bund and Länder with very diverse missions and research areas reaching from scientific service and documentation centers over applied economics to basic research in the natural, social and medical sciences.

These groups of research institutes are mainly differentiated by the type of research done and the intra- or extra-scientific interests and clients addressed while there is no clear differentiation according to scientific fields. By far the largest sub-sector are the national research centers accounting for about one

---

¹ In the following tables of the appendix are cited with an A, for example Table 1A.
² In official statistics the share of resources devoted to R&D at Fachhochschulen is estimated on a mere 5% (BMBF 1996a: 526).
third of financial and staff capacities in non-university research, whereas the other have a about the same size (Table 9A and 10A).

At the policy level the most important structural features are the federal state structure and the existence of a powerful national research ministry. Decentralization of responsibilities for higher education and scientific research on the one and sharing of these responsibilities between the federal states (Länder) and the central/federal government (Bund) on the other hand are the traditional characteristics of German science policy. Thus, regional governments play an important role in national science policy establishing the “Ministries for Cultural and Educational Affairs” (Kultusministerien) of the sixteen Länder as equal, in some areas even predominant, actors in national research policy with own legislative, administrative and budgetary powers. But this regionalization has been balanced by two counterbalancing developments. Firstly, already in the 19th century a trend towards cooperative federalism with an “interlocking” (Politikverflechtung) of federal and state responsibilities in the organization and promotion of scientific research and higher education emerged (Bentele 1979). Secondly, postwar government arrangements for PSR witnessed the establishment of a centralized federal research administration and over time the “Federal Ministry for Education and Science” (Bundesministerium für Bildung und Wissenschaft (BMBW)) and its predecessors have become one of the most powerful research departments in the OECD with regard to formal competence and budget (Stucke 1993). However, the BMBW has to accommodate itself with a number of other federal departments which finance and carry out their own sectoral research policies. On the other hand, due to the sharing and interlocking of responsibilities research policy actors both at the regional and the federal level are closely linked by a variety of formal and informal mechanisms for horizontal and vertical coordination. The most important intermediary policy-making bodies are:

- the Science Council (Wissenschaftsrat) acting as an advisory, planning and coordination body for higher education and research policy at the national level;
- the Bund-Länder-Commission for Research Promotion (BLK) the central decision-making body concerning the organization, funding and administration of PSR;

---

3 In most federal states the originally fusion of the competence for education, culture, and science in one department has been replaced by an organizational differentiation into a “Ministry of Science” (Wissenschaftsministerium) responsible for higher education and science, and culture and a “Ministry of Education” (Bildungsministerium) dealing with primary and secondary schools and vocational training. In this re-
• the Conference of State Ministries of Culture (KMK) serving the federal states as a forum for horizontal coordination in education and science policy.

The main actors and their most important relations are outlined in Figure 3.
Organizational structures and characteristic features of the German PSR system

Figure 3: Public sector research system of the Federal Republic

- Federal Ministry for Education, Science, Research and Technology (BMBF)
- Interdepartmental Committee for Science and Research
- Council for Research, Technology and Innovation
- Bundes-Länder-Commission for Educational Planning and Research Promotion (BLK)
- 16 Länder Ministries of Culture
- Science Council (WR)
- Federal Research Establishments (BFE)
- German Research Association (DFG)
- Blue-List-Institutes (BLI)
- National Research Centers (GFE)
- Fraunhofer-Society (FhG)
- Max-Planck-Society (MPG)
- Universities
- Other Research Facilities

Consultation/advice
coordination
funding
In addition to its organizational peculiarities several another feature of the German PSR system has to be highlighted, especially in comparison to other European countries, if one wants to understand its present situation and challenges, namely the strong prominence given to scientific autonomy and self-government of science as constitutive principles guiding the relationship between state and the scientific community in research policy. In international comparison PSR institutions enjoy a rather high level of freedom in the selection of research topics, objectives and methods. Although PSR is overwhelmingly financed by the state, universities as well as most extra-university research organizations are not subjected to tight political control with respect to the formulation and implementation of research programs (Mayntz 1992).

In summary, political guidance and funding of PSR in the Federal Republic is simultaneously decentralized and regionalized as well as coordinated. Unilateral action by either a federal state or the federal research ministry in many areas of research policy is de facto impossible. Instead decision-making is characterized by extensive bargaining and the search for compromises acceptable to all actors involved or affected. The basic ambivalence inherent to this kind of structure established by the last two features is a tension between a plurality which fosters productive competition, on the one hand, and a need for consensus which brings about a tendency to stick to the status quo, on the other. The plurality of actors at the policy and performing level provides both sides with manifold opportunities not to become caught in one specific relationship (Schimank 1994; 1996; Mayntz/Scharpf 1990). Almost never any PSR institution has a monopoly for the provision of certain kinds of scientific knowledge and services. Thus, they have to compete with each other to maintain or increase their reputation and resource base. The plurality of performing actors is matched by the multiplicity of government agencies supporting scientific research: “There is no overall research budget, nor is there any consistent research policy for all subsystems.” (Block 1990: 36). Accordingly, no performing actor is totally dependent upon only one policy actors for resources. Instead, researchers can turn to different funding agencies for support or open up additional sources of income. This is one of the most important institutional arrangements protecting the scientific autonomy of German PSR from too much external direction and control. The competition for resources, the existence of different sources of funds and the broad range of research topics and tasks which this diversity produces is seen as one of the strengths of German PSR stimulating scientific productivity and the taking up of new areas and lines of research (BMBF 1996a: 27; Rüttgers 1996a).

The other side of the coin is that many organizational arrangements are very rigid because they are the result of complicated power balances which nobody can disturb, or at least nobody dares to disturb because of possible incalculable consequences. Decisions to change arrangements also require in many cases unanimity or near-unanimity including the consent of the negatively affected actors and their implementation often cannot be enforced, but has to be based on voluntary cooperation by the addressee of reforms. This manifests itself in a very high level of institutional continuity. Existing or-
Organizational structures and arrangements for PSR have seldom been dissolved or radically transformed to adapt them to inner-scientific or economic, political and social changes. Instead the long-term development of German PSR has been characterized by a “functional specialization of existing research organizations, and the emergence of new types of functionally defined categories of research institutes” (Mayntz 1991: 55). As long as new challenges could be taken up by growth, which was the case up to the mid-seventies, the system could live quite well with this institutional rigidity. Since then, however, a serious lack of an ability to reform without simply expanding the system has become manifest. Many politicians, representatives of universities as well as extra-university institutes, and other observers lament now that the system’s institutional capacity of problem-processing and reform has reached a critically low level that threatens not only the scientific, but also the economic competitiveness of the Federal Republic in the future.
2 Historical development of German PSR

2.1 The development of the PSR system until 1945

The development of modern science in Germany is characterized by a pervasiveness of state action (Durchstaatlichung) (vom Bruch 1990: 16; Braun 1996: 99-100). Already the medieval universities were in most cases state institutions founded and controlled by sovereigns of the various principalities. In 1737, the reform university of Göttingen became the first university financed by annual state budgets (Stichweh 1982: 14). Due to the primarily educational mission of universities which focused on the training of civil servants and professionals it is the founding of scientific academies in the 18th centuries which can be regarded as the first deliberate government support for scientific research. Following the French and British models in 1700 the “Königlich Preußische Akademie der Wissenschaften” and in 1751 the “Königliche Gesellschaft der Wissenschaften zu Göttingen” were established with the task to cultivate and develop sciences and arts and their practical application. In general, however, government support for both universities and academies was extremely low and did not provide for a research infrastructure. The “take-off” of German PSR took place in the middle of the 19th century when German universities were gradually transformed into research universities and government departments started to establish own laboratories providing scientific advice and services supporting policy making. In the following paragraphs the most important stages in the institutional development and growth of the public research system are summarized.

A milestone in the history of organized and publicly financed science were the Prussian university reforms that are associated with the name of Wilhelm von Humboldt and the founding of the University of Berlin in 1809-10. These reforms ended the institutional separation of the teaching and research function between universities and academies and (re-)established the production of new knowledge through research as an integral part of the university mission. With the exception of some long-term collaborative projects in the humanities and the publication of scientific periodicals the role of the

---

4 See for the history of German universities McClelland (1980).
5 For example, the Prussian academy had in the beginning only a small observatory supplemented in 1744 by a botanic garden, laboratory and small collection of scientific apparatus, but it received no regular government funding. Even worse was the situation at many universities often disposing only of inadequate libraries and lecture halls.
7 See on the Prussian university reforms and the Humboldtian research university Ben-David (1971): Chap. 7; McClelland (1980); Schubring (1991) and Turner (1980) and (1987). Humboldt’s ideas are laid down in his famous memorandum “About the internal and external organization of higher scientific institutions in Berlin” (Humboldt 1993).
Historical development of German PSR

academies was gradually reduced to that of a learned society in which eminent scientists could meet and discuss interesting findings. “Learning through science” and “unity of research and teaching” became the constitutive and identity-forming principles of the Humboldtian university. Based on “research in solitude and freedom” pursuing “knowledge for its own sake” professors were expected to make research findings and methods the substance of teaching and to involve students in actual research work.\(^8\) By the means of science students were to be educated to autonomous and responsible subjects as well as trained in the latest knowledge and techniques needed both for an academic and a professional career (Gellert 1993: 5-11; Mittelstraße 1996: 101-103).\(^9\)

At the same time, the academic reformers around Humboldt argued for scientific self-government as the organizational principle of the university to ensure freedom of research and teaching and an undirected search for truth. Universities were envisioned as “republics of scholars” promoted and protected by a “cultural state” which abstained from interventions in academic affairs motivated by political, religious or social interests (Bruch 1997).\(^10\) When governments gradually accepted this relationship between state and academia the German “chair university” (Ordinarium Universität) developed in which full professors (Ordinarien) reign almost autocratically. Professors represent a discipline in research and teaching and autonomously decide on the topics and organization of their research and teaching programs, while collegial bodies deal with general faculty or university affairs and deans and rectors are chosen among the faculty. Central organizational and operational unit of the modern research university developing in nineteenth century Germany were state-financed seminars and institutes which equipped professors with the infrastructure (buildings; libraries; laboratories) and resources (own budgets; staff) for research-based teaching and systematic research in a growing number of theoretically and methodically specialized disciplines.\(^11\) During the second half of the 19\(^{th}\) not only the number, but also the size of seminars, institutes and clinics increased massively receiving the bulk of government spending on universities (Pfetsch 1974: 85-88). In this way, Germany was the first country in which university research became the objective of regular state support\(^12\) and were young scientists could receive systematic research training contributing to the rise of German universities to world-centers of science and scholarship and the model for university reforms abroad at the end of the 19\(^{th}\)

---

\(^{8}\) The “research imperative” (Steven Turner 1981) of the Humboldtian university is captured in the famous conceptualization of science as “something not yet completely revealed and never entirely to be found and to seek it incessantly as such.” (Humboldt 1993: 257).

\(^{9}\) According to Schleiermacher the unity of research and teaching allows students to “learn in every thought to be conscious of the basic laws of science and precisely by this means gradually develop in themselves the ability to do research, invent, and represent – this is the task of the university.” (quoted in Mittelstraße 1996: 102).

\(^{10}\) For Humboldt (1993: 257/260) universities are most productive and beneficial if the state follows the principle “that things would work infinitely better without the state.”


century. A second factor playing an important role in this process was the decentralization of the higher education system comprising about twenty universities in several independent states. This led to a productive competition of both governments and universities for professors, students and scientific reputation because it forced them to take over institutional and scientific innovations in order to stay attractive.13

Even today, the Humboldtian principles, academic self-government and the model of a cultural state (Kulturstaat) which promotes and protects universities, but grants them academic freedom are still the guiding idea of the German university and regularly evoked by supporters and opponents of university reforms. But already at the end of the nineteenth century the reality of hierarchical structures, disciplinary fragmentation and growing student numbers did no longer correspond to the Humboldtian ideals of a “republic of scholars” and close community of professors and students, if it ever bore much relation to actual academic life. This gap between the Mythos Humboldt (Ash (Ed.) 1997) and reality, which continuously widened with the transformation of science into a specialized, large-scale enterprise and the transition to mass higher education has contributed to recurrent university crisis and reform attempts and still forms one of the central problems and challenges of German science policy debate (Gellert 1993; Mittelstraß 1996; Mash (ed.) 1997). The Prussian university reforms also were influential in a second respect being the first major example of a recurrent pattern in the expansion of the PSR system. Major institutional reforms and increases of government support were often induced by political, economic or social crises, in this case the military defeats against Napoleon. In addition, developments abroad which were perceived as threatening the competitiveness of German science served as legitimization for new founding and financing activities, especially when government and industry discovered scientific research as a central asset in the “competition of nations” for power, wealth and prestige at the end of the 19th century (Brocke 1991: 273; Braun 1996: 100-107).14

The promotion of scientific research as an instrument of economic and social development as well as policy making is manifested in the emergence of an extra-university sector starting in the middle of the century. Although universities remained the predominant and in many scientific fields exclusive places for research, governments also started increasingly to fund research outside universities.15 This comprised on the one hand research projects or institutes which were supported due to their cultural, political or scientific importance. On the other hand, governments established scientific advisory boards, research institutes and government laboratories carrying out “technical-scientific services” and prob-

13 This argument is associated with the work of Joseph Ben-David (1991a); Ben-David/Zloczower (1991b).
14 See for the role of these factors in the establishment of the Physikalisch-Technische-Reichsanstalt (PTR), the first national government laboratory, Pfetsch (1974): 109-123 and especially the Kaiser-Wilhelm-Society, the predecessor of the Max-Planck-Society, and the Emergency Society of German Science, the precursor to the German Research Society (DFG) Brocke (1990a) and Schröder-Gudehus (1972).
15 According to Pfetsch (1974): 85-90 the share of universities in public expenditure on science fluctuated between about 50-66% between 1850 and 1914.
lem-oriented research for specific ministries or special interests. Similar to the higher education sector, the political fragmentation of Germany had a positive growth effect on non-university research, since every state needed at least a “minimum of scientific-technological facilities” (Pfetsch 1974: 236-238; Braun 1996: 101-102).

The founding of the German Empire in 1871 had a catalytic effect in this process. Firstly, national unification accelerated industrialization and urbanization creating a demand for scientific and technical knowledge in areas like agriculture, statistics and norm setting. Secondly, with the imperial government a new science policy actor was established which developed within a short time period important activities in PSR, although the Reich had received no legislative powers for higher education in the constitution which remained the competence of the federal states as part of their autonomy in cultural and educational affairs. Referring to the increasing importance of scientific research for the economy and policy areas like foreign affairs, infrastructure, standardization or public health for which it was responsible, however, the central government could gradually establish and extend its involvement in science funding and policy making. Since universities focused on curiosity-driven basic research and the Länder defended them as their exclusive domain, the Reich concentrated on the non-university sector, especially on research facilities and projects which (1) had an international character, (2) whose national importance, scale and costs exceeded the competence and capacities of a single Land and (3) which supported the imperial ministries in the formulation and implementation of their policies. Earlier than in other countries science was discovered as a “fourth factor of production” and instrument for social development making it the object of targeted and systematic state action (Brocke 1990a: 17-21).

Germany became a pioneer in the public promotion of the application of scientific knowledge to industry and policy-making. Science-based industries (chemistry; pharmacy; electrical and mechanical engineering) played a central role in the late, but accelerated industrialization inducing governments to establish teaching and research facilities for technical and applied sciences supporting economic development. The establishment of a national social insurance and health system in the 1880s and 90s was a further stimulus for PSR. A third factor contributing to the institutionalization and rapid growth of state-financed research outside universities where the structural rigidities and problems of the traditional universities. Due to their ideology of “pure science” universities were reluctant to integrate the empirically and practice-oriented natural and technical disciplines or to respond adequately to the increasing societal demand for professional and technical training at an academic level. In addition, the

---

16 See Pfetsch (1974) and Lundgreen et al. (1986) for an account of the institutional development of non-university research.

17 See for the list of about 100 scientific projects, organizations and institutes supported by the Reich between 1871 and 1914 Pfetsch (1974): 91-93.

18 German chemical companies were the first to operate own laboratories. For the development of industrial research in Germany see Lenoir (1988) and the articles in Edgerton (1996).
chair system promoted a disciplinary fragmentation and walling off, whereas the growing complexity and costs of the “large enterprise science” (Großbetrieb Wissenschaft) required concentration of infrastructure and resources and the coordinated collaboration of large numbers of scientists and technicians. Between the late 1870s and 1914 Prussian science administrators like Friedrich Althoff, influential academics like Adolf von Harnack and leading industrialists like Werner von Siemens expanded the German research system both institutionally and quantitatively laying the foundations of its present organizational structures (Beyerchen 1988; Brocke 1990a; 1991; Bruch 1997). But this research system corresponded no longer to the ideas of the early nineteenth century centered around undirected science at universities. Instead, “a state-directed system of industrial functionalization of higher education and focused research competence outside the universities” (Bruch 1997: 6) became dominant expressed in the new term “science policy” (Wissenschaftspolitik) introduced at the turn of the century (Stuchweh 1994).

Several groups of specialized universities were established since the 1860s, including 11 Technical Universities for natural and engineering sciences - most of them former polytechnics for higher technical training -, business schools, universities for veterinary medicine and several academies and universities for applied medicine, agriculture and forestry (Brocke 1991: 280). Against the protest of established universities governments granted Technical and Veterinary Universities in 1899 the right to award academic degrees including the doctorate. At the beginning of the 20th century the Technical Universities had become the most important places for teaching and research in the natural and engineering sciences maintaining close contacts to industry (Lundgreen 1990).

An important event in the development of the PSR system was the founding of the “Imperial Institute for Physics and Technology” (Physikalisch-Technische-Reichsanstalt (PTR)) in 1887 as the first of a number of national government laboratories. The PTR had the tasks to develop, test and improve precision mechanics and technical norm setting on behalf of public agencies and industry and to carry out “physical investigations and measurements” contributing to the solving of important scientific problems and requiring specialized research facilities not provided by universities or industry laboratories. Several elements made the PTR a new type of research organization and the start of technology policy in Germany (Ritter 1992: 20-21). It was the first large state-financed research establishment (1) outside universities, (2) funded exclusively by the central government, and (3) subject to direct government control in its research activities. The “Imperial German Health Office” (Kaiserlich Deutsches Gesundheitsamt) founded in 1876 carrying out research, testing and controlling tasks in the area of public health and the “Biological Imperial Institute for Agriculture and Forestry” established in 1905

---

19 Pfetsch (1974): 109-127; Hohn/Schimank (1990): 69-72. In 1914 the PTR had an annual budget of about 700000 Mark, whereas all chemical and physical-chemical institutes at Prussian universities received a total budget of about 420000 Mark (without personnel costs) (Brocke 1990a: 92).
for improving pest control and veterinary hygiene followed the PTR supplemented by a multiplicity of government laboratories operated by the Länder.²⁰

The setting up of mission-oriented research institutes at the end of the 19th century established a third type of public research located between universities and government laboratories which was based on a close collaboration between science, state and industry. These institutes constituted public-private partnerships financed jointly by governments and industry. Compared to universities the institutes provided favorable research conditions since they were exempted from teaching and disposed of modern and well-equipped laboratories. Compared to government and industry laboratories their scientists enjoyed greater freedom to follow their research interests. The founding of the “Kaiser-Wilhelm-Society for the Advancement of the Sciences” (Kaiser-Wilhelm-Gesellschaft zur Förderung der Wissenschaften (KWG)) in 1911 formed the apex of this development and the most institutional structural innovation in the German PSR system since the Humboldtian reforms and the establishment of the PTR.²¹ Its mission was “to promote the sciences, especially through the establishment and support of research institutes in the natural sciences” which provided outstanding scientists with the infrastructure and resources to concentrate on research. In its organization the KWG was a hybrid institution. Constituted as a private association the KWG private contributions financed the bulk of its budget, while the Prussian government provided building land and the salaries for the directors of the Kaiser-Wilhelm-Institutes. According to their position as main sponsors industrialists and bankers dominated decision-making bodies and the KWI concentrated on research areas meant to expand the science base of German industry. On the other hand, several institutional safeguards protected the KWI from direct interference in their research activities. Within the general mission of his institute the director was “not subject to any restriction with regard to the selection and the carrying out of his scientific works.”²²

The First World War led to an expansion and centralization of PSR and a stronger involvement of government in the planning and direction of research activities (Ritter 1992: 31-39). Science was assigned a central role both in the war effort and afterwards for national and economic reconstruction. In this process, the position of the central government in science policy was strengthened. The new constitution of the Weimar Republic made the “protection” and “cultivation” of science a shared responsibility of Reich and Länder and its superior financial capacities provided the central government with a key position in the reconstruction and expansion of the PSR system (Marsch 1994: 39-52; Brocke 1990b: 198-208). Since 1920, the Kaiser-Wilhelm-Society received annual public grants to compensate for the loss of own and private resources due to inflation and economic crisis. At the end of the

---

²⁰ For a list of government laboratories see Lundgreen (1990): 675-677.
²¹ See for the history of the KWG Burchardt (1975) and Vierhaus/Brocke (1990).
²² § 13 of the Agreement on the first KWI for Chemistry, quoted in Brocke (1990a: 148). This formulation was incorporated in the Statutes of all future institutes, even such industry-oriented ones like the KWI for Coal Research.
Weimar Republic the KWG had strongly expanded and received most of its funding from public sources, especially the Reich Ministry of the Interior (Brocke 1990b; Ritter 1992: 41-42).

The need to improve the material situation of science following the economic and social crisis at the end of the First World War led to the setting up of another institution having a strong impact on the German PSR system. In 1920 the “Emergency Society of German Science” (Notgemeinschaft der deutschen Wissenschaft) was established with the task to mobilize public and private funds for university research and young scientists through the distribution of research grants and scholarships. In this way, a dual support system for university funding was introduced whereby the institutional core funding of the federal states should provide for “well-founded” laboratories and salaries, while the Notgemeinschaft supplied additional grants for specific research projects. The Notgemeinschaft was constituted as a self-governed organization of science (Selbstverwaltungsorganisation der Wissenschaft). Only individual scientists could submit grant applications which were evaluated by disciplinary review committees strictly according to scientific originality and quality. The committee members were elected from and by the scientific community. In this way, the Notgemeinschaft performed the function of a national research council for academic research. Although the Länder regarded universities as their exclusive domain, the central government became the primary source of income for the Notgemeinschaft.

The Weimar Republic saw also first attempts of a more direct political guidance of public research (Schröder-Gudehus 1970; Nipperdey/Schmugge 1970: 25-39). With this governments responded to two developments. Firstly, many scientists showed a hidden or open hostility towards the democratic regime destroying the homogenous socio-political culture between political and scientific elite in the German Empire. Secondly, under the influence of social-democratic politicians governments demanded to align public research more closely with political and public interests. Using its position as main sponsor the Reich Ministry of the Interior received seat and vote in the decision-making bodies of KWG and Notgemeinschaft. In addition, the Notgemeinschaft established in 1925 a special program for long-term and collaborative research projects for the promotion of the national economy, public health and public welfare introducing prioritization and research planning into PSR funding.

2.2 The development of the PSR system in the Federal Republic

Despite the political regime breaks in 1933 and 1945 and the Second World War the German PSR system showed a high degree of institutional continuity. When the Federal Republic was founded in 1949 universities, Kaiser-Wilhelm-Society, Notgemeinschaft and government laboratories as the main sectors of PSR had resumed their activities on the basis of their pre-NS statutes. In addition, the new

---

23 See Marsch (1990); Nipperdey/Schmugge (1970); Schröder-Gudehus (1972) and Zierold (1968) for the history of the Notgemeinschaft.
Historical development of German PSR

constitution restored the federal state structure including the prerogative of the Länder in higher education and scientific research. Three issues dominated the German PSR system in the post-war period:

- the distribution of legislative and funding responsibilities for PSR between Bund and Länder and the institutionalization of government arrangements for PSR at the national level;
- the extent of scientific autonomy of universities and state-financed research organizations from political direction and control;
- the delimiting of research domains and resource conflicts between the different organizations of PSR.

2.2.1 From 1945 to the early 1960s

Universities were the first to resume research activities and established in April 1949 the “West German Conference of Rectors” (Westdeutsche Rektorenkonferenz (WRK)) with the task to develop and represent common interests, especially to preserve their reestablished right to academic self-government (Stamm 1981: 60-67). Despite the lack of resistance and often active collaboration of universities with the NS regime rectors and professors were largely successful in restoring the Humboldtian chair university against attempts for organizational reforms, institutional innovations and democratization arguing that the universities were “basically sound” (Jarausch 1997: 35-38). The new constitution guaranteed the freedom of research and teaching (Art. 5(3) of the Basic Law) and although most Länder passed university laws the degree of government intervention into university affairs remained generally low until the late 1960s. In 1948 the “Kaiser-Wilhelm-Society” (KWG) was recognized by the Allied Powers under the new name “Max-Planck-Society” (MPG). As a reaction to the entanglement of some Kaiser-Wilhelm-Institutes and scientists into the criminal policies and war of the Third Reich which was regarded as a consequence of the strong role played by business and government representatives in the KWG-bodies the revised statutes established the MPG as an “association of free research institutes which neither belongs to the state nor to industry. It pursues scientific research in complete freedom and independence, without being tied to contracts, subject only to the law.” (Art. 1). Accordingly the MPG was reorganized as a self-governed organization of science, controlled and run by the directors and senior scientists of its institutes. In January 1949, universities and Länder also re-founded the Notgemeinschaft. Originally the state governments intended to make the new Notgemeinschaft a national research council under their control for “supervising the planning and directing of research in its totality” and coordination and distributing public funding to all sectors of

---

24 The following paragraphs are based on Bentele (1979); Hohn/Schimank (1990); Osietzki (1984); Stamm (1981) and Stucke (1993). While the reconstruction of the extra-university research (funding) organizations and government arrangements for PSR have been the object of several studies, a comprehensive historical or analytical account of the post-war university system focusing on research is still missing; see instead Oehler (1998); Schiedermair (1996) and Schimank (1995).
public research. The universities, however, rejected this model of a centralized and state-guided PSR system and could preserve the status of the Notgemeinschaft as a self-governed organization of science supporting individual and collaborative research projects and young scientists mainly at universities through research grants. In 1951 the Notgemeinschaft was renamed into German Research Society (Deutsche Forschungsgemeinschaft (DFG)). Federal Research Institutes (Bundesforschungsanstalten (BFA)) operated by individual ministries of the central government and a group of independent research institutes of supra-regional importance jointly financed by the Länder, the so-called Bund-Länder-/Blauer-Liste-Institutes (BLI) complemented the PSR landscape. Most of the universities and research institutions had already existed before 1933.

The first postwar decade was characterized by the reconstruction of the research landscape, low level of institutional innovation and government support for science in international comparison and the absence of an active and coordinated national research policy (BMwF 1967: 7). Several factors were responsible for this. Firstly, government spending was primarily consumed by economic and social reconstruction and had to compensate the severe intellectual and material damages inflicted by the NS-regime and the Second World War.25 Secondly, the Allied Powers imposed bans and controls on defense and research areas like atomic energy or aeronautics driving (post-)war government support for science abroad (Braun 1996: 209). Thirdly, a permanent jurisdictional conflict between Bund and Länder emerged concerning the distribution of responsibilities for research policy which impeded coordinated and concentrated government support and the establishment of effective government arrangements for PSR. This conflict promoted a “laissez-faire”-approach (Bräunling/Harmsen 1975: 10-12) in science policy until the 1960s which left it largely “to the self-governed [research] organizations, the universities or the individual scholar to decide on research topics or objects” and to allocate resources (BMwF 1965: 10). In contrast to Bund and Länder the scientific community disposed with MPG, DFG and WRK of powerful corporate actors which had the expertise and administrative capacities for research planning and coordination at the national level.

The federal states used the absence of a central government until 1949 not only to reestablish their exclusive responsibility for universities, but to expand their domain on the national extra-university research organizations. This aimed basically at the Max-Planck-Society and German Research Society, which had developed into prestigious and influential institutions for academic research and were formerly financed by the Reich. In 1948 the Länder set up the “Standing Conference of Ministers of Education and Cultural Affairs” (Ständige Konferenz der Kultusminister (KMK)) with the task to ensure “that the cultural sovereignty of the Länder will be protected with regard to all measures of federal

25 See the first “Federal Report on Research” (BMwF 1965): 28-29 and Stamm (1981): 41-60 for a stock-taking. According to these sources already between 1933-39 1700 university teachers emigrated including 12 Nobel prize winners and the number of students declined from 112000 to 56000. For a detailed historical account of the post-war reconstruction of the PSR system on which the following paragraphs are based see Stamm (1981) and Osietzki (1984).
Historical development of German PSR agencies.” With the establishment of the KMK the Länder demonstrated their willingness to recognize and take over responsibility for cultural policy not only at the regional, but also at the national level and signaled their determination to keep out a future central government from this policy area. Horizontal self-coordination in the framework of the KMK was intended to make vertical cooperation between Bund and Länder or a hierarchical centralization by the Bund unnecessary (Götz 1992: 78-80).

To underline that this was not only a mere declaration of intent the state governments concluded in March 1949 an “Agreement on the Financing of Scientific Research Institutions”, the so-called “Königstein Agreement” (Königsteiner Abkommen), in order to show their ability their ability to organize and support supraregional scientific research. It declared the promotion of scientific research to be “basically a task of the Länder” and established a joint funding of “scientific research facilities whose functions and significance exceed the general sphere of activity of a single Land” or “whose need for support exceeds the financial capability of a single Land.” Included were the Max-Planck-Society, a number of independent research institutes, which became later the Bund-Länder-Institutes and, since 1954, the German Research Society. At the same time the agreement “assumed” that these facilities “are not simultaneously receiving subsidies from the Bund.” Only research institutions “which serve exclusively or predominantly the central administration in carrying out its tasks” were regarded as federal PSR domain. An Administrative Committee was set up composed of the state ministers of culture and finance to decide on the volume and distribution of the jointly provided research funds. The Königstein Agreement was clearly motivated by the imminent establishment of the federal government. By taking pre-emptive action the states wanted to present the Bund with a fait accompli excluding the latter from an involvement in research policy-making and funding (Bentele 1979: 69-71; Götz 1992: 81; Hohn/Schimank 1990: 102-107; Stamm 1981: 99-108/141-150).

The constitution of the Federal Republic largely confirmed this federal distribution of competence in science policy favoring the Länder. It restricted the powers of the Bund on concurrent legislation for the “promotion of scientific research” (Art. 74 No. 13 of the Basic Law) while the federal states received complete autonomy in cultural and educational affairs (Kulturhoheit) which includes according to the German tradition also responsibility for science. Culture, education and science are today regarded as the “kernel of the statehood of the Länder.” Accordingly the states have jealously guarded their prerogative in science and education policy and defended it against centralization. Until 1957 the KMK was the only intergovernmental institution dealing with education and science policy issues at the national level and the Königstein Agreement excluding the Bund remained in force until 1964 (Götz 1992: 82). Several attempts of the Bund to pass a federal law on research promotion failed not least because of the resistance of the Länder whose consent is needed, because concurrent laws require

---

26 Blair (1981): 161; Götz (1992): 74-75; The restriction of the legislative powers of the Bund in science policy follows from Art. 30 of the Basic Law according to which “the exercise of governmental powers and the discharge of governmental functions shall be incumbent on the Länder insofar as this Basic Law does not otherwise prescribe or permit.”, see Staff (1971): 36-38; Osietzki (1984): 321-328.
a majority in the Bundesrat, the second chamber of parliament composed of representatives of the state governments. Following the Königstein Agreement the states interpreted the powers in cultural and science policy which the constitution granted to the Bund very restrictively. On the one hand the Länder were open to or, with increasing costs of higher education and scientific research, even sought federal support for research funding (see below). On the other hand, the state governments wanted to limit the involvement of the Bund strictly on the provision of additional financial means while decision-making on resource allocation including the federal grants and organizational or substantial matters in PSR should remain the domain of the Länder in so far as these issues were not delegated to research institutions and scientists themselves (Hohn/Schimank 1990: 98-111; Stucke 1993: 35-41).

In consequence, the Bund was initially almost completely excluded from the research policy arena. Although its financial contributions quickly reached a significant level due to the Länder’s resistance and the lack of administrative capacities the central government took a low profile in science policy matters. Responsibilities were split between a department for “science and universities” within the “Federal Ministry of the Interior” (Bundesministerium des Inneren (BMI)) and the various ministries which operated Federal Research Institutes. The latter also controlled the bulk of federal research funds, because applied research supporting the federal ministries in policy formulation and implementation was an undisputed PSR domain of the Bund (Mayntz/Scharpf 1990: 61). An “Interdepartmental Committee for Research Matters” under the chairmanship of the BMI had the task to coordinate the research activities of the various departments, but had no authority for hierarchical coordination (Stucke 1993: 43-46; Stamm 1981: 141-150). However, as in the past the inability of the Länder to provide adequate support for PSR proved as a window of opportunity for the Bund to “buy” its way into research policy. Already in 1950 the former accepted a federal grant to the DFG. It was also the Bund that provided the DFG in 1952 with special means to finance priority programs (Schwerpunktprogramme) for helping particularly damaged or important areas of science to catch up with international standards and since 1953 the DFG received most of its funds from the Bund (Zierold 1968: 345-351; Stucke 1993: 41-42).

The early example of the DFG shows the inconsistency in the policy of the Länder towards the central government. Their strategy to accept federal co-funding while at the same time refusing the Bund seat and vote in the policy-making bodies deciding on the allocation of resources was doomed to failure.

27 The Bund can use its powers for concurrent legislation if a matter “cannot effectively be regulated” by individual Länder, if a regulation by “a Land law might prejudice the interests of other Länder or of the people as a whole” or if the maintenance of “legal or economic unity, especially ... uniformity of living conditions” requires a regulation at the federal level (Art. 72 § 2 BL). Science and (higher) education clearly fulfill one or several of these conditions. Since the Länder “execute federal laws as matters of their own concern” (Art. 83 BL), however, all legislative acts of the Bund requiring additional expenditures or changes in administrative structures by the Länder can only be passed with the consent of the Bundesrat.

28 In the mid 1950s, for example, the Federal Ministry of Agriculture disposed of about 40% of federal research funds (Stucke 1993: 43).
Historical development of German PSR

The effects even were contrary to the original intentions expressed in the Königstein Agreement. Far from reducing the influence of the Bund in science policy the exclusion from formal government and funding arrangements by the Länder turned out to increase its powers, because it gave the central government a maximum of flexibility and allowed it to pursue a carrot and stick policy towards states and research institutions. Contributions to the regular budgets of universities and research organizations were subject to long-term commitments and were provided mainly in the form of non-earmarked block grants. But instead of involving the Bund in this institutional funding the Länder restricted federal grants on specific programs and projects to set no precedence with regard to the jurisdictional conflict. This was unproblematic as long as their share in the overall research budgets remained low and the central government had no science administration which was capable of formulating an independent federal science policy. However, when the dependence of Länder and research organizations on federal support increased and the Bund established an own research ministry, it could influence the structural development and direction of public sector research more effectively than the Länder by offering grants to research institutions and projects which corresponded to its objectives in research policy.

At last, it were the Länder themselves which were interested in ending the “policy of the golden reign” by institutionalizing a joint funding system and formal intergovernmental arrangements in PSR as a means to stop the informal centralization of science policy and to get a say in and control over the use of federal research funds (Bentele 1979: 83-99; Hohn/Schimank 1990: 353-372; Stucke 1993: 77-82). The decision of the Länder to accept a joint federal-state funding of the German Research Society was the first step in the departure from the attempt to keep the Bund out of research policy and started a development in which the horizontal self-coordination of the Länder in research promotion was gradually supplemented by arrangements of vertical cooperation between Bund and Länder. This at first informal “interlocking” of policy responsibilities (Politikverflechtung) characterizing German federalism in general and research policy in particular was institutionalized in the sixties and early seventies.²⁹ In the end, the federal government had not only made significant inroads into a policy area which the Länder originally claimed as their exclusive domain, but its research ministry had become the predominant policy actor and funding agency in the PSR system (see below; Bentele 1979; Götz 1992; Stucke 1993).

Between 1955 and 1965 the German PSR system underwent a first phase of expansion and reorganization. Total expenditure on R&D showed a fourfold increase and its share in GDP doubled, but in international comparison government support for science remained low (Keck 1976: 117-121).

²⁹ “Politikverflechtung is understood as the establishment of intermediate structures linking the politics – namely, the decision processes – and policies – the substantive responsibilities – of initially autonomous organizations.” (Lehmbruch 1989: 222). The pioneering works on the German model of cooperative federalism, its problems and pathology are Scharpf/Reissert/Schnabel (1976) and Scharpf (1987).
Benefiting from a federal distribution of tax receipts in its favor especially the central government could increase its support for PSR and accounted already in the early 1960s for about half of overall public spending on R&D (Table 1A). The resistance of the Länder against a stronger involvement of the Bund weakened when education and science received a more prominent place in public and political discussion in the mid 1950s. Germany was perceived to lag behind other countries with regard to the training of a highly qualified workforce and scientific research threatening her economic and technological competitiveness. This debate reached a peak in the 60s when a “German education catastrophe” was proclaimed. An international dimension was added through the so-called “Sputnik-shock” and the resulting fear within the Western Alliance that it would loose its scientific-technological leadership to the Soviet Union (Schimank 1995aa: 60-61). On this background a consensus among Bund, Länder, industry and scientific community developed that a joint and coordinated effort was needed to close the “scientific-technological “gap” between the Federal Republic and its main economic competitors” (Götz 1992: 84; Hohn/Schimank 1990: 353-359; Stamm 1981: 195-209; Benz 1996: 1667-1668). However, the Länder lacked the budgetary resources for a simultaneous expansion and modernization of the education system including universities and the public research system. Since the central government was already involved in research promotion, if on a low level, it was rational for the states to concentrate federal support in this area while concentrating own resources on primary, secondary and vocational education which was one of their last exclusive spheres of responsibility (Hohn/Schimank 1990: 116/359-360). In addition, the increasing complexity and costs of most research areas, especially the resource demands of targeted big science and technology programs, which supplemented general science promotion as a second objective of research policy, clearly exceeded the means of even the largest Länder and were “natural tasks” of national authorities (Bentele 1979: 86-87).

For the research organizations the prospects of a stronger financial involvement of the central government offered two major advantages. Firstly, it provided an escape from the budgetary straitjacket following from an exclusive Länder-financing. Secondly, it was an additional safeguard of their scientific autonomy. In a joint funding system of Bund and Länder attempts for a political direction of research were more unlikely than in the present unilateral dependence from the states, because in the former an agreement of Bund and Länder on common positions and guidelines concerning substantial issues would be required, something which already had turned out to be almost impossible in the framework of the Königstein Agreement. It was the inability of the Länder to reach a consensus on which institutions should be supported and how resources should be distributed among the institutes and research areas, to which universities and research organizations owed their high level of scientific autonomy

---

30 This was the title of a widely noticed study Picht, Georg, 1964: Die deutsche Bildungskatastrophe. Olten: Walter.
and self-government in the first place, a lesson which was not lost to the scientific community (Braun 1996: 218-222; Hohn/Schimank 1990: 107-111).

In 1956, the demands for a stronger involvement of the central government in the financing of public research and higher education led to a major intensification and a year later to a first institutionalization of Federal-state co-operation in research promotion (Stamm 1981: 195-223). With the consent of the Länder the Bund extended its financial support on university construction and the Max-Planck-Society which were hitherto exclusively funded by the states. But still the state governments denied the central government admission to the Königstein Agreement and thus a formal recognition of its role as an equal partner of the Länder in research policy which the Bund had de facto acquired (Hohn/Schimank 1990: 117-118). A first partial settlement of the ongoing jurisdictional and political conflict impeding a joint and coordinated development of the university and research system at the national level was brought about by the establishment of the Science Council (Wissenschaftsrat (Wissenschaftsrat (WR)) in 1957 through an administrative agreement between Bund and Länder following an initiative of the DFG-president. 31 He demanded a long-term plan for research, which in his view could not be realized without a strong and long-term involvement of the Bund due to its superior financial capacities, and the setting up of a “central council for science” as a forum for regular consultation and systematic coordination among Bund, Länder and science organizations in order to ensure an efficient and effective resource allocation and to avoid duplication of founding and funding activities.

The Länder were interested in such a council, because it offered the opportunity to subject the proliferating system of federal donations to their collective control. Naturally, it was not in the interest of the central government to loose flexibility and discretion in science policy. But its main objective at that time was to attain a formal recognition and legitimization of its involvement in research policy. For this reason, any agreement with the Länder constituting a step in this direction could count on support by the Bund. For the scientific community a national science council which institutionalized the participation of scientific representatives in research planning and policy-making was even more advantageous than for Bund or Länder. It provided them with a means to control and limit political direction and government interference and gave them a formal and institutionalized role in thematic and structural priority setting for PSR protecting their scientific autonomy (Bentele 1979: 87-88; Hohn/Schimank 1990: 360-361; Stucke 1993: 55-57).

Reflecting this underlying interest configuration the Science Council became the first of the intermediary bodies linking Bund and Länder on the one hand and state and science on the other hand which are a structural feature of German government arrangements for PSR. In consequence, the founding of the Science Council can be regarded as a milestone in the postwar history of the public research system. In the WR the states granted the central government for the first time equal representation in a science

policy body. At the same time the federal and state governments officially recognized the role of the science organizations in research planning and policy formulation by delegating the preparation of decisions with regard to “professional and scientific aspects” to scientific experts. Until today the Wissenschaftsrat is the only institutionalized forum where high-ranking representatives of all major PSR actors including the federal and state finance ministries regularly meet to discuss science policy matters and where political and scientific interests could be mediated and coordinated with financial possibilities. This makes the Science Council at the same time a central institution of cooperative federalism and a scientific advisory body in higher education and public research. Its dual mission is clearly reflected in the intricate organization and decision-making procedures (see below) which guarantee that no decision can be taken against the will of either Bund, a majority of the Länder or the scientific representatives. Thus, decisions of the Science Council are based on compromises among the central players in PSR.

In this way the WR performs an indispensable function in the German research system where centralized and hierarchical would founder on the constitutionally guaranteed federal state structure and principle of scientific self-government providing Länder and research institutions with autonomous rights and scope of action. It is mainly this function which can explain why the Science Council has become a principal actor in German PSR despite of its weak formal powers (Hohn/Schimank 1990: 362-363). The WR has a strictly consultative mandate and can only give recommendations which are non-binding on Bund, Länder, universities or science organizations. However, since the recommendations have been passed with their consent they put addressees under political pressure to keep their commitments. Even more important for the authority of the Science Council is the declared policy of the federal refinance ministry to approve federal grants to new research institutions or projects only if they received a positive assessment by the Science Council concerning their scientific merit. With this strategy of the finance administration to use the Wissenschaftsrat as an instrument for subjecting research policy under budgetary control the Council moved unintentionally into a key position in research policy making. Although a positive evaluation of the Science Council does not automatically guarantee the realization of a proposal, a negative one means its termination. Accordingly, the WR occupies the role of a “gate keeper” for new initiatives and reforms in the public research system. This made the scientific representatives responsible for the professional assessment of proposals the real winner of the Science Council. Practically, the scientific community received a veto on all important government measures and projects in PSR which fall under Federal-state cooperation (Hohn/Schimank 1990: 362-363). The need to find compromises that are acceptable to Bund, Länder and science organizations means that decisions often reflect the lowest common denominator and that far-reaching reform proposals could not be expected from the Science Council. Especially plans implying a change
to the “balance of power” among these actors or which require a redistribution of resources or financial burdens have only a low chance to be implemented (see chapter 5.3.2). 32

Besides the extension and institutionalization of vertical cooperation between Bund and Länder in science policy the mid fifties were also a decisive period in the history of the German PSR system for two additional reasons. 33 Firstly, it marked the gradual departure from a passive science policy which left priority setting and resource allocation largely to universities and research organizations and concentrated on the promotion of basic research at universities and Max-Planck-Institutes. Instead program funding in the framework of a targeted technology policy became a second general objective and function of PSR along with the general advancement of science. Secondly and closely related, the federal government gradually developed an independent research policy and established an own research administration initiating a centralization of science policy making and research funding.

In May 1955 the Federal Republic regained its sovereignty with the coming into force of the Paris Treaties. For science this meant a lifting of all Allied research bans on research with the exception of the military use of nuclear energy. The central government sized this opportunity to expand its powers in research policy by setting up a number of targeted programs (Fachprogramme) in several big sciences and technologies marking the start of an active technology policy. Following the models of post-war S&T policies in the US, France and the UK the first and most prominent federal technology programs were set up for defense research (1955), nuclear energy (1955) and space research (1961) regarded as pacesetters of scientific-technological progress and economic development and in which the most advanced countries were estimated to have gained a lead of 10-15 years. It were these programs which became the core of federal S&T policy, to which the bulk of the increasing federal research funding went. In 1963, the Fachprogramme on defense (32%), atomic (20%) and space research (3%) accounted for 55% of federal science spending compared to 22% for general research promotion and 16% for departmental research (BMwF 1967: 160). In addition, it was the need for an administration and research infrastructure to formulate and implement these programs which led to the establishment of a federal research ministry and institutional innovations in the research system.

To the scientific and economic motives stimulating the federal programs one has to add two domestic political factors. Foreign policy considerations played a major role in the setting up and growth of the federal research programs. Participation in European and international collaborations in such fields as nuclear energy and defense research served as an instrument to establish the Federal Republic as an equal partner in EC and NATO. In 1952 Germany joined CERN and in 1957 it became a founding member of the European Atomic Community (EAC). Contributions to international organizations ac-

32 See for the work and an assessment of the Science Council Foemer (1981); Röhl (1994) and Benz (1996).

33 For detailed accounts of the development of federal research policy, especially the technology programs and the establishment of the research ministry see see Schmitz et al. (1976); Stucke (1993) and Eckert/Osietzki (1989).
counted for about 30% of total spending on atomic research (Bräunling/Harmsen 1975: 113). The space program was even more strongly international oriented and served mainly as an instrument to implement the projects of the “European Space Research Organization” (ESO) and the “European Launcher Development Organization” (ELDO) for which up to 80% of national funds were spent.

But even more important than influence of international developments was the escape route which the technology programs offered the Bund in the conflict with the Länder concerning its role in general science promotion. Speed and the extent with which the federal S&T programs expanded were clearly related to the still unsolved conflict with the Länder about the distribution of powers in research policy. The latter still refused the central government a formal involvement in the regular institutional funding of universities and research organizations as incompatible with their cultural autonomy. Accordingly the negotiations over the admission of the central government to the Königstein Agreement again got stuck in the late fifties. Even if it came to an agreement the best the Bund could hope to attain in general science policy was equal representation in policy-making bodies and science organizations in exchange for a sharing of financial burdens. In contrast, with the big science and technology programs the federal government could advance into a field which was not already occupied by the Länder and whose complexity, costs and international dimension seemed to call for a central organization. This provided the Bund with the opportunity to establish an own research administration and infrastructure with which it could pursue its S&T policy independent from the states (Bentele 1979: 82; Götz 1992: 83; Stucke 1993: Chap. 2).

The federal responsibility was undisputed in defense research. Following from the exclusive competence of the Bund for security and foreign policy and the right of federal ministries to operate programs and laboratories for departmental research the federal program for military research was assigned to the “Federal Ministry of Defense” (Bundesministerium der Verteidigung (BMVg)) set up in 1955. The volume of its research budget, the policy to allocate its funds mainly to universities and civil research institutes instead of operating own research facilities and the involvement of the defense ministry in decision-making in areas like aeronautics and space research made the BMVg an important research policy actor whose influence extended its functional domain, even if it never acquired such a prominent role for PSR as in the USA, France or the UK. But the nucleus of the federal research

\[\text{34 Two factors limit direct influence of military considerations on civil science in the Federal Republic. Firstly, the share of basic or application oriented research funding in the BMVg budget is relatively small. Due to a demarcation of responsibilities with the federal research department the BMVg restricts its funding activities on “add on”-programs for the application of civil scientific research for its departmental purposes. In addition, about 80-90% of research funding by the BMVg goes to industry while universities and civil non-university research institutes account only for about 2% of total R&D expenditure by the BMVg and only about 25% of the spending of the BMVg on R&D are classified as genuinely research-related (BMBF 1996: 271-274). Secondly, the Länder do not participate in the funding of defense research. Thus, even in the early 1960s when the BMVg was the main source of federal R&D funding defense research accounted only for 12-14% of total public expenditure on science (for data see Table 15-16A). This share decreased to 9% in 1981. Under the conservative-liberal Kohl government taking power in 1982 the}\]
Historical development of German PSR administration in civil R&D became the “Federal Ministry for Atomic Affairs” (Bundesministerium für Atomfragen (BMAt)). It was established in 1955 with the task to coordinate all research activities in atomic energy. With the BMAt the Bund for the first time claimed the lead in a major civil research area extending from basic research at universities to technology development in industry. For this reason, Länder and science organizations initially resisted the establishment of a federal agency or ministry, the former, because they regarded it as a precedent for a centralization of research policy, the latter, because they saw it as a precedent for a politicization and external direction of research. Referring to the models of the leading countries which all had created powerful centralized organization for their atomic programs and to the financial costs and international dimension of nuclear matters, however, the central government could overcome these objections. In addition, the atomic ministry tried from the beginning to alleviate these fears by following a subsidiary approach in policy making. It did not attempt a hierarchical top-down direction, but saw itself primarily as a sponsor and advocate of research and a coordinator of the decentralized R&D activities of Bund, Länder, science organizations and industry in order to ensure an efficient organization and adequate funding of atomic research. Planning and decisions on research programs and resource allocation were largely delegated to a “German Atomic Commission” (Deutsche Atomkommission (DtAK)) as a central planning and advisory body, composed of representatives from DFG, MPG, universities and business community and federal grants to research institutions were dependent on the consent of the responsible state government (Stamm 1981: 167-195; Stucke 1993: 50-52; Braun 1996: 225-226; Ritter 1992: 62-64).

Although in the first years the atomic ministry was a very small administration did not develop own initiatives to extend its competence into new fields, from 1961 to 1963 the BMAt in several steps was transformed into a general research ministry. This development, however, was more influenced by international factors and internal coalition arithmetic in the federal government than the result of a deliberate strategy to expand the federal role in research policy (Stamm 1981: 225-252; Stucke 1993: 60-65). In 1961, the BMAt received the competence for the new federal program on space research. The decision to concentrate the formerly fragmented federal responsibilities for aeronautics at the atomic ministry was mainly motivated by the need to establish a central political actor which could represent Germany at the international level (Stucke 1993: 62). A first attempt of the BMAt to use the space program as a model for a further domain expansion, however, failed due to the resistance of science organizations and Länder, but also other federal ministries defending their responsibilities and research budgets. It was the coincidental factor to meet the demands of the liberal party (FDP) for an upgrading of its representation in the government after a coalition crisis which finally led to the conversion of the BMAt into the “Federal Ministry for Scientific Research” (Bundesministerium für wis-

BMVg could improve its relative position rising its share in the federal R&D budget from 15% in 1981 to 23% in 1989 and accounting for about 13% of overall government support for science. But the end of the Cold War reduced these figures again to the level of the early 1980s.
senschaftliche Forschung (BMwF)) in December 1962. But once created a quick and far-reaching concentration and centralization of federal research policy developed. Since May 1963, the research ministry is responsible for “principle questions of science promotion”, “the funding of the entire scientific research as far as no other Federal Ministries ... remain responsible” and “the coordination of the entire activities of the Bund in the area of science” (quoted in Stamm 1981: 330). For this purpose the Federal Ministry of the Interior (BMI) had to hand over its administrative division which had hitherto been responsible for general science policy including relations to the states and science organizations and especially the federal support for DFG, MPG, and universities. Already in 1963 the BMwF administrated about 55% of federal and 20% of total public expenditure on civil PSR. Only the Ministry of the Interior (12%) responsible for study grants, Economics (7%), Agriculture (5%) and Transport (5%) kept own research programs and budgets of significant volume, whereby the latter three dispensed their funds mainly to industry and department research in Federal Research Establishments operated by them.36

The setting up of the BMwF meant a dramatic change in the government arrangements for PSR, because the central government now had a power- and resourceful actor with the financial and administrative capacities to pursue an independent and consistent federal research policy. Within a few years one of the most powerful research ministries in the OECD had emerged which became quickly the central policy actor in the German PSR system, although the need to find stable institutional arrangements with the Länder and science organizations insisting on their autonomous rights and acquired domains in policy-making and funding made a hierarchical centralization of science policy by the BMwF impossible. But with the ever increasing costs of an expanding university an research system new research facilities and projects could only be financed with federal support. In addition, an active research policy of the Länder towards the Bund was hindered by the need to reach a common position while the Bund now disposed of an unitary actor which was capable of formulating and implementing own policy objectives and programs (Stucke 1993: 15-16; Braun 1996: 226-229; Stamm 1981: 225-252).

The federal S&T programs led not only to the institutionalization of a federal science administration, but also to major institutional innovations in the German research system. Most important, at least in quantitative terms, was the establishment of “National Research Centers” (Großforschungseinrichtungen (GFE)) which were inspired by the model of US national laboratories.37 These research centers

36 BMwF (1967): 160; for the development of the shares of the most important federal ministries in the federal R&D budget see Table 15A. See for the development of the federal science administration Stucke (1993).
37 See for the establishment and development of the GFE Hohn/Schimank (1990): Chap. 7; Ritter (1992); Szöllösi-Janze/Trischler (Ed. 1990). Krech (1996) provides a good overview over the present situation of this sub-sector.
have a dual mission. Firstly, they carry out strategic research in “big science” which require a concentration of resources and large-scale and sophisticated installations like reactor stations which go beyond the scope of traditional university or Max-Planck-Institutes. Thus, the Großforschungseinrichtungen shall provide the critical mass of infrastructure, financial means and staff that is necessary for competitive research in complex scientific fields. Secondly, GFE have the task to develop solutions for large technical systems like nuclear power plants or complex societal problems like cancer in close collaboration with industry and state whose costs, technical risks and long-term character exceeds the possibilities of industry or government laboratories.

The starting point for and classical domain of the Großforschungseinrichtungen has been atomic energy. Six research centers and reactor stations for civil atomic energy were established between 1956 and 1960. Although only one of these six facilities was a deliberate foundation by the federal atomic ministry they became quickly a domain of the Bund (Hohn/Schimank 1990: 240-259; Stucke 1993: 142-146). The BMAt was the only actor which participated in the operation of all centers and within a few years it had become the most important funding agency when industry and state governments were no longer willing or able to bear the exploding costs. In 1963, the GFE accounted already for about 46% of total R&D expenditure and employed about one third of scientific staff in the non-university sector (Wissenschaftsrat 1975: 397/407; Hohn/Schimank 1990: 253). At the same time, the research centers offered better opportunities to influence the planning and direction of research than at universities or Max-Planck-Institutes. In most GFE final decision-making power on research programs, organizational matters and resource allocation lays with a supervisory body in which government representatives have a majority or decisive vote (Krech 1996: 1312; Meusel 1992: 234-235).

Due to these structural features the BMAt discovered the nuclear centers as a general institutional model for implementing its S&T programs when it expanded its activities into new scientific and technological fields. National research centers seemed best suited for the type of complex and mission-oriented “project sciences” that now were the undisputed domain of the federal research ministry (Hohn/Schimank 1990: 249-253; Wissenschaftsrat 1965: 41-46). Equally important for the BMwF, however, was that the GFE provided the opportunity to establish an own research infrastructure in which the influence of the Länder was weak and which was open to political influence (Hohn/Schimank 1990: 256-258; Stucke 1993: 150-153). Four new national research centers were founded in the sixties, whereby the centers for aeronautics and space research (1962) and data processing (1967) marked the expansion of the GFE into new scientific fields following the setting up of corresponding federal priority programs. Even though the Länder refused to hand over responsibilities for the national research centers completely in exchange for an exclusive federal funding, a formal agreement was reached in 1969 according to which the Bund provided 90% and the Land, in which the GFE is located, 10% of the budget. This gave the Länder a veto position concerning the expansion or
reduction and especially the dissolving of research centers, but confirmed the leading position of the Bund vis-a-vis the centers (Hohn/Schimank 1990: 253-259).

The standardizing and stabilizing of organizational structures and funding arrangements “from above” was paralleled by identity formation and the setting up of common institutions “from below”. Both development established the research centers as a distinct and independent sub-sector in the public research system. Already in 1958 the existing centers had founded a working committee for information exchange and the formulation and representation of joint interests. In 1970, this committee was upgraded into a formal organization the “Association of National Research Centers” (Arbeitsgemeinschaft der Großforschungseinrichtungen (AGF)) to provide its members with a corporate actor at the national level which could coordinate research activities and even more important represent the centers towards Bund, Länder and other research organizations and in intermediary institutions like the Science Council linking these main research policy actors (Szöllösi-Janze 1990).

A second institutional innovation with important long-term effects on the PSR system was the development of the “Fraunhofer-Society for Applied Research” (Fraunhofer-Gesellschaft für angewandte Forschung (FhG)) into a national research organization for applied contract research.38 The FhG had been founded already in 1949 with the active support of the Federal Ministry of Economics as an organization for industry-oriented research in order to complement universities, MPG and DFG whose activities concentrated on fundamental research. But the latter resisted the inclusion of this new competitor for government support into the institutional funding of either Länder or Bund. Without adequate state financing, however, the Fraunhofer-Institutes could not become an attractive research partner for industry, because the institutes lacked the infrastructure and resources to develop promising ideas and lines of research to a level where they could be converted into innovative products and processes and offered to firms.

It was the search of the defense ministry for a research organization which was willing to administer and operate military research programs that finally provided an escape route from this vicious cycle. Between 1957 and 1963 the FhG established five institutes financed by the BMVg performing defense research and acted as a mediator towards civil research institutions on behalf of the ministry. At the same time the generous funding by the BMVg allowed the Fraunhofer-Society also to expand and strengthen its civil research activities reflected in the rapidly growing income from contract research with industrial clients and the establishment or incorporation of new civil institutes (Hohn/Schimank 1990: 197-207). Thus, when in the mid 1960s the newly established federal research ministry looked for an organization which could take over the promotion of applied research and technology transfer and close this “organizational gap” (Hohn/Schimank 1990: 213) in the public research system the FhG was the only German institution with significant experience and capacities in this area. The objections

of the established research organizations against a state-financed Fraunhofer-Society also had weakened in the meantime. Due to an administrative agreement between Bund and Länder in 1964 (see below) putting the funding of Max-Planck-Society and German Research Society on a stable basis, the FhG no longer was perceived as an immediate threat to their own resources. In 1967 a positive recommendation of the Science Council finally paved the way for an incorporation of the Fraunhofer-Society in the institutional funding of the BMwF and a second Science Council commission on the expansion and organizational reform of the FhG regarded the “promotion of applied research with public means” as a condition for “ensuring the technological development in the FRG” (quoted in Hohn/Schimank 1990: 218).

In summary, the German public research system had undergone a major expansion and significant organizational changes in the late fifties and the sixties which transformed its institutional landscape both at the policy as well as at the performing level. With the Science Council and the Federal Ministry for Scientific Research powerful science policy actors at the national level had emerged which increasingly replaced the state ministries of culture and their Conference as the locations for thematic and structural priority setting in PSR and research policy-making. At the same time, universities and Max-Planck-Society had lost their near monopoly in public research. With the national research centers and later the Fraunhofer-Society new research organizations had been established which not only showed strong growth rates, but whose application- and user-oriented mission made them particularly attractive for the innovation and technology policy which increasingly moved into the forefront of research policy. Especially university research was negatively affected by these developments. Already in 1964 the Science Council demanded “restraint in the founding of new research institutions. They shall only be established or supported with public means if it is absolutely necessary for the development of science” (quoted in Bentele 1979: 108).

The background to this warning was the concern that universities will fall back in the resource competition with non-university institutions despite the fact that a major expansion program for universities had started in the early sixties. But this expansion was mainly focused on enlarging teaching capacities in the transition from elite to mass higher education, although research automatically profited from it following from the unity of research and teaching. As long as infrastructure, financial and staff resources grew more strongly than student numbers, research conditions at universities actually improved. However, when this was reversed in the seventies and resource increases no longer matched student increases a profound crisis of the overcrowded mass universities developed whose effects were particularly worse for academic research. In the sixties the lacking organizational, budgetary and role differentiation between the teaching and research function in the German Humboldtian university had allowed professors to use additional resources for research. Now precisely the opposite happened. Without institutionalized safeguards protecting research teaching and examination tasks absorbed an increasing share of budgetary and staff resources leading to a gradual “driving out” of the former by
the latter. While the amount of working time and budget which a university teacher had to devote to research was not codified such a regulation took place for teaching. In addition, governments, industry and, of course, students and their families were primarily interested in teaching output, that means short study times and a maximum number of well-trained graduates which mostly should be qualified for the non-scientific labor market. In consequence, academic research increasingly had to operate under the “shadow of teaching” (Schimank 1995a).

Under these conditions extra-university institutes became more attractive places for research for both policy-makers and researchers. The mission-oriented character of most non-university institutions and the representation of governments in their policy-making bodies made them more amenable to external direction than universities, at least with regard to the selection of research areas and formulation of general research objectives and tasks. For scientists in turn the freedom from teaching obligations and the often superior infrastructure of extra-university institutes offered better research conditions than at universities. A third decisive disadvantage of universities in the competition with extra-university research for resources, however, followed from the federal state structure. With the exception of university construction and supplementary research funding via the DFG the financing of higher education is the responsibility of the Länder. In contrast, the state governments carried only half (Max-Planck-Institutes) or even less (National Research Centers; Fraunhofer-Institutes) of the operating costs of extra-university research organizations creating a strong financial incentive for state governments to locate new research capacities outside universities.

For the Bund the non-university sector was even more attractive than for the states which denied the Bund a direct involvement in university matters to defend higher education as their exclusive sphere of influence. In contrast, federal representatives had seat and vote in DFG, MPG, FhG and the National Research Centers. Here, de facto no decision concerning the founding of new research facilities or programs could be taken without consent of the Bund due to the dependence on federal support. If the Bund wanted to extent its role in research policy the non-university sector provided far better opportunities than universities, especially if one takes into account that academic self-government and the constitutionally guaranteed freedom of research made any meaningful direction of university research almost impossible (Hohn/Schimank 1990). Summing up one can say that “through the establishment and expansion of the national research centers and the MPG a considerable part of research capacities was withhold from universities” (Schimank 1995a: 63).

On this background three major structural problems dominated the research policy debate since the end of the sixties. Firstly, still a stable agreement between Bund and Länder on the distribution of rights and responsibilities in public sector research had to be found. Secondly, the plethora of government and funding arrangements for the various research organizations had to be replaced by a more rational system and a demarcation of research domains and tasks among these organizations established. Thirdly, the university crisis increasingly moved into the center of science policy and PSR had
to be adapted to inner-scientific developments and changed social needs and demands. While the first two problems basically could be solved until the mid seventies the last one is the object of ongoing reform efforts.

2.2.2 From the mid 60s to the late 70s: expansion, institutional consolidation and stagnation of the German PSR system

2.2.2.1 Cooperative federalism and the consolidation of the German research system

The two decades between the mid 50s and 70s can be regarded as the “golden age” of PSR in the Federal Republic. It was first characterized by a “period of affluence” concerning public research funding which originated in economic growth and a corresponding increase of tax income which the state could spend relatively generously on many policy areas including research policy (Hohn/Schimank 1990: Chap. 2). In addition, the attitude of policy makers in Germany was strongly influenced by the “science-push model”, namely that science would contribute best to economic and social development if it was provided with adequate funding and the right to decide which thematic priorities and research topics should be followed (Stucke 1993). The settlement of the jurisdictional conflict between Bund and Länder in favor of a cooperative federalism between 1964 and 1975 acted as a further stimulus for PSR. It is based on an interlocking and sharing of decision-making and funding responsibilities between both levels of government without forcing one or the other side to give up its autonomous rights and powers. For universities and research organizations the establishment and institutionalization of a joint decision-making and funding system meant that the hitherto voluntary federal donations to their budgets were transformed into formally guaranteed, calculable and stable funding. This allowed medium-term planning and the setting up of new institutes and funding programs both in the university and the non-university sector. Equally important for the long-term development of the public research system and closely related to the reform of government arrangements was the so-called “reparcelling” (*Flurbereinigung*) of the research system which assigned the different groups of research institutions specific missions and types of research and established for each group corresponding government and funding arrangements. This does not mean that a clear-cut division of functional domains or even research areas was intended or feasible which would have implied a radical departure from the historically grown institutional landscape. Rather a “basic domain consensus” was reached on who are the important corporate actors in public research and what are their responsibilities and spaces of action. But overlapping and duplication of research activities as well as recurrent debates about an undue shift of influence remains a feature of the German PSR system. However, these domain and resource conflicts were now moderated by the mutual recognition of the existence and specific identities of the different research actors so that fundamental conflicts, which could easily immobilize a decentralized decision-making with powerful autonomous actors, are avoided (Mayntz 1993; Hohn/Schimank 1990: 111-132).
In summary, one can speak of an “constitutional consensus” which had replaced the protracted domain and resource conflicts of the fifties and sixties. Renate Manytz (1993a: 192) describes this consensus as “normatively approved” and covering “(1) basic principles such as the autonomy of research from political direction, decentralization and federalization, and the subsidiary relation of nonuniversity to university research; (2) a patterned division of labor and of legitimate spheres of influence.” The development of a dense layer of intermediary bodies and informal networks of communication and personal relationships linking the main policy (Bund, Länder) and corporate actors (DFG; MPG; FhG; WRK; AGF) stabilized and reinforced the consensus. Decision-making on the structural and thematic development of the PSR system and resource provision and allocation is largely delegated to these “negotiation systems.” In addition, it is here where the demands of government and business representatives for accountability and socio-economic relevance of PSR can be reconciled with the constitutionally guaranteed freedom of research and right to scientific self-government. This formation of sectoral network structures was formalized in the constitutional amendments of 1969 and the administrative agreements and institutional arrangements following from them. The end and apex of this process formed the “Framework Agreement between Bund and Länder on the Joint Promotion of Research” (Rahmenvereinbarung Forschungsförderung (RV-Fo) and the establishment of the “Bund-Länder-Kommission for Research Promotion” (Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung (BLK)) in November 1978 (Bentele 1979; Mayntz/Scharpf 1990: 68-72). Since then government and funding arrangements for PSR as well as the organizational structure of the public research system basically have remained unchanged (Hohn/Schimank 1990: Chap. 9).

Of central importance for the development of the German PSR system was the establishment of stable government and funding arrangements ending the jurisdictional conflict between Bund and Länder over responsibilities in research policy. A first step was the conclusion of an administrative agreement between Bund and Länder in 1964 on the joint institutional funding (50:50) of DFG and MPG (Götz 1992: 88-89; Bentele 1979: 97-103). In addition, the Bund committed itself to provide 250 million DM matched by the same amount from the Länder for the construction of new and expansion of old universities based on the guiding recommendations of the Science Council on the expansion and development of the university system which provided for a doubling of student places and a significant enlargement and modernization of research facilities within ten years (Wissenschaftsrat 1960; 1967). The institutional structures created for implementing the agreement anticipated future intergovernmental arrangements in research policy. An administrative commission was charged to determine the annual volume of the jointly provided funds for DFG and MPG. In this commission the Bund sent six and each of the Länder one representative whereby decisions required a two-third majority. In consequence, neither the former nor a majority of the latter could be outvoted (Bentele 1979: 99). However, while the first “Federal Report on Research” (BMwF 1965: 8) regarded the administrative agreement

39 See for the legal texts BLK (1996).
as a “firm basis” for a permanent Federal-state cooperation, the Länder interpreted it as an interim solution until the planned fundamental reform of the federal state structure, especially the distribution of tax income now favoring the central government, would allow again an exclusive state funding of higher education and scientific research. Accordingly, the state governments restricted the original duration of the agreement to two years with an option for re-negotiation after this period. Only when in February 1968 the constitutional reform was still not realized the Länder consented to a renewal until 1970 (Bentele 1979: 95-97).

But the overhaul of the federal and financial constitution in 1969 did not lead to an American-type federalism in which responsibilities and revenues are assigned either to the federal government or the states and thus both levels of government dispose of separate and independent authority and scope of action. Instead, the developed practice of cooperative federalism which is characterized by the sharing and interlocking of responsibilities and in which neither Bund nor Länder can act independently from each other was confirmed, formalized and expanded (Scharpf/Reissert/Schnabel 1976). Even though not in the center of the debate in research policy this development was particularly far-reaching (Bentele 1979). A constitutional amendment established university construction (Art. 91a Basic Law) and educational planning and the promotion of scientific research of supraregional importance (Art. 91b Basic Law) as “Joint Tasks” (Gemeinschaftsaufgaben) of Bund and Länder for which they share legislative and financing responsibilities. Finally the Bund was empowered to pass a framework law on the “general principles governing higher education” (Art. 75 No. 1a Basic Law). However, both the enactment of the framework law and the Joint Tasks requires the consent of the Bundesrat. Thus, the constitutional amendment did not constitute a centralization of research policy at the federal level through a transfer of power from the Länder to the central government. Instead, the states abandoned their unilateral scope of action for a federal support in research funding and extensive participation in decision-making at the federal level. In this way, the state governments wanted to accommodate their autonomous spheres of competence and influence “with the widely perceived demand for nation-wide uniformity of policy outputs” and “increasing externalities and indivisibilities” in public policies (Lehmbruch 1989: 228-229; Scharpf/Reissert/Schnabel 1976). A pooling of resources and a standardization of organizational structures and administrative regulations was perceived to be of particular importance in higher education and scientific research as the increasing Federal-state cooperation had shown because of the costs and complexity of research exceeding the financial and administrative capacities of even the largest Länder, the need to ensure the mobility of students and scientists and an effective and efficient resource allocation at the national level (Bentele 1979).

That the Länder were not willing to give up their powers in research policy was shown in the difficult and protracted negotiations on the implementation of the Joint Tasks. On two conditions concerning

---

40 See for the two models of federalism Scharpf (1988): 242-244.
the future institutional arrangements for Federal-state cooperation in research and higher education policy the state governments were adamant. Firstly, decisions should not be delegated to the central government, but dependent upon the agreement of the Länder. Secondly and even more problematic in the view of the federal research ministry, decisions should be taken unanimously or nearly unanimously (Scharpf 1988: 254). In this way, the state governments wanted to prevent a “divide and conquer” strategy of the Bund using its superior financial powers to enter into bilateral agreements with individual Länder or research organizations and to play them off against each other. However, for the federal research ministry a decision-making system in which it could no longer act independently of the Länder while each single Land could block a decision was hardly attractive, especially if compared to the flexibility and discretion the ministry possessed under the status quo, because it made a proactive research policy almost impossible. In the end, however, the Bund gave in to the demands of the state governments forced by the better constitutional position of the Länder and the pressure of the science organizations which were interested in a quick agreement after the Königstein Agreement and the Bund-Länder agreement on research promotion had run out putting the financing of most research institutions under extreme uncertainty (Bentele 1979: 139-209; Stucke 1993: 80-83).

The first result of the constitutional amendments in research policy was the “Act for the Support of University Construction” (Hochschulbauförderungsgesetz; hereinafter HBFG) in 1969 codifying the already existing joint funding system for university expansion. For this purpose a “Planning Commission for University Construction” (Planungsausschuß für den Hochschulbau) composed of representatives from the federal research and finance minister and each Land. Its task was to draw up a rolling four-year “Framework Plans” (Rahmenpläne) prepared by the Science Council, which has to evaluate proposed projects and to assess their level of priority, and to decide on the annual volume and allocation of construction grants. Decisions are taken by a three-quarter majority whereby the Bund carries the same number of votes than the Länder. By agreeing to the framework plan the federal government commits itself to reimburse one-half of the costs for projects which are approved for immediate realization (Götz 1992: 92-93). The law on university construction was followed by the “Framework Act for Universities” (Hochschulrahmengesetz; hereinafter HRG) in 1976 after difficult and protracted negotiations. It completed the national arrangements in higher education by setting uniform minimum standards concerning (1) the organization and administration of the higher education system, (2) study courses and examinations, (3) admission to higher education and the selection, (3) employment statutes in the individual Länder.

After a decade of negotiations in 1975 finally also a permanent arrangement for the organization and funding of non-university research was found and formalized in the “Framework Agreement on Research Promotion” between Bund and Länder. It completes the “cartel formation in general research promotion” reflected in the declaration of intent that the Framework Agreement regulates “substance
and procedures of their cooperation in the area of research promotion comprehensively and exclusively” (Protocole note to Art. 1 RV-Fo). With the exception of the federal government laboratories it covers all major sectors of extra-university research for which it establishes a joint funding system. This includes the Max-Planck-Society, the German Research Society (special ratios apply to specific funding programs), and the Bund-Länder-/Blue-List-Institutes receiving 50% of their budget from the Bund and 50% from the Länder, while the ratio is 90:10 for the Fraunhofer-Society and the National Research Centers and 75:25 for the Collaborative Research Centers at universities (see below). In addition, the RV-Fo commits Bund and Länder to “strive for a common position in important questions of research policy in their collaboration with the autonomous research organizations and science organizations of supra-regional importance.” To implement the RV-Fo Bund and Länder set up the “Bund-Länder-Commission for Research Promotion” (BLK) with the mandate (1) to coordinate federal and state planning and decision-making in research policy and to draw up a medium-term planning for research which serves as a negotiation basis for financial planning of Bund and Länder; (2) to plan priority measures for research promotion; (3) to develop uniform administrative and budgetary regulations for the research institutions. However the most important tasks of the BLK are decisions on the in- and exclusion of research facilities into the joint funding and the determination of the annual budgets of the research institutions and programs covered (Art 10 RV-Fo).

From 1975 onwards de facto all major decisions concerning the organization, funding and administration of state-financed non-university research have to be taken jointly by Bund and Länder in the framework of the BLK. For routine and administrative affairs and the preparation of decisions a “Committee Research Promotion” with several permanent working groups was established in which federal and state representatives carry the same number of votes. Central decision-making body is the Commission composed of seven representatives of the central government under the leadership of the federal research ministry and two representatives of each state government. Members have to be ministers or secretaries of state. Decisions require either a three-quarter majority whereby each Land has one and the Bund has eleven votes which have to be cast as a block. Formally the Commission can only give recommendations to the heads of federal and state governments, come only into effect if at least nine of (12) have agreed and is binding only to the consenting parties. To accelerate and simplify these complicated decision-making procedures a proposal of the Commission is also considered to be

41 For the negotiations leading to the framework agreement see Bentele (1979): 133-209.
42 The core of the Bund-Länder-/Blue-List-Institutes (BLI) formed the former group of supraregional research institutes jointly financed by the Länder under the Königstein Agreement of 1949. In contrast to MPG, FhG or the National Research Centers the BLI are a loose collection of institutes with very diverse research areas and missions and without a central organization. Their status as a distinctive sector of PSR derives from the administrative decision to draw up a list of the institutes which will be included in the joint funding. Originally, this list was printed on blue paper from which the Bue-List-Institutes received their name.
43 See for the BLK Schlegel (1996).
approved if no objection is raised by either the Bund or a Land within four weeks. In addition, in so-called routine affairs including financial plans, budgets and annual grants to the jointly funded research institutions decisions also take effect if they have been taken unanimously by the Commission (Götz 1992: 104-105; Bentele 1979: 209-214).

Looking at these institutional arrangements it is not surprising that the BLK did not become a strong actor in German research policy where Bund and Länder formulated objectives and developed instruments for a political direction of PSR. It has been proven largely impossible to agree “a on common position in important matters of research policy” towards the “autonomous research organizations and supraregional science organizations” (Art. 4 RV-Fo) among twelve autonomous governments with diverging interests in science policy. Instead the Bund-Länder-Commission functions as the central forum and clearing house for Bund and Länder on the administrative and especially financial aspects of institutional research promotion exceeding a certain threshold of importance and costs in the Federal Republic. The work of the BLK has been dominated by the determination of the overall volume of annual grants to the jointly funded institutions and projects, the distribution of costs between Bund and Länder and the decision on the establishment or termination of research institutes, projects and funding programs. These latter decisions, however, are mostly prepared outside the BLK in the Science Council and the policy-making bodies of research organizations with regard to substantial issue whereas the Commission is mainly concerned with budgetary implications and particularly the effects on the regional distribution of research capacities, but normally does not deal with the substance of proposals (Schlegel 1996: 1997; Götz 1992: 100-102).

The government arrangements established between 1969 and 1975 have had both positive and negative consequences for the development of the public research system. On the one hand, it put the public funding of university and non-university research on a permanent and stable basis and widened its resource base through the formalized involvement of the Bund. With the exception of general university funding which is still an exclusive responsibility of the Länder the central government carries half or more of the costs for supraregional research. Moreover, the “extremely high thresholds for consensus formation” (Lehmbruch 1989: 231) in the Bund-Länder-Commission and other Federal-state decision-making bodies on research policy protects science organizations against abrupt fluctuations of budgets and political interference as for example British universities and research institutes have experienced in the eighties. To implement budgetary cuts, to close research institutions or to subject research to political direction is very difficult if one needs the unanimous consent of more than ten autonomous governments. In consequence, selection of research topics and resource allocation is largely delegated to the scientific community in order to depoliticize decision-making, while Bund and Länder mainly determine the overall level of government support and discuss with science organizations thematic priorities including political and socioeconomic interests and organizational and administrative issues. Thus, with respect to their scientific autonomy and the stability and predictability
of funding the research organizations have clearly profited from cooperative federalism (Stucke 1993: 83-85). It is also not least because of these government arrangements that German PSR escaped severe resource cuts and political interventions in the eighties and nineties when economic problems and a growing discontent of governments and industry with the output of universities and public research institutes put them under pressure.

Over time, however, the deficiencies and dysfunctional effects of the vertical interlocking of responsibilities in research policy also have come to the fore. Firstly, for the increased stability of funding the jointly financed research organizations had to pay with narrow margins of growth. The development of public research funding follows a “convoy principle” in which the slowest ship, that means the financially weakest government, determines the pace of the whole convoy, that means the growth rates of joint institutional funding by Bund and Länder (Hohn/Schimank 1990: 132-134/378). In the Bund-Länder-Commission on Research Promotion financial decisions can only be taken unanimously, while additional contributions to the regular budgets of research institutions covered by the Framework Agreement are subject to the consent of all or the majority of parties (Art. 6 RV-Fo). The Länder, however, have no interest in a further shift of weight towards the Bund in research policy, while for an individual Land there is no incentive to provide additional funds which benefit all states. An escape route from this growth trap offers project funding which is not covered by the Framework Agreement. But these funds are no functional equivalent for general block grants, because they are provided for specific projects and normally do not cover infrastructure and overheads. In addition, they reduce the scientific autonomy of research organizations. Secondly, the principle of unanimity which de facto governs all major decisions in the Science Council and the Bund-Länder-Commission makes decision-making in both institutions “bureaucratic, slow and cumbersome” (Götz 1992: 106).

Changes to the status quo in the organization and funding of PSR are permanently endangered by the veto of a negatively affected government whose consent is needed either for passing a decision or implementing it. For this reason, research policy-making in the Federal Republic is characterized by the constant search for compromise and consensus which often allows only decisions on the lowest common denominator. Especially, reform proposals which threaten the existence, identity or “vital” interests of one of the main actors, that means Bund, Länder and science organizations, are almost impossible to implement. In times of growth this “reform immobility” was not of major concern, because institutional and thematic innovations in PSR could be realized through the establishment of new research facilities and programs. But when in the mid seventies the expansion almost came to a halt the dysfunctional effects showed. Now, innovations and reforms required selective priority setting and resource concentration including decisions on which research institutes and areas to terminate in order to free resources for more innovative and promising ones. In a policy-making system in which each Land pays attention to the regional distribution of research capacities and universities and research organizations have manifold possibilities to undermine unwelcome reforms, such, naturally disputed,
decisions are extremely difficult to take and especially to implement. In the view of many commentators the institutional and financial stability in PSR following from cooperative federalism has turned from an asset into a liability because it prevents its adaptation to new challenges and demands (Krull/Meyer-Krahmer 1996). This applies especially to the universities, which fell into a profound crisis in the late seventies (Wissenschaftsrat 1988; 1993c). But structural problems and shortcomings are also obvious in non-university sectors like the National Research Centers (Hohn/Schimank 1990: 259-295).

2.2.2.2 The Federal Ministry for Research and Technology

In parallel to the expansion and institutionalization of Federal-state cooperation in science policy also an expansion and consolidation of federal research activities took place characterized by a proliferation of funding programs and the growth and reorganization of the federal research administration. In 1969 the Federal Ministry for Scientific Research was renamed into “Federal Ministry for Education and Science” (Bundesministerium für Bildung und Wissenschaft (BMBW)) in response to the new federal powers in educational affairs. This renaming also reflected the high priority which education policy was given on the agenda of the new social-liberal government taking power in 1969. To open up higher secondary schools and universities to all social groups and to democratize and modernize (higher) education was one of the central projects of the “reform” coalition between SPD and FDP. But four years later, when educational reform had run into difficulties due to ideological disagreements between the central government and the conservative-ruled Länder, the BMBW-departments responsible for research and technology again were assigned to a separate department.

With the establishment of the “Federal Ministry for Research and Technology” (Bundesministerium für Forschung und Technologie (BMFT)) the central government wanted to avoid a superseding of research by education policy and a spill over of the political conflicts on Federal-state cooperation in research promotion (Stucke 1993: 70). One important consequence of this reorganization was the splitting of competence for university and non-university research with negative effects for the former. Federal responsibilities for university planning and reform, and the institutional funding of the German Research Society as the main funding agency for university researchers remained with the BMBW. As a classical education ministry, however, teaching considerations clearly dominated its higher education policy. Lacking the formal powers and financial means for a strong involvement in university affairs the BMFT concentrated its attention and resources on its own domains: extra-university research, industrial research and targeted program funding. Already in 1975 the Science Council criticized the low participation of universities in the federal programs and demanded to adapt program formulation and grant procedures in a way that would correspond better to the interests and organization of university research and improve their application and success rates (Wissenschaftsrat 1975: 61-62).
At the beginning of the seventies the federal research administration also underwent an internal reorganization. By then it had reflected the historical development of the federal involvement in science policy and the division of labor with Länder and research institutions. Two general departments for (1) overall questions of research promotion and (2) basic research and research coordination were responsible for policy formulation, Federal-state cooperation in Science Council and Bund-Länder-Commission and relations with the science organizations. However, the most powerful actors within the federal research administration were the departments built around the big science and technology programs, for which the atomic program had served as an organizational model (see above). For each Fachprogramm a separate administration and scientific advisory body had been established leading to a horizontal segmentation of the federal research administration along thematic lines. The development of rather independent and uncoordinated program domains was reinforced by vertical integration within the programs among the responsible BMFT-department, its scientific advisory bodies, mostly a rather small and closed group of influential scientists and industrialists, and its major clients, often the same research institutions and firms from which the consultative experts originated. These “iron triangles” defending “their” programs and resource domains made comprehensive research planning including change of programs and redistribution of resources in response to new scientific developments, political priorities or socioeconomic demands difficult. As long as new priorities could be realized by adding new programs and establishing new research institutions no major problems emerged. But similar to the joint funding system of Bund and Länder this changed when the growth rates of the BMFT-budget slowed down in the mid seventies. New research topics and funding instruments now could only be financed at the cost of established programs. This turned out to be a slow, cumbersome and only partly successful process, because the latter could mobilize a powerful coalition of actors inside and outside the federal government. In addition, financial commitments to long-term and costly projects, for example in atomic and space research, reduced the flexibility of the federal research policy to react to new challenges further (Stucke 1993). On this background, the Science Council saw already in 1975 that the “tendency of the Federal Ministry for Research and Technology to establish for each program at least one national research center” implies “the danger that the individual programs will strive for autarky” (Wissenschaftsrat 1975: 60) and that “the persuasiveness and forcefulness of departments and sections of the Federal Ministry of Research” play a far more important role for budget planning than scientific advice (ibid. 58). Accordingly the federal research policy showed a high level of path-dependency concerning the number and topics of funding programs as well as their relative weight.

On this background the new social-democratic research minister undertook in the early seventies a complete overhaul of the advisory system, the establishment of a comprehensive information and planning system and the introduction of systematic quality control at the federal level. With these measures the minister wanted to make research policy-making more democratic and transparent by
breaking up the “iron triangles” and reducing the dependence of the federal science administration from the cartel of academic notables and industrialists dominating the influential expert bodies like the German Atomic Commission. At the same time, research activities should be better coordinated within the BMFT and with other departments and support more strongly concentrated on promising and innovative research areas and technologies and the most productive research institutions and researchers (BMBW 1972: 9-13; Schmitz et al. 1976; Stucke 1993: 89-92). In 1971, the former commission for the individual Fachprogramme were dissolved and replaced by special committees (Fachausschüsse) with reduced competence and membership complemented by a number of ad-hoc commissions dealing with specific program aspects or issues crossing program boundaries.

With this more problem-oriented organization the BMFT wanted to meet the “ossification” of existing program and spending patterns. In addition, terms of membership principally was limited to two years and the circle of experts broadened to promote the taking up of new ideas and lines of research and the responsiveness of PSR to scientific and technological developments and social needs (BMBW 1972: 11-12; Wissenschaftsrat 1975: 57-58; Stucke 1993: 92). To ensure that program formulation, priority setting and resource allocation takes into account considerations reaching beyond the confines of individual programs these tasks were delegated to the “Advisory Committee for Education and Science Policy” (Beratender Ausschuss für Bildungs- und Wissenschaftspolitik (BABW)) established in 1967 (BMBW 1972: 11). The reform of the advisory system was accompanied by new inter-departmental arrangements to ensure a consistent and coordinated federal S&T policy. A systematic and obligatory information system on the planning and implementation of research programs and projects by the various federal ministries was established based on annual “program budgets” and “performance plans” laying down program objectives and criteria according to which progress and goal attainment could be controlled. This was complemented by creating or strengthening existing inter-departmental coordination bodies and jointly administrated priority programs in order to avoid duplication of research efforts and to bring departmental activities into line with the general objectives of federal science policy (BMFT 1975: 22; BMFT 1979: 24).

2.2.2.3 Programmatic expansion: the transition from a “passive” to an “active” research policy

The reorganization of government arrangements and the expansion of the public research system from the mid sixties to the mid seventies has to be seen on the background of a strongly increased political and economic interest in scientific research (Stucke 1993: 119-126). New scientific knowledge and its conversion into innovative technologies, products and problem-solutions were perceived as the key elements of economic competitiveness and social development in a “post-industrial society” in which knowledge becomes the most important resource and production factor (Bell 1975). In addition, Keynesian demand management and science-based state planning and policy-making reached a high-point in the late sixties and early seventies with the entry of the SPD into the grand coalition (1966-69)
Historical development of German PSR (1969-1982). In the same period the OECD (1968) published its influential reports on “Gaps in Technology” arguing for a new research and technology policy to (1) “relate government science policy more explicitly to clear-defined economic, social, defence and other objectives in order to provide clearer orientation of effort”; (2) strengthen communication and co-operation among industry, the universities and government agencies; and (3) “to consult industry much more comprehensively in the formulation and execution of policy ... in order to overcome the weakness in the innovation process” (OECD 1968: 34). This demand for a more active research policy was enthusiastically taken up by the federal research ministry which was still on the search for an own identity and mission (Stucke 1993).

The cornerstones of the “need-oriented” research policy became political priority-setting to ensure and increase the economic and social responsiveness and relevance of PSR, a corresponding resource allocation and a new emphasis on quality control. It was based on the principle that scientific knowledge and its application had become too important to leave research planning and distribution of resources to science alone. Instead, the targeted promotion of key technologies and problem-oriented research in areas of general public interest was to be strengthened vis-à-vis the general advancement of knowledge (BMwF 1967: 7). This policy change is reflected in the “Federal Reports on Research” (Bundesbericht Forschung). The first report (BMwF 1965) was mainly a survey on the existing institutions, government arrangements and public funding of PSR providing “data and ideas” for a better coordinated research promotion among Bund, Länder and science organizations, but abstained from formulation thematic priorities. Institutional funding even dominated in the federal priority programs while targeted project grants accounted only for about a quarter or third of overall expenditure on R&D showing that the federal research ministry did not attempt a thematic direction of research within the broad framework of its special programs.

Already the second and third report of 1967 and 1969, however, emphasized the necessity “to concentrate more strongly and consequently than before on such tasks on whose solution the further development of society and economy is especially dependent.” (BMwF 1967: 7). To realize a “systematic, technological-economic utilization of scientific knowledge” (Stoltenberg 1966: 16) the federal research ministry expanded its promotion for applied research (BMwF 1967: 8) and problem-oriented basic research (BMwF 1969: 8) through the establishment of new priority programs and a shift of weight towards project funding (see below). The 1969 report also introduced a section on “planning and quality control” for “the selection of projects and the assessment of their relative urgency and the

---

44 See Bräunling/Harmsen (1975); Schmitz et al. (1976) and Stucke (1993): Chapter 2 for the following. The Bundesbericht Forschung are the most important official documents on German research policy. Published every two or four years by the federal research ministry the reports contain an outline of policy objectives, government and funding arrangements. The core of the reports form a comprehensive survey and statistical annex of public and private R&D in the Federal Republic and the funding programs of the Bund and since 1984 the Länder making the Federal Reports the best source for data and policy analysis.
expected benefits of their realization” (BMwF 1969: 34) following from the need that increasing research costs not longer allow “a country with the size of the Federal Republic of Germany to advance all conceivable research directions” (ibid. 35). In this context the report stressed the need to include scientific experts in the planning process, but also the political character of decisions on research priorities marking the gradual departure from the postwar “science-push” to a more demand-driven model of research promotion (ibid.: 36).

The change of government in 1969 bringing for the first time a social-democrat to the top of the federal research ministers accelerated and reinforced the conceptual re-orientation of S&T policy. Headed “goal orientation of research policy” the first section of the fourth federal report on research stated the principles and general objectives of the new demand-oriented research policy that formed the guidelines of German research policy until the end of the 1980s (BMBW 1972: 15-21; BMFT 1975: 13-22; BMFT 1984: 11-15; BMFT 1988: 14):

“Research and new technologies influence the future of our society decisively; they help to solve social problems. The research policy of the federal government shall contribute as part of its overall policy federal government

- to preserve and improve the productivity and competitiveness of our economy,
- to improve the living and working conditions of citizens,
- to increase our scientific productivity.” (BMFT 1975: 10).

In line with these three objectives the federal government saw its main tasks in ensuring together with the Länder a broad and competitive science base and “to orient science policy towards social needs through the planned setting of priorities.” (BMBW 1972: 7). Research planning was no longer to be based on the “imitation” of developments abroad, but on a systematic and transparent information and coordination among the interests and demands of state, science, industry and the general public (ibid.: 9-13). In addition, the federal research ministry developed for each goal a specific set of funding instruments.

- Acknowledging the importance basic research as the “general source of new knowledge and theoretical fundament of application-oriented research and the innovation process” (BMBW 1972: 15) the BMFT committed itself to promote fundamental research in its “entire breath and variety” (BMFT 1975: 15). This was to be implemented through an adequate institutional support of universities, Max-Planck-Society and German Research Society in the framework of Federal-state cooperation in general science promotion leaving resource allocation mainly to the established procedures of scientific self-government (BMBW 1972: 15). Universities and science organizations, however, were required to establish institutional structures for structural and thematic priority setting and systematic quality control (BF 1972: 15-16; BF 1975: 18-19).
• Economic competitiveness and employment was to be secured through a modernization of the economy. “In this context research policy has to make a significant contribution through the promotion of new technologies and processes for innovative sectors of industry and services.” (BMFT 1975: 10). Due to the economic problems and rising unemployment in the wake of the oil crisis this objective clearly dominated federal research policy (Hauff/Scharpf 1975).45 Instruments of innovation policy were (1) new federal priority programs for key technologies; (2) targeted project funding of industry research and collaborative research between industry and public research institutions and the (3) establishment of institutions for technology-transfer. Increased government support for industry was justified with three features of scientific research leading to inadequate private R&D efforts: (1) the high scientific-technological and financial risks; (2) the long time horizon of most areas of technology development and the (3) public good character of scientific and technological knowledge (BMBW 1972: 18-20; BMFT 1975: 13-18).

• A third and new focus of German S&T policy which clearly reflected social-democratic values became the so-called “precaution” or “public” research (Vorsorgeforschung). By establishing research programs and capacities in the areas of health, environment, working conditions, transport and urban planning the federal research ministry wanted to “create the scientific and technological basis” for the solution of pressing social problems and to cope with unwelcome effects of social and technological change (BMFT 1975: 10; BMBW 1972: 17-18). The programs in this area are characterized by a mixture of institutional funding of basic research and mission-oriented research institutes as well as targeted program funding in all sectors of the research systems.

The new need- and innovation-oriented research policy is reflected in the proliferation of federal programs and a shift of weight in federal research spending from institutional to project funding on the one hand and from PSR to industry on the other hand. While the Fachprogramme for data processing (1966) and maritime research (1967) still mainly imitated international developments, the program for “new technologies” established in 1968 and constituted a programmatic innovation in several respects (Stucke 1993: 121-124). Firstly, it was a political initiative by the Federal Ministry for scientific Research signaling the transition from a passive research policy responding to demands of science and industry to an active S&T policy in which government sets priorities according to political, social or economic needs. Secondly, the program was not confined to a specific scientific or technological field, but formulated as an open “search program”. Its mission was to identify and support innovative technologies which was broadened in 1972 to include the promotion of “precaution research”. Thus, the federal research ministry claimed technology policy as its domain. Thirdly, the bulk of funding was

45 In 1975 the fifth “Federal Report on Research” made the “safeguarding and strengthening of economic productivity and competitiveness” and the “modernization of the economy” the main objectives of federal S&T-policy (BMFT 1975: 10/24). The following report of 1979 emphasized even more the promotion of
distributed to industry and in the form of project funding reflecting its character as a flexible instrument of targeted technology promotion and problem-oriented research (Wissenschaftsrat 1975: 59-61; Schmitz et al. 1976). Based on the new technology program the number of civil *Fachprogramm* increased from 4 in 1968 to 13 in 1975 including

- key technologies and innovation with various sub-programs like new materials and information technologies;
- research and development in the service of health including programs for cancer research and biotechnology;
- research and development in the service of nutrition;
- improvement of working conditions;
- environmental research including sub-programs for housing and infrastructure;

The program expansion was accompanied by a steep increase of project at the expense of institutional funding. While in 1965 project grants accounted only for about 25% of federal expenditure on R&D (Schmitz et al. 1976: 275), their share had doubled to over 50% in 1975 and reached 56% at the beginning of the eighties. Industry was the main beneficiary of this development. In 1965, about 30% of federal expenditure went to companies (Bräunling/Harmsen 1975: A1). This proportion increased to 44% in 1981 (Table 17A). Losers of the new emphasis on relevance and innovation in research policy were the universities and research organizations focusing on basic research. Instead, the national research centers could stabilize their share in the federal science budget (Table 17A).

The concept of a need- and demand-oriented research policy in which the BMFT performed the role of a planning and steering body promoting economic and social modernization encountered increasing problems and criticism at the end of the 1970s. On the one hand, the “active structural policy” (Hauff/Scharpf 1975) could not prevent a deep recession and mass unemployment in the wake of the two oil revealing precisely the structural rigidities and a lack of innovation in the German economy which the BMFT wanted to overcome. On the other hand, when government support for R&D became scarce in the mid seventies the funding instruments and spending patterns of the federal research min-

---

46 In 1975 the fifth “Federal Report on Research” made the “safeguarding and strengthening of economic productivity and competitiveness” and the “modernization of the economy” the main objectives of federal S&T-policy (BF 1975: 10/24). The following report of 1979 emphasized even more the promotion of (technological) innovation in the economy as the decisive factor for solving the economic problems and reducing unemployment (BF 1979: 11-19).
istory came under closer scrutiny and led to a debate about the effectiveness and efficiency of its policy showing several weaknesses and failures.

The objectives to reduce the number of advisory bodies and to establish a more transparent and accountable planning and coordination system for R&D largely had failed and the dissolving of the Beratender Ausschuß für Bildungs- und Wissenschaftspolitik in 1978 was an indicator for this failure to formulate a coordinated and coherent federal research policy. At the end of the seventies the number of committees, commissions and expert councils involved in program formulation and implementation at the federal research ministry had grown to about 130 (Stucke 1993: 89-97). In parallel, the number of program areas and projects had proliferated to an extent where one could no longer speak of a targeted, coordinated and coherent science and technology promotion. In 1981, the BMFT supported about 6000 individual projects and the share of project funding in the federal science budget had increased to 57%. This exceeded by far the informational and administrative capacities of the ministry and increased the dependence on external experts with close relations to the recipients of federal grants for project selection and resource allocation. For these reasons, political priority setting and direction remained rather weak and a systematic and effective evaluation of both project proposals and results did not take place. In consequence, federal research policy was dominated by the continuation of existing programs and project grants concentrated on a relatively closed group of large enterprises and the National Research Centers thematic inflexibility and fragmentation of the federal research policy had not been a major cause of concern and conflict as long as a growing science budget allowed to add new programs and to establish the corresponding infrastructure. However, when the economic crisis of the mid seventies brought the expansion of PSR to a halt the negative consequences showed and led to a disillusionment with and finally a departure from the concept of a need-oriented political direction of research. Three developments exemplify the difficulties and ultimate failure of the active research policy (Stucke 1993: 161-170).

In the mid 1970s the BMFT established a system of so-called “project carriers” (Projektträger). These administrative units were located either at research institutes, mostly national research centers, or industrial associations and responsible for the administration and supervision of a specific federal priority program on behalf of the research ministry. Main task of the Projektträger is the management and evaluation of projects by advising project applicants, preparing the selection of proposals, monitoring the implementation of projects and evaluating their results (BMFT 1975: 21; BMBF 1996: 516). The original purpose of the project carriers was to relief the BMFT from routine administration allowing it to concentrate on strategic decisions like priority setting and to ensure a better control of outcomes (Stucke 1993: 165). In reality, however, the Projektträger “led to a giving up of political control, because the project carrier ... had the possibility to channel information and to predetermine decisions of the BMFT.” (ibid.: 166). Like in the sixties close relations between Projektträger and grant recipients developed and since the former were not autonomous in and responsible for funding decisions laying
with the research ministry they had no strong interest in a stringent project selection and evaluation: “De facto the BMFT had been contend with the function of administrative relief by the project carriers and no longer pursued the objective of controlling outcomes. Decisions of the project carriers were more or less ratified.” (ibid.: 167).

A second indicator for the problems of the federal research policy was its conservative funding profile. Despite the declared intentions of the research ministry to reduce or terminate programs which had run out of steam or were no longer seen to reflect political priorities or social needs, a redistribution of resources towards innovative technologies and research areas of public interest had only partially taken place. In 1968 defense research (37%), nuclear physics (25%) and space research (11%) accounted for almost three quarters of federal expenditure on R&D (Bräunling/Harmsen 1975: A3), in 1975 their combined share was still almost 50% despite the many new programs (BMFT 1979: 396). Even in 1981 the share of the atomic program and the defense program in the federal science budget still was almost as high as the combined expenditure for key technologies (data processing; biotechnology; materials) and innovation or for precaution research (health; environment; renewable energies; transport; living and housing conditions). For example, the health (3,3%) and biotechnology program (0,9%) accounted for less than one third of the nuclear program. The BMFT also was increasingly criticized for the high level of support going to industry in general and a small number of large companies in particular. At the beginning of the eighties industry accounted for more than 40% of federal research grants and these were concentrated on traditional sectors (aeronautics; space, electrical and mechanical engineering) and a few big companies like Siemens and Daimler-Benz in contrast to official policy favoring innovative areas and small and medium-sized companies. Despite an explicit demand for risk sharing between state and industry through joint funding of projects and a participation of the state in the profits arising out of successful projects, the majority of projects was exclusively or predominantly financed by the BMFT and proceeds were marginal. Control and evaluation of research projects was low reinforcing the conservation of existing spending patterns and the trend to a mere subsidizing of industrial research without a directing effect. In consequence, the technology policy of the research ministry was blamed to be largely a distribution of hidden subsidies to outdated technologies and a few privileged firms at the expense of PSR and innovative fields (Stucke 1993: 158-165).

A third area of disappointed expectations and critique became the national research centers. In the mid seventies the establishment of new and consolidation of existing centers was largely completed and budgets and staffs grew only slowly or even stagnated (Hohn/Schimank 1990: 262-264). The challenge for the BMFT was now to adapt the Großforschungseinrichtungen to programmatic changes and new political priorities, whereby two objectives dominated. Firstly, the research programs of the seven

47 The last national research center established in the West German Länder was the “Alfred-Wegener-Institute for Polar and Oceanographic Research” in 1980 which was needed for representing the Federal Republic in the international programs for oceanography and the Antarctic.
nuclear centers had to be diversified, partly because they had fulfilled their original mission, partly because atomic energy met increasing political resistance. Instead, these centers were to focus on new and innovative technologies like materials or environmental technologies. Secondly, the BMFT regarded the national research centers as central elements of its “active structural policy” for economic modernization and wanted to orient the centers more strongly towards industry collaboration and technology transfer. But the plan to make the GFE the instrument of a politically directed innovation policy largely foundered on the resistance, inflexibility and structural rigidities of the centers (see below; Hohn/Schimank 1990: 264-281; Stucke 168-169).

2.2.2.4 From expansion to stagnation: public sector research in the seventies

The organizational expansion and reform of the federal science administration have to be seen on the background of a rapidly growing public research system and a programmatic change in research policy. In 1965, the first “Federal Report on Research” proclaimed a doubling of the national science budget within 5 years in order to rise its share to 3% of GDP. This effort was justified with reference to the higher levels of R&D spending in other OECD countries (Bundesbericht Forschung 1965: 21). Although the goal of 3% could not be reached the share of gross domestic expenditure on R&D in GDP rose from 1.6 to 2.3% (Table 3A). At the beginning of the seventies the Federal Republic surpassed France and the United Kingdom whose national R&D budget had been almost twice as high in absolute and relative terms a decade ago (Keck 1976: 117-121). In the decade from 1965 to 1975 government and industry support for R&D more than tripled, whereby the federal science budget expanded with growth rates almost twice as high than that of the Länder. Accordingly, the Bund accounted in the mid seventies for almost two thirds of public research funding (Table 1A) and a clear division of labor between Bund and Länder could be observed. While the former concentrated on the financing of research infrastructure, the institutional funding of non-university research and targeted program funding through its Fachprogramme, the states spent almost 90% of their science budgets for universities. However, research benefits only partly and indirectly from these general university grants, which are mainly allocated according to the needs of teaching and other university tasks (Wissenschaftsrat 1975: 21-24/49). In consequence, the central government clearly become the dominant political actor in the formulation and financing of research policy, whereas the Länder used their extensive veto positions in Science Council and Bund-Länder-Commission to influence and control federal research policy, but developed only rarely own programmatic initiatives.

48 These impressive growth, however, is qualified if one takes into account the rising inflation in the late sixties and that R&D spending both by governments and industry already slowed down in the early seventies anticipating the economic recession following the first oil shock. While real expenditure on R&D rose by half from 1965 to 1971, it stagnated until 1975. Only the Bund showed still a positive growth rate in real terms (Table 2A).
Sustained by this high level of government support an unprecedented expansion of research and teaching capacities took place in which the Science Council took a central role by formulating guidelines for the structural development of the overall research system and the mission, organization and relationship among the institutional sectors of public research. In 1975, the Science Council published a report on the “Organization, Planning and Promotion of Research” (Wissenschaftsrat 1975) which attempted a first comprehensive survey and assessment of the national research system and served as a reference point and blueprint for the ongoing reorganization of research organizations and government arrangements. The report started from two assumptions. Firstly, the need to take into account the intensified external interests in public research following from the increased importance of science for economic and social development. The demands for relevant and useful research had to be reconciled with sufficient scope for undirected fundamental research as guaranteed by the constitution. Secondly, the expansion of the research system and rapidly rising research costs required coordination of efforts and priority setting to avoid unnecessary duplication of efforts and to direct resources to the most innovative and productive areas and researchers and most pressing problems. On this basis the Science Council tried to identify the various functions and tasks of public research, to assign them to the different institutional sub-sectors and to establish the corresponding internal structures in order to create a more rational organized and coordinated public research system (Wissenschaftsrat 1975: 9-48).

Higher education

Between 1960 and 1975 27 universities were founded (Table 2.2), the number of positions for scientific staff at universities more than quadrupled from 14600 to 67300 (Wissenschaftsrat 1988: 405-406) and government funding for universities (including university hospitals) even rose eightfold from 1.7 billion to 13.8 billion DM (BMwF 1965: 91; BMFT 1984: 344). The main driving force for this growth of higher education was the rapidly increasing demand for higher education supported by state and industry as an indispensable prerequisite for improving and ensuring the economic and technological competitiveness and social development of the Federal Republic. At the same time the social-liberal coalition taking power in 1969 pursued a policy of “social opening” of universities for students from lower social strata. Education was proclaimed as a “civil right” and especially university studies were regarded as a central instrument for social advancement and a more equal society (Schimank 1995a: 58-63; Schiedermair 1996: 40-42). While in 1960 only 247000 students were enrolled at universities or equivalent institutions of higher learning in 1975 their number had exploded to 675000 (Wissenschaftsrat 1988: 312). Even though teaching needs clearly dominated university expansion and resource allocation, academic research profited from this development due to the Humboldtian principle of the unity of research and teaching which means that no organizational, budgetary or role differentiation between research and teaching exists. To the extent that it was not absorbed by teaching and
administration professors could use the additional infrastructure, money and staff for research and as long as budget and staff increases exceeded or at least matched the growth of student numbers the “piggy-back legitimization” of academic research via teaching (Schimank 1995a) was to the benefit of the latter (Wissenschaftsrat 1993c: 18). Thus, “the enlargement of teaching capacities was followed by an expansion of the research institutes according to the principle: Each professor his institute with a corresponding infrastructure.” (Oehler 1998: 415). Accordingly, overall R&D expenditure by universities more than tripled from 1.5 to 4.6 billion DM between 1960 and 1975 (BMFT 1993: 352-353).

Based on the work of the Science Council Bund and Länder attempted an organizational reform of universities to adapt them to the realities of mass higher education and a democratized professional society without giving up the founding principles of the German, that means Humboldtian, university (Wissenschaftsrat 1960). Responding to the inflation of the traditional faculties to a point where they became “ungovernably” on the one hand and ongoing disciplinary specialization on the other hand, chairs and institutes were reorganized in smaller and, so the intention, more coherent, functional and open units, still called faculties or renamed into departments (Fachbereiche), and the representation of all professors in faculty and university bodies was replaced by an electoral system. Through smaller decision making bodies and flexible organizational structures universities should be enabled to react more quickly to new scientific developments and social demands and to combine the advantages of specialization with the needs of large-scale research and interdisciplinary collaboration in research and teaching. It was not least because of the inability of universities to take up new research areas, often located between established disciplines, and to implement large research programs that they had lost ground to non-university research organizations (Wissenschaftsrat 1970: 93)

At the same time, a cautious innovation and democratization of academic governance was implemented to break up the almost autocratic rule of full professors conflicting with the fact that junior faculty made up the majority of academic staff and democratic principles. Under the counteracting forces of radical student and junior faculty demands and the determinate resistance of professors defending their corporate privileges, however, the result of the attempted university reform was half-hearted and its compromises satisfied no one. On the one hand, the position of the rector was strengthened in order to counteract the centrifugal forces of faculties and professors pursuing their own interests without paying much attention to the needs of the overall institution. However, university management remained dependent on the decisions of self-governing academic bodies in the most important areas of research planning and resource allocation, while the professorial right to determine topics of research and teaching autonomously was not restricted. On the other hand, academic self-governance was democratized through the establishment of the so-called “group university” replacing the “chair

university” by granting students, junior staff and non-scientific personnel seat and vote in university and faculty bodies.

These reforms were formalized in the Framework Act on Higher Education of 1976 (Oehler 1998: 416). But a ruling of the Federal Constitutional Court limited the participation rights of junior faculty staff and students. Professors must have at least half of the votes in decision directly affecting teaching matters and the decisive vote in all questions relevant for research including the appointment of professors. The complicated and cumbersome decision-making procedures of the group university is seen as one of the main causes for the inability of universities to react to the challenges of changed social demands and resource stagnation with internal reforms leading to the widespread sense of crisis and malaise of German higher education in the eighties and nineties (Jarausch 1997; Mittelstraß 1996). Decision-making is always threatened by the mutual blocking of the represented interest groups, especially if strong political or ideological conflicts exist as was the case most of the times since the seventies. In addition, the still dominating collegial rule of professors tend towards a conservation of structures and a resource allocation according to historical patterns and quantitative indicators like student numbers and staff positions instead of thematic priority setting and performance indicators. Relations among professors are characterized by mutual consideration and “esprit de corps”, whereas open confrontations and resource conflicts are relatively rare (Wissenschaftsrat 1996a: 9). The professorial policy of non-aggression pacts can be explained as rational action following from the organization of academic life where (1) one often meets daily, (2) ones has to cooperate regularly, (3) the costs of coalition building are high compared to potential gains and (4) one can easily become the victim of retaliation or future redistributive initiatives (Schimank 1996: 114). However, still no consensus exist on how to reform the reformed university. Bund, Länder and Science Council favor a professionalization and strengthening of an autonomous university administration according to the American model of the “dean university” as it was already attempted in the sixties which will allow the formulation of research and teaching profiles and a corresponding resource allocation to be implemented against the resistance of negatively affected faculties and professors (Wissenschaftsrat 1993c; 1996; Lundgreen 1997). Others, especially traditionally-oriented professors, accuse the political control and administrative regulation and the group university to be the main cause for the present crisis of universities and demand a turning back of the 1960s reforms (Rupp 1982). The amendment of the “Framework Act on Higher Education” passed in 1985 after the government change to the conservative-liberal coalition in 1982 brought a first step in the latter direction by reinforcing the position of professors in decision-making (Shiedermair 1996).

More successful, at least partly, were two other measures with which governments and the Science Council attempted to relief universities from student overcrowding and to strengthen university research. In 1968, Bund and Länder concluded an agreement to transform and upgrade several groups of advanced secondary schools into “colleges for higher professional training” (Fachhochschulen (FH)).
This followed the plans of the Science Council to establish a “horizontally structured differentiated higher education system” (Wissenschaftsrat 1991: 65) to cope with exploding student numbers making professional training for occupations outside academia the dominating interest of students. In addition, overcrowded seminars and institutes finally made the unity of research and teaching a fiction for most students having no contact to actual research (Jarausch 1997). Originally the FH were seen only as a transitory type of institutions until the proposal of the Science Council to transform and integrate the various groups of higher education institutions into “integrated comprehensive universities” (Gesamthochschulen) had been implemented. However, this plan failed due to ideologically motivated political conflicts and the resistance of established universities fearing a downgrading to mere advanced teaching institutions and loss of status and corporate privileges. This left the already existing Fachhochschulen as a second best option for a higher education system “in which universities and Fachhochschulen have each their own tasks and profiles” (Wissenschaftsrat 1991: 65/9-12). Confirming the Humboldtian idea the mission of the former would be “theoretical-analytical teaching … which is oriented towards the actual research findings of scientific disciplines.” (ibid.). By channeling more students to polytechnics universities again would be able to concentrate on research, long-term “scientific studies” and (post)graduate training of students aiming for an academic career and young scientists.

In contrast, the polytechnics50 should offer a “different, but equal … alternative to universities” focusing on practically and vocationally oriented “short-cycle” studies. Accordingly, Fachhochschulen have primary an educational mission. Their purpose is to fulfill the demands of the labor market for academically trained professionals by preparing students for specialized occupations on the basis of scientific principles and knowledge. Accordingly FH-studies are “more transdisciplinary and problem-oriented and less disciplinary and analytical” (ibid.). In the long run the Science Council planned to direct the majority of students not interested in an academic career, but in access to attractive jobs towards the Fachhochschulen as a way to preserve the unity of research and teaching at universities in times of mass higher education for which they were prepared neither materially, organizationally or intellectually and which threatened to damage the original university tasks, research and research training (Wissenschaftsrat 1975b: 205-210; 1993c).

But the economic crisis of the mid seventies put an end to the grand plans for the expansion and differentiation of the higher education system. An abrupt and sharp reduction of government support for higher education had even worse consequences for the polytechnics than for universities. In 1973, an “overall educational plan” (Bildungsbesamplan) agreed by Bund and Länder wanted to increase the number of student places to about 1 million student places in the mid eighties. With the oil crisis and

50 In the following the terms Fachhochschulen, and polytechnics are used interchangeably, because the former correspond basically to polytechnical institutions in other countries; see the OECD (1991) report on non-university institutions.
the following recession this objective became the victim of the struggle against soaring public deficits. In addition, a stagnating economy and public sector seemed no longer pose the problem of a shortage of academics, but an oversupply. Thus, in 1975, the Science Council proclaimed an end to the policy to expand teaching capacities in line with demand and revised the planning figure to 850000 student places, although the actual number of students already exceeded official places (Table 20-21A) and a rise of enrolments over one million was predicted (Wissenschaftsrat 1975b).

While in 1960 only 8% of an age cohort studied, this figure had increased to 20% in 1975 and forecasts reckoned with a share of 25-30% in the eighties. At the same time, the federal constitutional court and governments blocked attempts to restrict the admission of students to prevent an aggravating overcrowding of universities.\(^{51}\) In the so-called “numerus-clausus-decision” of 1972 the former declared that the system of local or regional restrictions of enrolments contradicted the constitutionally guaranteed right of every citizen to a freely chosen profession and place of training. Limits (numerus-clausus) on student admission were only authorized if universities could demonstrate that they made full use of their capacities. Thereupon the Länder concluded in October 1972 an “Agreement on the Allocation of Student Places” setting up a “Central Office for the Allocation of Study Places” (Zentralstelle für die Vergabe von Studienplätzen (ZVS)). In theory the agreement commits the Länder to introduce a national numerus-clausus for all studies in which the total number of applicants exceeds the number of available places. In practice, however, the educational ministries used the instrument of national numerus clausus very restrictively for political reasons, because this was highly unpopular in the electorate. Finally, Bund and Länder took in November 1977 the so-called “opening-decision” with the declared aim “to avoid further restrictions of admission and to dismantle existing restrictions as far as possible” in order to enable every entitled applicant “to pursue the course of higher education of his choice”. Only in medicine, biology and some selected disciplines like architecture the restrictions of student admission was continued (Wissenschaftsrat 1988: 108-113).

Governments and Science Council justified the overcrowding of universities with reference to its temporary character. Based on demographic projections this strategy for “under-tunneling the student mountain” expected that in the mid eighties the number of new students and at the end of the decade also total enrolments would start to decline when weaker birth cohorts would enter universities. For this reason, universities should bear a temporary “overloading” with students until the expected normalization of student numbers (Wissenschaftsrat 1975b: 187-188; Schimank 1995a: 68-69; Jarausch 1997: 45). Neither the predicted “normalization” of enrolments materialized nor could even the moderate expansion plans of the mid seventies be realized. Contradicting official forecasts, the number of new students entering universities continued to rise, if on a lower level than in the seventies. In 1990, 238000 students took up courses compared to 157000 in 1975 and 187000 in 1985 increasing the pro-

\(^{51}\) See for the following (Merritt 1979; Schimank 1995a: 83-89)
portion of an age cohort in tertiary education to 30%.\textsuperscript{52} In parallel, the duration of studies had considerably lengthened. Accordingly, total enrolments steeply climbed from 781000 in 1975 to 1.4 million in 1990 (Table 20-21A).

Even worse the Science Council admitted in 1981 that the goal of 850000 student places “cannot be realized in the eighties” and financial means had to be concentrated on the completion of facilities under construction and the replacement and modernization of existing one (Wissenschaftsrat 1981). In fact, the number of official student places reached only 734000 in 1990 (Table 20-21A). At the beginning of the eighties university construction was even on the verge of collapse when the Federal Ministry of Finance unilaterally reduced the volume of federal contributions to the joint task below the agreed framework plan of the Science Council leading to a near investment stop at universities. Only the most urgent projects were continued and even for these the Länder had to provide advance payments substituting federal funds. After an improvement of the situation in the mid eighties the Bund again lowered its budgetary appropriations. From 1975 to 1979 expenditure on university construction and large-scale equipment declined by more than one third in nominal and was halved in real terms and in 1990, nominal spending was still lower than in 1975 and its increase had only compensated the accumulated inflation of the eighties. Moreover one has to take into account that 40-50% of overall investments went to university hospitals largely for the needs of patient care (Table 19A; Wissenschaftsrat 1993f). In consequence, investments in new research and teaching facilities at universities and Fachhochschulen reached a critical level and aging and overburdened buildings, libraries and equipment threatened especially the competitiveness of university research (Wissenschaftsrat 1988: 261-263).

Here, the “joint decision trap” and the “convoy principle” of cooperative federalism showed its negative consequences in full force. While the central government could determine the overall level of expenditure for university construction there was even for the financially strong Länder no incentive to realize projects on their own, because without the consent of the Bund they had to bear the full costs, while state governments curtailing their investment plans in line with federal demands got half of their costs reimbursed. Bund and Länder had also failed to provide the promised additional staff and budgetary resources for the overcrowded universities to keep research and teaching standards at an adequate level. Instead, the number of staff positions was held constant and general university funds stagnated in real terms (Wissenschaftsrat 1996a: 22-24; Schimank 1995a: 72-77; Jarausch 1997: 45). While in 1975 there were 12 (16) students per scientific staff member at universities (FH), this figure had risen to 21 (36) in 1990 (Table 20-21A) and at the end of the 1980s the Science Council calculated that at universities the actual number of students exceeded available study places by about one third and that at Fachhochschulen there were even twice as much students than official teaching capacities

foresaw. This indicators show not only that the higher education system had to cope with a dramatic resource squeeze, while demands for academic training and research continuously increased, but also that the Fachhochschulen were the most prominent victims of the budgetary cuts in higher education.

In times of extremely scarce resources universities were not willing to tolerate a redistribution in favor of these new competitors. Only about 30000 FH-student places were established from 1975 to 1990 leaving their total number at 138000 compared to the originally envisioned 215000. A collapse of the Fachhochschulen only could be prevented by introducing a comprehensive numerus clausus system. Thus, although the number of FH-students doubled in the period under review and their share in the student population reached about one fourth, the polytechnics could not relief universities to a significant extent. Instead, the closing of Fachhochschulen redirected turned down applicants to the universities and intensified the tension among the conflicting interests and demands of (1) a majority of students seeking systematic instruction and competent professional training, (2) governments and industry expecting socioeconomic relevant research and academic training heeding the needs of the labor market, (2) a minority of students and postgraduates qualifying for an academic or research career and (3) university teachers whose self-understanding and reward and promotion systems are oriented almost exclusively on inner-scientific criteria of original research.

The result is a profound crisis of the German university lacking an accepted sense of purpose on which to orient organizational and study reforms harming both research and teaching. Long duration of studies, high drop out rates and complaints a worsening quality of research and graduates are symptoms of this malaise (Ash 1997 (Ed.): vii). Especially for research and the training of young scientists, still regarded as the most prominent parts of the university mission, the Science Council noticed “fatal consequences” from the failure to establish a differentiated university system (Wissenschaftsrat 1990: 43; Wissenschaftsrat 1993c: 15-16). Assessing doctoral and postdoctoral studies the Council found structural weaknesses following from an insufficient supervision and integration in larger research programs, the dependence of even postdoctoral students on their supervising professor and the burdening with teaching and administration tasks (Wissenschaftsrat 1996a: 41-44; 1995; 1996b). In addition, lacking career opportunities for younger scientists became a major problem in the eighties. After the massive staff expansion in the higher education boom, the hiring of professors was virtually frozen and incumbents blocked existing positions for years. As a consequence, many qualified young scholars moved abroad or to industry and the renewal of faculty guaranteeing a stimulating intellectual climate through the constant influx of new ideas and lines of research threatened to come to a standstill with severe long term effects for the whole research system following from the near monopoly of universities on (post)graduate training (Wissenschaftsrat 1996a: 42; 1980; 1988).

Insufficient resources for maintaining and modernizing buildings and equipment made competitive research at universities increasingly difficult. An equally pressing problem have been. In its report on the “Perspectives of Universities in the 90s” the Council warned that without a significant improve-
ment of capital expenditure and core funding (*Grundausstattung*), but also a fundamental reform of higher education the position of universities as “places of innovative research and qualified teaching” is threatened and that Germany lacks “an adequate base for further scientific, technological, economic and social development in the future” (Wissenschaftsrat 1988: 263/260). The cornerstones of the reform model recommended untiringly by the Science Council since the sixties are (Wissenschaftsrat 1960; 1975a; 1979; 1988; 1993c): (1) a differentiation and sequencing of mass vocational and advanced research training accompanied by an organizational and budgetary de-coupling of research and teaching tasks; (2) temporary and competitive resource allocation based on regular evaluations of both research and teaching; (3) introduction of an autonomous and powerful university management responsible for planning, priority setting and resource allocation; and (4) a dismantling of bureaucratic control and administrative regulation giving universities more autonomy and flexibility how to perform their tasks and to use their resources. “But such constructive proposals have been time and again by accusing them of violating the hallowed Humboldtian legacy. The result of this reform blockage (*Reformstau*) is a loss of competitiveness and a sense of pervasive malaise.” (Jarausch 1997: 49). This is not to say that excellent teaching and research completely give way to complete mediocrity. In some scientific fields individual professors, departments or universities have been able to attain and maintain a leading position internationally and to attract promising scientists and students worldwide. But these niches are typically found in disciplines or universities with relative few students or privileged support by governments for political or economic reasons, which cannot compared to the average. Only in the nineties, teaching and research conditions have become so worse and problems so pressing that cautious reform steps have been started by several universities and state ministries of culture.

While university expansion and reform encountered severe difficulties since the mid seventies a third instrument of higher education policy for the strengthening of university research proved far more successful. In 1967, following a proposal of the Science Council (Wissenschaftsrat 1967: 126-143), the first so-called “Collaborative Research Centers” (*Sonderforschungsbereiche* (SFB)) were established as a new funding program. SFB are “long-term research institutions of universities … in which scientists collaborate in the framework of transdisciplinary research programs” (DFG 1995: 205). Participating research groups, which can include teams from local non-university institutes, work on specific aspects of the overall topic to enable “the pursuance of demanding, costly and long-term oriented research projects through the concentration and coordination of the skills existing at a university” (ibid.). The program is administrated by the German Research Society and financed jointly by Bund and Länder. Universities can submit proposal for a SFB to the DFG which evaluates the scientific merit of the research program, whereby special emphasis is laid on its collaborative and transdisciplinary dimension. In addition, the university and the responsible state ministry of culture are required to provide an “adequate personnel and material resource base” and to continue the organizational struc-
tures of the SFB after its official termination (ibid.). If a collaborative research center is approved by the DFG funding can run up to 15 years, in some cases even longer, following regular evaluations.

With the Collaborative Research Centers the Science Council reacted to specific developments and problems of university research which had lost competitiveness, especially in many of the most promising and productive scientific fields for several reasons (Wissenschaftsrat 1967: 126-131). Firstly, the increasing costs and complexity of most research areas require resource concentration and thematic priority setting. Secondly, scientific problems increasingly cross the boundaries of traditional disciplines and the frontier of research changes constantly. For both challenges, however, German universities have been ill prepared. Basic organizational unit of teaching and research are departments and chairs following a disciplinary matrix: “This basic structure restricts collaboration across disciplinary boundaries, which is increasingly necessary for innovative research, and impedes a project-oriented resource allocation in place of the dominating discipline-oriented system.” (Wissenschaftsrat 1996a: 29). The collaborative research centers deal with both structural problems. On the one hand, they provide the critical mass of infrastructure and resources for creating problem-oriented centers of excellence at universities. On the other hand, SFB combine the disciplinary specialization of university research with transdisciplinary collaboration for specific projects and problems. In this way, universities shall use their unique potential for flexible cooperation among disciplinary specialists and develop “research profiles” supplemented by complementary priority setting and cooperation at the regional and national level (Wissenschaftsrat 1996a: 30-31; 1997: 5-7). Starting with 17 SFB in 1968 their number increased rapidly to 116 in 1975 (DFG 1995: 206). Over time the collaborative research centers have become a central instruments for priority setting and strengthening of university research and the number of SFB is regarded as an important indicator for the quality of a university in research.

Non-university research

The expansion of the non-university sector was even stronger than in the higher education sector. While the budgetary growth index (1965=100) for university research from 1965 to 1975 is 317 and from 1975 to 1990 is 214, it is 362 and 244 for the non-university sector (Table 2.1). In reality this gap even has been wider. Official statistics overestimate the proportion of university budgets available for research, because a rising share of general government grants had to be devoted to teaching (Wissenschaftsrat 1988: 54-57), while in the non-university sector only in the Federal Research Establishment other tasks compete to a significant extent with research for resources (Hohn/Schimank 1990). Thus, university research continuously lost ground to extra-university research institutions and higher education was particularly affected by the cuts in public science budgets in the mid seventies. (Wissenschaftsrat 1988: 54-62; Schimank 1995a: 70-79). Two reasons are mainly responsible for this disadvantaging of universities. Firstly, research institutes outside universities were far more suitable for implementing the new innovation and technology-oriented research policy than universities which focused on fundamental research, largely eluded an external direction of research programs and were
absorbed with teaching (Wissenschaftsrat 1988: 61). Secondly, while the central government contributed at least half of investment costs and institutional funding for non-university research organizations, the Bund did not participate in the financing of regular university budgets. For this reason, the Länder had a strong financial incentive to prefer the expansion of non-university over academic research (Schimank 1995a: 70-72; Wissenschaftsrat 1988: 61-62). In addition, the Länder reduced their science budgets even more strongly than the central government. This affected universities much more than non-university institutions. Universities account for about 90% of state support for science. Moreover, if under the pressure of the Bund at least moderate growth rates for non-university research had to be preserved, less funds for academic research remained. Warnings of the Science Council to preserve the subsidiary relation between both sectors had not much effects under these conditions (Wissenschaftsrat 1975a: 86-87).

Even though the institutional growth of extra-university research was highest during the reconstruction and early post-war period, the number of research institutes continued to rise in the sixties and seventies, if with a downward trend (Table 2.2). This number would be even higher if one would take into account “qualitative growth”, that means the replacing of old institutes and departments by new ones which does not show in absolute numbers, but is a central element of research planning and modernization in the non-university sector.

Table 2.1  
R&D expenditure in the public sector by sector of performance in the FRG 1965-1995 (million DM)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Non-university</th>
<th>GFE</th>
<th>MPG</th>
<th>FhG</th>
<th>BLI</th>
<th>BFA</th>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>811</td>
<td>494</td>
<td>157</td>
<td>20</td>
<td>44</td>
<td>96</td>
<td>1450</td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>1473</td>
<td>856</td>
<td>325</td>
<td>33</td>
<td>75</td>
<td>184</td>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>2939</td>
<td>1593</td>
<td>602</td>
<td>112</td>
<td>212</td>
<td>420</td>
<td>4591</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>4342</td>
<td>2236</td>
<td>778</td>
<td>253</td>
<td>386</td>
<td>689</td>
<td>6312</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>5459</td>
<td>2836</td>
<td>923</td>
<td>439</td>
<td>456</td>
<td>805</td>
<td>7289</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>7163</td>
<td>3748</td>
<td>1171</td>
<td>757</td>
<td>591</td>
<td>896</td>
<td>9849</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>9778</td>
<td>4222</td>
<td>1539</td>
<td>1261</td>
<td>1321</td>
<td>1148</td>
<td>14900</td>
<td></td>
</tr>
</tbody>
</table>

A closer look on the different groups of non-university research institutions reveals interesting insights concerning the effects which the “cartel formation in research promotion” (Karl-Heinz Bentele) between Bund and Länder and the demarcation of research domains led by the Science Council had on the development of the PSR system. A first striking feature is the high overall institutional stability. No significant new research actor entered the existing cartel of national science and research organizations, as the institutional innovations Fraunhofer-Society and National Research Centers had done in the fifties and sixties. This cartel is reflected in the regular meetings of the presidents of DFG, WRK, MPG, FhG, AGF amongst themselves and with the federal research ministry to discuss science policy matters.53

Looking at R&D staff as the best indicator of research capacities there is almost no change in the relative share of the individual non-university sectors (Table 10A). The only exceptions are the Fraunhofer-Society which could more than double its share and a corresponding relative loss of the National Research Centers. This “freezing” of organizational resources shows again the domain consensus among the main policy and research actors, but also the existence of the joint decision trap in which Federal-state cooperation was captured. The federal research ministry on the one hand and the state ministers of culture on the other hand took care that “their” research institutes are not disadvantaged. For the former these are mainly the national research, while each state government protects the interests of the institutes located in its territory. Thus, often the only acceptable compromise to avoid a blocking of decision-making is to leave the established institutional equilibrium and spending patterns

53 The presidential meetings are aptly called the “holy alliance” according to the nineteenth century predecessor that tried to preserve the European frontiers and balance of powers as it emerged from the Congress of Vienna.
unaltered (Schimank 1996: 116; Hohn/Schimank 1990). Two exceptions to this rule can be observed. Firstly, when government interests converge a redistribution of additional resources becomes possible, but this mostly stopped short of a downsizing or dissolving of existing research institutes if the parent organization or “host state” could not be compensated. Secondly, their specific funding arrangements allow some research organizations to escape the “convoy principle” of joint federal-state funding. The inter-organizational differences in the development of non-university research described in the following reflect these mechanisms.

The Max-Planck-Society (MPG) entered in the mid sixties a period of institutional consolidation after a rapid expansion in previous years. Although its budget still rose above average until 1975, the MPG used these resource increases mainly for enlarging and modernizing existing institutes, while new facilities were mostly accompanied by the closing or merging of existing ones. This reflects the Max-Planck-philosophy to operate internationally competitive centers of excellence at the forefront of scientific development and to make the establishment and continuation of a Max-Planck-Institute dependent on the scientific promise of its research program and if a leading scholar in the field can be won over as director. Thus, the quality of its institutes clearly takes precedence over their number in research policy (Meusel 1996: 1296). However, especially research in the natural sciences, where most Max-Planck-Institutes are located has been characterized by rapidly increasing complexity and costs requiring large institutes and resource concentration. The Munich MPI for Plasma Physics became even one of the national research centers funded outside the regular MPG-budget. This limited the scope for founding new institutes.

Even though the Max-Planck-Society is frequently cited as the international flagship of German science in official research policy, its budget showed the slowest increase of all public research sectors from 1975 to 1990. Its growth index (195) has been even lower than for universities (Table 2.1). Until the mid eighties the MPG could realize new projects only by an internal redistribution of budgetary and staff resources. But even without institutional expansion real annual growth rates of about 1-2% meant an actual decline and a worsening of research conditions, because salaries and research costs rose faster. Only in the mid eighties the situation improved somewhat and in 1989 finally a return to “normal” growth rates could be attained when Bund and Länder agreed to increase the budgets of MPG and DFG by 5% in the following years after warnings of Science Council, MPG and DFG that without a competitive base of fundamental research Germany will also lose technological and economic competitiveness.

Looking for explanations why the Max-Planck-Society despite the recognized quality of its institutes nevertheless was subject to particularly severe budget cuts, a fate it shared with universities, two factors are most relevant. Firstly, undirected basic research as pursued by both groups of institutions clearly occupied a secondary rank in the research policy of the seventies and eighties emphasizing relevance and usefulness of research. Secondly, the MPG was the most prominent victim of the “con-
voy principle” characterizing the joint funding system of Bund and Länder. In the case of the Fraunhofer-Institutes and the National Research Centers the central government contribute 90% to the funding and only the Länder hosting Fraunhofer-Institutes and GFE participate in the financing. Accordingly, budget increases of these institutions are very attractive for state governments which receive for every mark from their own resources nine additional mark from the Bund. In contrast, the Länder bear half of the costs of the MPG independent of the number of MPI located in their territory. But until the late eighties the financially weakest Länder, Saarland and Bremen, were at the same time the only ones having no Max-Planck-Institute and their governments understandably were not interested in spending their scarce science budgets on a research organization operating outside their borders. It is no coincidence that the solution of the budgetary conflict between the MPG and its sponsors coincided with the plans of the Max-Planck-Society to establish an institute in Bremen and the Saarland.

A striking contrast to the MPG constitutes the development of the Fraunhofer-Society. The number of Fraunhofer-Institutes doubled between 1965 and 1975 and although a period of consolidated growth set in afterwards comparable to that of the MPG in the mid sixties and early seventies, the number of institutes again showed a strong increase in the eighties (Table 2.2). Still more impressive is the explosive growth of the FhG-budget, by far the highest in PSR, allowing the Fraunhofer-Society to expand and modernize its institutes. Even if one takes into account that the “take off” of the Fraunhofer-Society started only in the late sixties when it was included in the institutional funding by the federal research ministry (Schimank 1995a: 78), growth rates remain stunning. From 1981 to 1990 the FhG-budget tripled compared to a mere 50% increase for the MPG. While in 1975 the budget of the MPG was six times higher than that of the FhG, in 1990 the latter was only about one third lower.

Two motors of growth can be identified. Firstly, the mission of the Fraunhofer-Society, applied contract research and technology transfer for state and industry, fitted precisely the objectives of research policy and made it the “favorite child” of research ministries and industry (Kreklau and Knoerich in FhG’90 (1991): 31/79). Secondly, an innovative financing system turned out to be a unforeseen stimulus for expansion. For ensuring that the Fraunhofer-Institutes continued to orient their research activities towards the interests and needs of its clients despite long-term core funding, the federal research ministry introduced the so-called “variable success-dependent institutional funding” (erfolgsabhängige Grundfinanzierung) (Hohn/Schimank 1990: 217-226). According to this model the Fraunhofer-Society receives for each Mark acquired through research contracts an equal sum of institutional funding from Bund and Länder creating strong incentives for the Fraunhofer-Institutes to intensify their acquisition activities, because this meant also more resources which could be used for own research. At the same time this “incentive funding” unintentionally freed the FhG from the “convoy principle” of the joint financing system of Bund and Länder. Not the financially weakest government now determines the growth of the FhG-budget, but the demand for applied research by industry and state and the attractiveness of the Fraunhofer-Institutes as a research partner. While the latter could be
significantly improved through the institutional funding the former also increased strongly in the seventies due to structural problems and a declining competitiveness of the German economy and new societal challenges like the environment and the management of technological progress.

Already in the early eighties this new funding system had been so successful that Bund and Länder departed from matching contract receipts with an equal amount of block grants in order to limit the growth of grants to the FhG. Since then the proportion of institutional support to contract income had been reduced to about 40:60.

A middle position between MPG and FhG take the national research centers. Their expansion came to a stop in the mid seventies after two decades of vigorous growth. In 1975, the Großforschungseinrichtungen accounted for more than 50% of research expenditure in the non-university sector and employed almost half of the researcher personnel (Table 2.1 and 9a) making them the second largest group of research institutions after the universities. Research areas and missions now reached from operating large-scale installations for basic research like particle accelerators and nuclear reactors, basic and applied biotechnological and medical research to problem-oriented research and technological development in aeronautics, materials or the environment. But for budgetary as well as political reasons the BMFT restricted further expansion to consolidating the recently established centers after 1975 (Hohn/Schimank 1990: 259-295). The relationship between the ministries and the centers can be best described as “disappointed expectations” (ibid.: 259). The BMFT regarded the centers as the most important instruments of its active research policy for the “modernization of the economy” expressed in the concept of “global steering” (Globalsteuerung) which was especially developed for the national research centers. According to this concept the state “determines on the basis of a comprehensive research planning the overall research objectives and financial framework” and “sets priorities, coordinates the work of the research institutions and ensures an objective and effective evaluation” while the research institutions is granted scientific and administrative autonomy in implementing their mission (BMFT 1971; 1974; Hohn/Schimank 1990: 260-262). For the BMFT this meant to induce the national research centers to diversify into new innovative technology fields, to intensify collaboration with industry and to focus on technology transfer corresponding to the priorities of the need-oriented research policy (BMFT 1975: 19; Matthöfer/Haunschild 1976: 76-77; Hohn/Schimank 1990: 265-276).

But this re-orientation proofed difficult, time consuming and rather unsatisfactory (Stucke 1993: 138-140). Firstly, capacities in traditional research areas, especially nuclear physics, could be dismantled only very slowly, because most scientists had received tenured contracts when the centers were established and nuclear physicists could not easily turned into environmental or material specialists. In 1985, the share of nuclear research in overall research expenditure of the GFE was with 56% even

54 For the GFE they year 1975 is a less appropriate interval for analysis, because two new centers were established in 1976, although the formal decision was taken in 1975 and they received considerable federal support before.
higher than in 1975 (51%). Secondly, organizational and thematic inflexibility obstructed a more transfer-oriented research. Partly this followed from the unwillingness of the centers’ scientists to leave their research areas or to give application criteria more weight in their activities. Partly, this was caused by the disinterestedness of potential users. Thirdly, the centers opposed the concept of global steering which in their views mainly meant undue government interference characterized by a multiplicity of confusing and contradictory demands and a straitjacket of administrative regulation obstructing effective research planning and suffocating innovative research (Hohn/Schimank 1990: 273-281; Stucke 1993: 168-169).

In consequence, the national research centers faced a crisis of legitimacy and increasing criticism at the beginning of the eighties leading to an ambivalent strategy of the research ministry (Hohn/Schimank 1990: 282-295). On the one hand, the BMFT continued its restrictive course concerning research capacities. Growth rates of staff were even slightly lower than for universities and Max-Planck-Society and would have been even lower without the newly established “Alfred-Wegener-Institute for Polar an Oceanographic Research”\footnote{Considerations of foreign policy mainly were responsible for the founding of the AWI. The Federal Republic wanted to become member of the international Antarctic Pact and needed a corresponding research center (Hohn/Schimank 1990: 283).} and a strong expansion of externally-financed staff. In 1981, the centers were committed to reduce the number of institutionally financed positions by 7.5% within five years. On the other hand, the budgets of the \textit{Großforschungseinrichtungen} showed the second highest growth rates in PSR between 1975 and 1990, a striking contrast to universities, but especially the Max-Planck-Society, whose research mission and quality was not put into question. Several reasons are responsible for this development. The centers still provided the largest research potential for “industry-oriented promotion of technology” and “long-term government programs” in the public interest which remained the dominating goals of research policy into the eighties (Bundestags-Drucksache 10/1327 and 10/6225). Not to be underestimated is the fact that the national research centers are still the most important “power base” of the federal research policy. Only here, the research ministry can claim a prerogative for research planning and resource allocation (Hohn/Schimank 1990: 267-268). In addition, a partial or even complete closing down of a \textit{Großforschungseinrichtung} would have met strong resistance and involved high social and political costs. Most scientists were employed on non-terminable permanent contracts. Moreover, a dissolving of such large research institutions would have been inevitably interpreted as an admission that the corresponding research policy had failed. Finally, the Länder, although contributing only 10% of institutional funding, had de facto an effective veto position against unilateral actions of the BMFT by threatening to block decisions in other areas of Federal-state cooperation. For the states the national research centers are highly regarded elements of their regional innovation system, not least because of their size and federal funding (ibid.: 270-272).
These converging interests secured the *Großforschungseinrichtungen* above average financial growth despite the continuing debate on the relevance and quality of their research and development activities. Especially industry, once regarded as the main research partner and client of the GFE voiced critique culminating in their characterization as “research fossils” whose “right to exist” was challenged (ibid.: 287-290).

The Bund-Länder-Institutes (BLI) are the group of non-university research institutes most affected by the practice of cooperative federalism for two reasons. They are literally a “child” of cooperative federalism owing there recognition as a distinct sub-sector in the public research system to two administrative acts: the decision of state governments in 1949 to establish a joint funding system for supraregional research institutes which could neither incorporated into universities nor the Max-Planck-Society and the agreement of Bund and Länder in 1975 to continue this practice in the framework of the “Framework Agreement on Research Promotion”. A second reason is, that the Bund-Länder-Institutes are exposed to the unmitigated impact of the “joint decision trap” and “convoy principle”.

While MPG and FhG can rely on central organizations with the resources and authority for independent research planning, the BLI lack a common identity or powerful interest representation necessary for formulating and asserting own interests. Accordingly, decision-making on including or excluding institutes in the joint funding and the volume and allocation of resources are taken in the Bund-Länder-Commission on Research Promotion and dominated by political consideration, whereby the Bund and the individual Länder are mainly interested to protect “their” institutes. Since decisions de facto require unanimity results normally continue the institutional and budgetary status quo (Hohn/Schimank 1990: 152-170).

This is shown by the very small number of newly established Bund-Länder-Institutes between 1955 and 1975 and from 1977 to 1990. It was only the transition from the joint Länder to the joint Federal-state financing which provided a break to review the list of institutes whereby the increase from 32 to 46 BLI reflected to a large extent the incorporation of research and service institutions advocated by the Bund and was the price the Länder had to pay for the federal co-financing of “their” institutes. The reason for this institutional stability is that the inclusion of a new institute would lead to an advantaging of the respective “host Land” (*Sitzland*) at the expense of the other members in the joint funding system. Thus, only in the case of convincing scientific considerations an applicant has a chance of success. But the exclusion of an institutes is also highly improbable, because it requires the

---

56 For the BLI the year 1975 even is a less appropriate time interval than for the GFE, because the agreement on the list of the Bund-Länder-Institutes came into force only in 1977 (Wissenschaftsrat 1993d: 461). For this reason, it is this year that serves as basis for analysis as far as the institutional development of the BLI is concerned.

57 Originally about 200 candidates were proposed by the federal and state governments. In the end, two thirds of the former “Königstein-Institutes” were again included, while only about one third was excluded making room for new institutes (Hohn/Schimank 1990: 143-152).
consent of the host Land which cannot be interested to loose a BLI and to increase the share of its contributions flowing into other Länder. In consequence, between 1977 only five institutes were excluded from the joint funding, while six new ones were included. Three of the six new institutes were located in the Länder which had lost one and four were service institutions, which were traditionally of special importance to the Bund (Wissenschaftsrat 1993d: 461-462).

To de-politicize decision-making and to avoid total immobility with regard to the Bund-Länder-Institutes evaluation of existing and applying institutes was delegated to the Science Council. While in the cases where its “neutral” scientific advice recommended a termination of support were implemented this was not the case for inclusion recommendations. The negative reports provided especially for the federal finance ministry an instrument to exert pressure on possible opponents of closure, which could no longer argue with scientific reasons. Financial reasons are also responsible why a positive scientific evaluation is only a necessary, but not a sufficient condition to become a Bund-Länder-Institute. The Federal Finance Ministry follows a quid-pro-quo policy for limiting federal contributions by demanding to compensate the incorporation of a new BLI into the joint funding with the termination of an existing one (Hohn/Schimank 1990: 152-162; Wissenschaftsrat 1993d: 465-466). Budgets and staff of the Bund-Länder-Institute show the typical slow growth rates of the convoy principle, whereby in this case the Bund bearing half of the costs without receiving special scientific (MPG; DFG; FhG) or political benefits (GFE) acts as a “brakeman”. Accordingly, the resources of the BLI rose steadily between 1975 and 1990, but on an even slightly lower level than that of universities and Max-Planck-Society (Table 9-10A).

A last sector of non-university research are the Federal Research Establishments occupying a special position.58 They are the only important group of research institutions not subject to Federal-state cooperation. At the same time the BFA pursue research on behalf and under hierarchical direction of the responsible federal ministry and research is only part of their statutory tasks including to various degrees service functions like data gathering, monitoring, norm setting, licensing and scientific-technical advice in law-making and bureaucratic regulation. According to a survey in 1980, more than half of the BFA estimated the share of research in their actual work to be less than 50%. In addition, a large share of their research activities is relatively unattractive “routine research” with a low level of new scientific knowledge (Lundgreen et al. 1986: 217-247; Hohn/Schimank 1990: 306-317).

For these reasons, the institutional development and growth of the federal research establishment reflects more the increasing scientification of a growing number of public policies and intra-departmental politics. Decision-making on the establishment, reorganization, closing down and budgets of the individual BFA is the preserve of the responsible ministry: “There are no inter-departmental

---

58 Information on the Bundesforschungsanstalten is scarce. The following overview draws on Lundgreen et al. (1986) and Hohn/Schimank (1990): Chap. 8.
planning or decisions with regard to the federal research establishments” (Hohn/Schimank 1990: 319) while the Science Council has no mandate for or strong interest in this research sector. On the one hand, the BFA elude the influence of federal research ministry, which is only responsible for several historical and culture institutes abroad, and state ministries of culture. On the other hand, the BFA are not regarded as competitors by universities and research organizations not interested in this kind of applied and politically directed research forming a “niche” which spared the BFA from the domain and resource conflicts in the public research system despite the fact that their combined research capacities are almost as large as that of the MPG (ibid.: 321-324).

As Table 2.2 shows the number of federal research establishments increased most strongly from 1949 to 1965 and again in the early seventies. These period coincide with the founding, consolidation and expansion of the central government into new policy fields and the establishment of corresponding federal ministries and the demand for government research to support policy formulation and implementation grew accordingly. In 1954, seven of fifteen departments operated research facilities, while in 1988 only three of sixteen ministries had no BFA. The replacement of the above average growth rates of budgets and staff in the seventies, by the lowest growth of all sectors of public research in the eighties (Table 9-10A) can be related to changes in government. In 1969, the establishment of the social-liberal coalition led to a massive expansion of government tasks, especially in social and infrastructure policy, and a belief in indicative state planning of economic and social development based on scientific expertise. This policy paradigm was replaced when in 1982 the conservative-liberal Kohl government took power making liberalization, deregulation, and private initiative the central elements of its philosophy. However, the overall development of the federal research establishments conceal significant differences among policy areas and individual institutes reflecting the decentralization of the sector and diverse dynamics of public policies. Strong absolute as well as relative growth show federal research institutes in the area of health, transport, defense, environment and working and living conditions. With the exception of defense research, these fields have become central elements of the post-war welfare and service state. In contrast, government research in agriculture and technical norm-setting, the classical domains in the nineteenth century, stagnated at a high level (Hohn/Schimank 1990: 305-307). While the “Federal Institute for Physics and Technology”, the former PTR, had a budget of 370 million DM and a staff of almost 1400 in 1989, the eight cultural and historical institutes had a budget of about 3-4 million DM and employed a staff of about 15-30.

***

Summarizing the development of PSR and research policy from the seventies to the eighties, the German research system faced three main challenges leading to repeated reform efforts without leading to major changes in the institutional landscape or government and funding arrangements. First, ongoing economic problems and fiscal constraints continued the period of scarcity in government funding for PSR. Especially universities were negatively affected from stagnating resources, while student num-
bers continued to rise. At the same time, institutional or thematic innovations had to be realized through a redistribution of resources from existing ones entailing painful decisions about “priorities and posteriorities”. Second, following the disillusionment concerning a politically directed and need-oriented research and innovation system a “reorientation of research policy” took place accelerated by the conservative-liberal government under Helmut Kohl taking power in 1982. This reorientation is based on a more indirect “hands-off” approach in research promotion without giving up the emphasis on relevance and usefulness. But the role of government is now defined as organizing and moderating “innovation networks” bringing together science, industry and other user groups of scientific and technological knowledge for defining thematic priorities and creating favorable framework conditions for scientific productivity and collaboration with industry. Thirdly, in line with this material situation and policy change and following international trends Bund and Länder increasingly stressed the social responsiveness, accountability and relevance of PSR and embarked on corresponding organizational reforms based on three instruments: (1) competitive resource allocation, (2) research foresight and quality control and (3) resource concentration.

3 The situation of German PSR in the mid 1990s

3.1 Research capacities

In 1995, overall expenditure on R&D in the Federal Republic amounted to 81 billion DM and R&D personnel numbered 459000 (full time equivalents), of which 231000 were classified as researchers (Table 1A and 7A). This made the German public research system the largest in Europe and the third largest within the OECD in absolute capacities. Looking at relative numbers, however, a different picture emerges. Concerning the percentage of GDP devoted to R&D the Federal Republic (2,3%) occupies only a third rank among the largest industrial nations together with France and is clearly distanced by Japan (3%) and the USA (2,6%). Even some smaller OECD countries like Sweden and Switzerland spent a higher share of their GDP on R&D.

59 In the following a distinction is made between overall R&D expenditure by financing sector and gross domestic expenditure on R&D (GERD) by performing sector, according to the systematic used in the “Federal Report on Research”, the most important official document on research policy and national science statistics published by the Federal Ministry of Education and Research (BMBF) every two years since 1963. While overall expenditure includes R&D spending by domestic sources abroad, but excludes domestic R&D funding by foreign sources, GERD takes only into account expenditure on R&D within Germany irrespective of its source. GERD is also used for international comparison since it is the OECD reference indicator. GERD is traditionally lower than overall R&D spending, that means that German R&D investments abroad are higher than domestic R&D spending by international organizations and foreign companies. For example, in 1995 domestic sectors spent 80,8 billion DM on R&D compared to 79,5 billion DM used for R&D in Germany.
The development of both financial and staff capacities in PSR has been characterized by a period of slow to moderate growth in the eighties, a one time increase caused by reunification and the integration of the East German science system at the turn of the decade and decline afterwards. As Table 1A shows public spending on R&D rose only by about one third from 1981 to 1989. In real terms this meant a mere growth of 11% (Table 2A). If one takes into account that salaries, research costs and the number of R&D personnel employed in PSR increased more strongly than research budgets the volume of money available for R&D activities at most universities and non-university institutions in fact has declined. Between 1991 and 1995 the financial situation of PSR even worsened due to the costs of reunification and the most sever economic recession in postwar Germany. Government expenditure on R&D almost stagnated and in 1995 public science budgets had lowered by 6%, although the rebuilding and modernization of the East German research system absorbed a high share of financial resources. Accordingly, universities and research institutes in the West for the first time were confronted with a sharp resource squeeze. In the eighties slow, but steady budgetary growth moderated distributional conflicts between and within the various groups of research institutions and allowed the limited taking up of new research areas and functions without painful decisions on cuts in existing areas prone to fierce resistance and high social costs.

The twin challenge of reunification and an international economic recession put an end to this still relatively comfortable situation of German PSR compared to other countries like the UK. Drastic measures could no longer avoided, if the flexibility and productivity of PSR was to be prevented from collapse. As a former president of the Science Council puts it: “Through the cuts, now called “underfinancing”, a situation has developed, which is not only new and exciting, but also a mirror image to that forty years ago. At that time the task was swift reconstruction and expansion … now it is the dismantling and cutback of universities and non-university institutions. … For not a demolition with the wrecking ball, but a downsizing is on the agenda. This requires not less imagination and strength.”

For financial, but also political reasons Bund and Länder forced research organizations to operate strict quality control and to streamline of research programs and facilities to free resources for reconstruction in the East and innovative subjects. At the same time political actors, under the impact of the economic crisis and demands from industry, have increased their pressure on public sector research to concentrate on “relevant” research contributing to industrial innovation and social problem-solving. “Scientific excellence”, promotion of high technologies” and “orientation towards innovation” have been confirmed as the guiding programmatic principles of German research policies in the nineties (BMBF 1996a: 6-56; Rüttgers 1996a; 1997): “The government agencies of the Federal Republic will have to operate under restrictive financial conditions, at least in the following years. … Research also has to stand the discussion about priorities and posteriorities. … Of prime importance is the development of instruments for accelerating the transformation of results from basic research into products and
production processes for new markets. In contrast, not every desirable program or projects of pure knowledge-oriented basic research can be pursued in the following years. Large technological programs, like space travel, will be restricted on a adequate share in the overall budget.” (BMFT 1993a: 7-8; Rüttgers 1996)

The eighties continued the transition from the “period of affluence” to a “period of scarcity” in PSR that had taken place in the mid seventies in most OECD countries and for which John Ziman (1987; 1990) has coined the term “science in a steady state”, but increasingly resembles a “declining state”. Confronted with a stagnating economy, mass unemployment and soaring public deficits following the oil crisis growth rates of public science budgets have continuously deteriorated (Rilling 1994). While in the 60s the national R&D budget in the Federal Republic recorded an average annual growth of 15% (1962-70), this figure declined to 9% (1971-1980) and 4,5% in the decade from 1981 to 1990 and reached a low of 3,5% in the nineties. Out of these low increases, however, the costs of reunification had to be met, for which they were by far inadequate. From 1992 to 1995 R&D expenditure showed even negative annual growth rates in real terms. During the eighties an even stronger slowing down of economic activity nevertheless led R&D spending rise in proportion to GDP. At the end of the decade with about 2,9% national expenditure on research reached an all-time high in relation to Gross Domestic Product and provided Germany together with the USA and Japan a top rank in international comparison. But this mainly was due to the dynamic growth of R&D spending in the business sector which was far higher than government support. With an average of 8,1% annual growth rates were almost twice as high than in the public sector between 1981 and 1990. Thus, when in the nineties industry sharply scaled down R&D activities and this figure abruptly fell to a third of its former level this showed immediately in the national science budget. From 1991 to 1995 the share of gross domestic expenditure on R&D has steadily declined from 2,6 to 2,3% and the Federal Republic has fallen back in international comparison (Grenzmann 1996: 213-218).

The development of public and private R&D investments in the Federal Republic clearly reflects the course of the business cycle, sometimes acting as an early warning indicator. Economic downturns have been preceded and accompanied by slowing or falling expenditure on R&D, a pattern which can be witnessed in the early seventies, eighties and nineties. When the economic climate improved again at the end of the seventies and in the mid 1980s it was paralleled by rising science spending. However, in each case average growth rates were lower than in the previous upswing.61 The slowdown of public spending for research in the first place was caused by the central government which had largely financed the strong expansion of public sector research from the fifties onwards and in whose science budget the share of funds going to R&D is far higher than for the Länder due to their responsibilities

61 See for a detailed analysis of the national R&D budget by spending and performing sectors Rilling (1994).
The situation of German PSR in the mid 1990s

for higher education consuming more than 80% of their science spending (see chapter one). Table 1A reveals that from 1975 to 1981 federal expenditure on R&D rose even more slowly than that of the states and after a short period of more vigorous relative growth in the early eighties, when Länder expenditure came almost to a halt, the federal science budget again showed lower growth rates than its counterparts in the Länder. Accordingly, the share of the Bund in public R&D spending declined slightly from 63% to 60% in 1989.

Three factors are mainly responsible for this development. Firstly, the economic problems had a particularly negative effect on the federal budget financing the bulk of unemployment costs and support to ailing industries. Secondly, for the conservative-liberal coalition under Helmut Kohl taking power in 1982 financial consolidation and a “leaner” state were two overriding political priorities. Thirdly, the high share of variable capital expenditure and project funding in the federal science budgets made reductions easier than in other policy fields, where long-term financial commitments existed and savings met strong political and public resistance. The Länder lacked such a flexibility because their science budgets were to a large extent bound by staff and operating costs for a higher education system that was already overcrowded and underfunded. With reunification the financial difficulties of the Bund heightened again, because the West German Länder were able to shift its costs largely to the central government and Federal Republic entered the worst economic crisis of its history. From 1991 to 1995 federal R&D expenditure decreased by 400 million DM amounting to a real decline of about 6% (Table 1-2a). In the West German Länder the Bund reduced its support even by 10% to finance reconstruction in the East where it had to shoulder the main burden due to the financial weakness of the new Länder (Table 6A). In consequence, a zero sum game developed in which the reunification of the PSR systems partly was financed by a redistribution from West to East.

In the 1990s the overall situation of German R&D deteriorated significantly sector did not longer compensate the decline of public research funding. Instead industry reduced its R&D investments and capacities more strongly than governments. Although this mainly was caused by the near collapse and de-industrialization of the East German Economy following the economic shock of the economic and monetary union in July 1990, it was not restricted to the former GDR (Grenzmann 1996). Industrial research in East Germany experienced an almost complete breakdown from 1989 to 1995. R&D staff decreased by more than two thirds from 85700 to 23700 (Table 5-1A). Simultaneously, private R&D expenditure dropped from 7,4 to 1,9 billion DM within two years before slightly recovering to 2,7 billion DM in 1995 (Table 5A). In the mid nineties the new Länder account only for about 8% of overall R&D staff in the business sector and a mere 5% of overall spending. But also the West German

---

62 This can be seen in the development of receipts and deficits of Bund and Länder since 1970 (Schimank 1995a: 71). From 1974 to 1976 the federal budgetary deficit increased fivefold and was in the following years mostly twice as high as that of the Länder, although the tax income of the Bund rose faster than that of the states in the eighties.
industry has curtailed its research efforts. This development started already in the late 1980s despite a still booming economy and accelerated with the recession in the mid nineties (Table 5 and 5-1A). It is most clearly revealed when one looks at personnel resources. In 1995, the number of R&D personnel in the business sector in reunified Germany was 4% lower than in the Federal Republic in 1989! (Table 7A). The unfavorable development of the German research system in the nineties shows in international comparison. R&D expenditure as a share of GDP has declined from 2.9% to 2.3%, the level of the early seventies, and Germany has fallen back from her first to a third rank in the G-7 countries concerning this indicator (Figure 4) and even in some small OECD countries like Sweden and Switzerland relative research efforts by now are higher than in the Federal Republic. Two other comparisons accentuate the “break” of reunification. Looking at the big five (France; Germany; Japan; United Kingdom; USA), between 1981 and 1989 gross domestic expenditure on R&D in total and per capita - measured in purchasing power parities (US-$) - rose only in Japan more quickly than in the FRG (BMBF 1998: 68-69). This favorable relative position was completely reversed in the nineties. Although R&D efforts lessened in all countries significantly Germany occupied together with France the bottom rank for these indicators between 1991 and 1995 (ibid.). (BMBF 1996a: 115-118; BMBF 1998: 66-68).

**Figure 4:** Gross domestic expenditure on R&D in the G-7 countries 1975-1995

![Figure 4: Gross domestic expenditure on R&D in the G-7 countries 1975-1995](image)


Public research institutions could partly compensate the lower level of government support by mobilizing resources from industry or international funding agencies. Accordingly PSR expenditures by performing sectors show higher, but still moderate, growth rates than public R&D spending (Table 3-
During the eighties the share of PSR financed by the business sector more than doubled, if from a low level (Table 8A). This was encouraged by research policy as the most welcome instrument to make universities and research institutes more responsive to the needs of industry and to foster collaborative research between both sectors and governments took several measures to create favorable framework conditions and incentives for such collaborations (Bundestags-Drucksache 10/225). For example, the BMFT allowed the national research centers to keep two thirds of receipts from technology transfer as additional resources and made administrative procedures for joint projects and undertakings with companies easier (Hohn/Schimank 1990: 285). To make the acquisition, administration and carrying out of externally financed research contracts more easy also was a central objective of the amendment of the Higher Education Act in 1985. It granted university researchers the right to carry out R&D projects for third parties without the need for approval by the university, to use university facilities for this purpose and to employ researchers on temporary contracts for these projects (Sandberger 1996). In the nineties the high growth rates of industry expenditure industry for extramural research have dropped in correspondence with the scaling down of in-house capacities (Grenzmann 1996: 223-224). Thus, this source of income which anyway was available only to certain researchers, research institutes and disciplines also has partly dried out intensifying the resource squeeze of PSR and competition for the increasingly scare public and private funds. If an improvement of the economic climate will lead to a resumption of higher business expenditure for public research remains to be seen. Experts like the president of the Fraunhofer-Society question this assumption and warn governments that private means are no panacea for insufficient public efforts for science. R&D investments of the business sector will always be predominated by rather narrow utilitarian considerations limiting their volume and restricting their flows to research areas and institutions which focus on application-oriented and applied research.

3.2 The position of PSR in the overall research system

In order to understand the function of public sector research in the German science system, one has to be aware of its position in this overall system. An eminent structural feature of R&D in the Federal Republic is the predominant position of the business sector both at the financing and performing level (Krull/Meyer-Krahmer 1996: 5). Already in the early sixties industry has provided about half of overall expenditure on R&D and used about 60% of research funding (Table 1A and 2A). From the mid seventies to the late eighties, however, a further significant shift of weight between public and private sector has occurred. In this period the share of public spending in the national science budget has steadily decreased from 50% in 1975 to 36% in 1989, while the business sector increased its share to 64% (Figure 5; Table 1A).

At the same time the share of R&D performed in the public sector dropped from 37% to 28% (Table 2A) while industry absorbs 72% of national R&D expenditure. A similar picture emerges if one looks
at R&D personnel as the more appropriate indicator of (potential) research capacities. Here, the share of industry rose from 62% in 1975 to about 70% in 1989 with a corresponding decline in the public sector (Häusler 1989: 22-23). Thus, taking into account that a growing, if still relative small, part of PSR is financed by industry (Table 8A) and governments purposely promoted the participation of business representatives in priority setting and program formulation for research policy, even by conservative estimates one can say that about 80% of German R&D activities are directly or indirectly controlled by industry (Grande/Häusler 1992: 10; Rilling 1994: 80-83). On this background it is justified to speak of a “privatization” of the German research system in the eighties which delegated public research institutions to a secondary role at least in quantitative terms, although one has to keep in mind that industry research includes a large share of applied research and product development with a low content of new knowledge. In international comparison, only in Japan, Sweden and Switzerland the business sector contributes a higher share of R&D financing and industry research accounts only in the USA, Sweden and Switzerland for a higher proportion of R&D activities (BMBF 1998: 420-421; Häusler 1989: 23).

Figure 5: Expenditure on R&D in the FRG by financing sector in 1995

Source: for data see Table 1A.

Far from being a cause of concern for research policy the dominant role of private interests and resources is regarded as a welcome relief for public science budgets. It has been a declared objective of the federal research ministry to maintain and stimulate own R&D activities in the business sector as necessary for industrial innovation and economic competitiveness. For this reason the federal research ministry saw the shift of weight from public to private research in the context of an overall growth of national R&D expenditure as a “desired development” corresponding to the “importance and dynamic
of market-oriented research” and “the trend in comparable industrial countries” (BMFT 1988: 16). The same positive attitude applies to the stronger involvement of industry in policy formulation and resource allocation which is not seen as an undue influence, but as an indispensable requirement to concentrate scarce resources on socioeconomic relevant research areas. “Integration of research institutions in the innovation process as partner and provider of technological services” and “closer collaboration between research institutions and industry” through an “early agreement of researchers and users on priorities concerning research topics and questions” and “offering companies access to laboratories and testing facilities, but also direct personal support by experienced scientists in the respective technology area” has been a central goal of current research policy (BMBF 28-29; Krull/Meyer-Krahmer 1996: 5).

In the 1990s the public sector has regained lost territory. But this is mainly a negative effect of reunification and the economic crisis of the mid nineties and not a sign of recovered public investments in R&D. While governments had a political obligation to preserve an adequate level of higher education and PSR in East Germany, industry was not bound by any such commitment. Accordingly many industrial laboratories which were not already terminated with the shut-down of their companies were dissolved or radically reduced by their new parent firms or owners. Simultaneously, the dynamic of private R&D activities in the West also slowed down due to recession and a reorganization and streamlining of business activities in order to reduce costs. Especially with regard to long-term capacities the shedding of R&D personnel in West and especially East Germany has decreased the share of industry to the level of the mid seventies (Table 3A and 7A; Figures 6 and 7). This has alarmed policy makers which warned that the economic problems could not be overcome by rationalizing and scaling down production alone, but required an intensification of R&D efforts for developing innovative products which could compete on internationalized markets (BMFT 1993a: 92-94).
Figure 6: R&D-expenditure in the FRG by performing sector in 1995

Source: for data see Table 3A.
The situation of German PSR in the mid 1990s

Figure 7: R&D-personnel in the FRG by employing sector in 1995

Source: for data see Table 7A.

The importance of PSR for the overall research system, however, cannot be assessed solely in quantitative terms. Its central function is indicated by the concentration of industrial research on practical problem-solving. About 95% of industrial R&D-spending is classified as short-term applied research and development tasks and only 5% as basic research (Häusler 1989: 35). Thus, long-term fundamental and pre-competitive research primarily oriented towards the production of new scientific and technological knowledge is the domain of PSR (Mayntz 1991: 46; Wissenschaftsrat 1996: 18). In addition, industry research is concentrated in four branches (electrical engineering; chemical and pharmaceutical industry; mechanical engineering; vehicle construction) constituting the “big four” dominating the German economy both with regard to R&D activities as well as turnover and export shares (Häusler 1989: 24-27). Together these five branches account for more than 80% of R&D-expenditure and employ three quarters of R&D-personnel in the business sector.63

A second feature is the dominant role of large enterprises with more than 500 employees spending nearly 90% of overall R&D expenditure and employing more than 80% of R&D staff in industry (BMBF 1996a: 562-563/594; Häusler 1989: 33), although small and medium sized enterprises form

---

63 Among these science-based industries, however, a redistribution of resources from chemistry to vehicle construction has taken place. In 1975/1995 the share of these sectors in R&D-expenditure (R&D-personnel) in the business sector was (1) 28,2/18,2 % (26,9/17,5%) for chemical industry; (2) 11,2/9,4% (13,4/11,4%) for mechanical engineering; (3) 11,2/21,4% (11,1/18,15) for vehicle construction and (4) 26,6/24,5% (28,7/27,3%) for electrical engineering; see for data Stifterverband für die Deutsche Wissenschaft: Forschung und Entwicklung in der Wirtschaft 1975 and 1995. Essen: Stifterverband.
the “main pillar of the social market-economy” (BMBF 1996a: 30) in the Federal Republic. In consequence, important industrial and service sectors and many SME do not have any or sufficient in-house R&D capacities and have to rely on access to extramural research facilities and technology transfer for innovation. For this reason, the built-up and strengthening of intramural R&D has been the object of several targeted research policy measures and the support of, especially small and medium sized, enterprises in the innovation process has been made a third central function of PSR in addition to basic and pre-competitive since the late seventies (BMFT/BMWi 1979; BMFT 1993a: 103-106; BMBF 1996a: 30-34). This included the establishment of technology transfer offices and information and demonstration centers at universities and research institutes, the provision of venture capital and administrative support for academic start up companies and small high tech firms and subsidies for R&D personnel in SME. An important role for SME plays the “Federation of Industrial Research Associations” (Arbeitsgemeinschaft industrieller Forschungsvereinigungen (AiF)) for collaborative research projects exceeding the resources of individual firms. The AiF is supported by regular grants from the Federal Ministry of Economics (BMBF 1996a: 407-408). However, only in the nineties the long proclaimed redistribution of government support for industry research from large companies to SME has taken place.

The growing importance of industry research in the eighties was accompanied by a second significant change in the relationship between public and private sector, namely a gradual retreat of government from financing R&D activities in the business sector. Between 1975 and 1995 the share of government-financed private research more than halved from 19% to 9% (Table 8A). Especially the Federal Ministry for Research and Technology as the main source of research grants to industry has drastically reduced its support to industry from about 45% at the beginning of the eighties to under 30% in 1995. By now, almost 89% of industry research is self-financed. At the same time the share of PSR funded by the business sector has tripled, if from a very low level (1981: 2%; 1995: 6%). Thus, despite a strong emphasis on a closer collaboration between PSR and industry in research policy in the period under review with regard to funding a clear separation of responsibilities can be observed, which has even increased in the period under review (Table 8A). This corresponds to the principle of subsidiarity underlying federal research policy towards industry since the beginning of the eighties (see below).

---

64 In SME which carry out R&D, however, the share of R&D in turnover and staff is higher than in large enterprises. It is this critical mass required for performing meaningful research and development which forms a high threshold for smaller companies to establish an own R&D infrastructure (BMBF 1996a: 103).

65 In 1982 SME accounted for about 15% of federal research subsidies to the business sector. In 1989 this figure had actually declined to 12% showing a huge gap between rhetoric and reality. Since then the proportion of SME has increased to about 26% in 1995; data are taken from BMFT (1993): 102/104 and (1998): 56-57, own calculations.
3.3 Challenges for German PSR in the eighties and nineties

As was already mentioned in chapter two German PSR encountered increasing criticism since the mid seventies due to its perceived inability to respond to structural problems and scientific as well as social developments. This criticism is captured in the term “reform blockade” and has something to do with the specific pattern of challenges which German PSR has had to face since the beginning of the eighties. Most of them were basically the same as in many other Western countries, but one was peculiar to Germany. Without going into detail about topics by now familiar, one could distinguish in a rough summary two groups of challenges. Firstly, there are those which result directly from research policy. Secondly, there are those which have their origin in broader political or social changes.

To start with the first group research policy in Germany, as in many Western countries still has to cope with the quite abrupt end to the “period of affluence” in the mid seventies and the transition to a “period of scarcity” which even has worsened in the early nineties when the “steady” turned to a “declining state”. In Germany, research policy had suffered more than other policies from general cuts in public budgets. Had science budgets grown far more quickly than general government expenditure until the early 1970s, growth rates moved largely in parallel between 1975 and 1990. Since then the share of R&D expenditure in overall government spending has sharply declined to the level of the mid sixties. The share of education, science and culture in overall public expenditure and in relation to GDP has continuously decreased since the mid seventies (Schimank 1995a: 70-72). This shows that not only the economic and financial problems were responsible for the reduced expenditures for state-financed research. Partly, this was also attributable to a certain political and public disillusionment concerning the possibilities of PSR to contribute to the overcoming of the perceived economic and social stagnation. Universities, for example, were characterized at the beginning of the eighties by overcrowding, aging graduates, rising academic unemployment and complaints by industry that teaching and research were not oriented to its needs. Similar critic was leveled against other PSR sectors because of a perceived lack of involvement in innovative and promising fields and the transfer of research findings into new products and problem solutions. The low capacity for reform in the PSR system, however, prevented swift problem-solving which in turn increased the impression of an immobile research system not responding to changed economic and social needs.

In this situation, German research policy has wanted to make a virtue out of necessity. Supported by policy recommendations from the Science Council, the federal research ministry as well as the state ministries of culture came to the conclusion that the increased scarcity of resources could be used as an instrument to terminate too much mediocre or useless research which had been accumulated during the period of affluence (Wissenschaftsrat 1975a). This strategy was based on the assumption that a competitive system of resource allocation within the PSR system could be established which redistributes resources according to the relative strength of institutes and individual researchers. In this way, policymakers sought to implement the budgetary cuts without worsening the productivity of public sector
research. Instead the leaner, but more focused research system is expected to be more competitive than before (BMBF 1996a: 27-28; Wissenschaftsrat 1979).

Besides inner-scientific quality, extra-scientific relevance of research has become of overriding importance for research policy. Public research funding has ceased to be a spending item which governments and the public scarcely notice, although government support for R&D is still relatively low accounting even at its peak for only about 4% of total public spending (Table 11A). But in times of tight budgets PSR has to compete with other public tasks even for this money which is needed urgently for other purposes. Consequently, research budgets have had to be legitimized more scrupulously since the mid-seventies. Especially, basic research which implies no immediate use or potential utilitarian benefits in the foreseeable future is often considered as a luxury society can no longer afford (BMFT 1993a: 8). In consequence policy has tried to direct research toward areas of vital concern for society, such as solutions to environmental problems. But clear priority was given to the contribution of PSR to industrial innovation and economic growth through the promotion of key technologies for innovate products and services as a precondition for securing existing and creating new employment in an open economy with high labor costs and a lack of natural resources. Innovation and technology transfer has been the twin and unchanged imperative in research policy since the mid seventies (BMFT 1984: 21-26; BMBF 1996a: 27-39). Even the technology areas targeted had remained the same: biotechnology, new materials, information and communication technologies, production, especially micro and laser technologies and environmental technologies (ibid.). However, the increased orientation of public research towards socially and industrially relevant research was not only a function enforced by external actors on an unwilling research community. Instead it could be said to be in the well-understood self-interest of PSR because only with economic prosperity a new “period of affluence” could be hoped for. Again, research policy could make a virtue out of the necessity to scale down support for PSR by putting research actors under pressure to become more responsive to societal and economic demands, something much more difficult in times of generous public funding.

These internal changes in research policy have been accompanied by two equally important external changes. The first of these has by now affected most policy areas in all countries of the European Union (EU). Since the eighties, the EU has become an increasingly prominent agent of research funding (Grande 1994: 201-269). In some important research areas, such as information technology, the EU competes vigorously with the German federal ministry of research when it comes to the political guidance of research activities. This partial loss of influence on the part of national political actors is underlined by the fact that the finance ministry exerts pressure on the federal ministry of research to reduce domestic programs in areas where corresponding EU activities take place lessening the flexibility and autonomy of national research policy (see for the role of the EU for German PSR chapter 7.3). The other external change forced on the German PSR system since 1990 has been the unique phenomenon of German unification. Research policy has suddenly and unexpectedly been confronted with the un-
Political regulation and guidance

3.4 PSR functions and research policy objectives

According to the latest “Federal Report on Research” the S&T policy of the Federal Republic is oriented towards the following eight objectives (BMBF 1996a: 7-10):

- promotion of key technologies with a high potential for innovation, economic growth and job creation.

- stronger orientation of research policy towards innovation through a combination of traditional research funding, stimulating collaboration between science and industry, and the establishment of favorable framework conditions for scientific research and innovation.

- safeguarding the richness and productivity of culture through the support of scientific research reflecting on the development of modern society and the consequences of the scientific-technical progress.

- coping with the challenge of accelerating social and cultural change through “precautionary research” that contributes to the understanding and preservation of the natural and socio-cultural living conditions.

- safeguarding and strengthening scientific excellence within PSR without restricting the constitutionally guaranteed freedom of science through an evaluation of research areas and institutions and
an achievement-oriented public funding system based on inner-scientific competition rules and performance criteria.

- reorganizing and expanding PSR capacities in East Germany in order to establish a modern and competitive research system in the former German Democratic Republic.

- improving the societal acceptance of new scientific and technological developments and preserving the freedom of research by an unprejudiced public debate on the potentials and risks of scientific progress and the dismantling political and administrative restrictions of PSR.

- promoting the international character and cooperation of science in order to make the Federal Republic attractive for outstanding scientists and to take into account the internationalization of science and industry.

The responsibilities and functions of PSR within this general framework are to provide the knowledge base for a competitive “national innovation system” (Rütgers 1996a: 294; BMBF 1996a: 8-9). However, while the general objectives of research policies formulated in the seventies largely were kept, its underlying concept changed in the eighties. Two developments coincided in this and reinforced the policy change. Firstly, the change of government from the social-liberal to the conservative-liberal coalition under Helmut Kohl proclaiming a “reorientation of research and technology policy”.66 Secondly, this reorientation drew its ideas and principles from the change in economic thinking to a supply-side- and market-oriented philosophy which dominated to various degrees policy agendas in most OECD countries. From the start liberal economics had sharply criticized the concept of an active research and technology policy in which the state claims the ability to identify economic and social needs and to direct public and private research accordingly as an unjustified presumption and denounced the corresponding massive expansion of earmarked project grants as hidden subsidies and undue government interference in the market process. Following Hayek’s thesis of a decentralized distribution of knowledge in economy and society which cannot be made available to or processed by a centralized administration the risk of state failure in R&D planning was regarded as far higher than the risk of market failure (Jüttemeyer 1985; Kaufer 1979; Kaufer 1982). Two elements of supply-side economics and the liberal ideas inspiring it had a particular strong impact on German research policy with considerable repercussions on policy formulation and implementation.

The first element was the general objective of reducing government intervention and regulation in favor of private initiative, market mechanisms and “achievement” (Leistung) that was not only applied

---

66 The main policy documents on this reorientation are a White Paper - “Neuausrichtung der Forschungs- und Technologiepolitik in der Bundesrepublik Deutschland” (Bundestags-Drucksache 10/710) - published by the new Christian-democratic minister for research and technology in August 1983 and the Federal Report on Research (BMFT 1984: 11-41), in which the new guidelines and priorities of the federal research policy are laid down.
to economic policy, but also to other sub-systems of society including education and science. For this reason, the federal research policy claimed a new functional division of responsibilities among state and industry concerning R&D. Following the German liberal approach of the so-called Ordnungspolitik the principal task of the state in the market economy is seen in providing and maintaining a reliable legal framework and positive climate in which private initiatives and economic activities can unfold, while government interference is restricted on ensuring fair competition and correcting market failures. Applied to education and research this means the creation and maintenance of “framework conditions conducive to innovation” and the provision of an “innovation-friendly environment through the promotion of basic research and an education policy on which the R&D activities of companies can be based” (BMFT 1993a: 17; BMFT 1984: 13/28-29) underlining again the strong orientation towards the needs and interests of industry in the eighties and nineties. The main instruments to realize this objectives were seen in “a continuous and reliable research policy, the elimination of unnecessary bureaucracy and the support of cooperation and thematic and organizational change” in the research system (BMFT 1988: 32). According to these “guiding ideas” (BMFT 1984: 11) of the new research and technology policy the responsibilities of governments and public research on the one hand and industry on the other hand are more precisely delimited.

Three kinds or types of research are declared to form the task of PSR due to their public good character or systematic bias to market failure leading to an under-supply of private activities (BMFT 1984: 15-16/26-30; BMFT 1993a: 7-18):

Undirected fundamental research as the classical domain of public research. A broad and productive basic research is regarded as a conditio sine qua non for two reasons. Firstly, it provides the knowledge base of the innovation system. Secondly, support for basic research deepening the understanding of nature, man and society is conceived as one of the most distinguished mission of a civilized and developed state in the same way as the promotion of arts (BMFT 1984: 11). In exchange for a high level of support the central government expected universities and science organizations to orient their research planning and resource allocation more closely towards scientific excellence and performance criteria by giving more weight to evaluation and competitive funding (BMFT 1984: 14; BMFT 1988: 37-40). In the eighties also a shift of emphasis with regard to basic research can be observed. At the beginning of the decade research policy stressed the “freedom of research” as the “opportunity of science to unfold according to its own logic and will forming” Concerning PSR the government under Helmut Kohl stated its “explicit loyalty” to the constitutionally guaranteed freedom of research and to the principle of scientific self-administration in basic research (BF 1984: 15-16): “Selection of topics and methods in basic research must remain a matter of science” (BMFT 1984: 15) regardless of the political demand for thematic priority setting and a closer collaboration with industry (BMFT 1988:

67 “Achievement has to be worth it again” (Leistung muß sich wieder lohen) was one of the central statements
In addition, the central government promised to continue support for basic research at a high level (ibid.: 16). By now the responsibility of fundamental research to contribute to industrial innovation and social development has taken precedence. Although the “high quality of basic research” is still regarded as an “asset” of the German research system which requires further promotion, “application-oriented basic research” is now described as the “normal case” of research while curiosity-driven research is delegated to a secondary rank (BMFT 1993a: 8-9).

A second area for PSR is research in the public interest. Even though in some of these areas, like health research, also significant private activities take place a high level of public research is necessary to guarantee that short-term economic interests do not dominate over long-term general interests like in environmental research and that the benefits of research are made available to all people needing them like in health research (BMFT 1993a: 11-12; BMBF 1996a: 8). But also here the “development of scientific knowledge and new technologies must be oriented towards the criterion of application” (BMFT 1993a: 12).

Government support, however, is also justified in specific areas of application-oriented or applied research which could in principle be performed by industry, but whose financial and scientific risks, long-term character and resource demands lead to an under-investment in the private sector. Extent and volume of this support, however, is declared to be strictly following the principle of subsidiarity and restricted on the punctual and targeted promotion of key technologies, because “research, development and innovation in the economy are the domain of companies. Firms have to decide on their own where in their opinion research efforts are worthwhile and to what extent they should be performed.” (BMFT 1988: 42-43). Here, the liberal supply-side rhetoric of the new research policy distinguishing it from the former social-democratic ideas has been strongest: “Innovations cannot be decreed by the state or substantially directed; investment steering is the wrong way. … In all measures, especially with regard to direct project funding in the economy, the principle of subsidiarity has to be heeded to ensure that the search and selection functions of the market are not invalidated.” (Riesenhuber 1984b: 4).

Restraint of the state concerning the direction of private R&D and the creation of framework conditions stimulation industrial R&D and innovation became two pillars of official S&T policy (BMFT 1984: 13/26-28; BMFT 1996: 16-18). These were to be implemented by a reduction of direct project funding with a detailed prescription of research topics and objectives in favor of “indirect-specific grants” in strategic technology fields leaving the formulation of precise topics and research strategies of individual projects to industry. At the same time the federal research ministry declared its will to scale down its support for industry and to use the freed financial means to strengthen basic and pre-competitive public research (BMFT 1984: 28-29; 1988: 86-91). In turn, it promised to make PSR more...
responsive to the needs of industry and to improve the conditions and incentives for and to promote collaborative research and technology transfer between companies and public research institutions (Riesenhuber 1984a: 7-8; BMFT 1984: 33-38; 1988: 37-45). But the main instrument for promoting private R&D efforts was seen in deregulating and liberalizing the economy and reducing corporate taxes and social security contributions (BMFT 1984: 27-28). In this way, companies were to be enabled “to invest more in the expansion of research and to strengthen especially applied research in own responsibility.” (ibid.: 28).

In summary, research policy does not longer claim a direction of public and private research towards politically determined social and economic needs. Instead, the federal research minister defines its present role as a “moderator” organizing “innovation networks” in which a constructive dialogue among and between science and industry on priorities can take place, while in research promotion a bottom-up approach is given precedence by which the state takes up the initiatives of the latter. A second task is to ensure that public research institutions follow the programmatic changes in research policy and that resources are allocated according to quality (Rüttgers 1996a; 1997). This is informed by a new understanding of the model and process of scientific and technological innovation found gradually its way into German science and technology policy. The classical “linear” model in which basic research produces a continuously expanding stock of knowledge, applied research converts this knowledge into ideas and prototypes for new products, processes and services finally taken up by development and production for commercialization has been replaced by complex “circular” models. In these models the different stages of the innovation process are characterized through permanent and often simultaneous interaction and feedback between the different stage of the innovation process. At the same time, partly reflecting the debate on innovation and partly reacting towards inner-scientific developments, the traditional mode of knowledge production, defined as “academic” and “disciplinary organized”, is perceived to loose in importance and relevance in favor of a new or so-called “Mode 2” (Gibbons et al. 1994). Its main characteristics are described as “dialogue-oriented, transdisciplinary and closely linked to social, economic, political and cultural contexts” (BMBF 1996a: 6).

On this background research policy focuses on three general objectives concerning PSR.68 A first concern is to reduce “the institutional funding of research institutions in favor of a program- and achievement-oriented resource allocation” based on systematic evaluation and competitive funding. In this way, the quality of PSR shall be improved and support more strongly channeled towards centers of excellence: “High scientific productivity and reputation are the criteria against which all research institutions have to be evaluated” (BMBF 1996a: 8). A second goal is to increase the autonomy and own responsibility of PSR concerning the internal distribution of their research staff and budgets by dis-

---

68 These objectives are laid down in the report “Safeguarding the Quality of Research” of the Bund-Länder-Commission for Research Planning (BLK) from November 1997 which has been approved by both the central and the state governments as guideline for the joint research policy.
mantling legal and administrative regulations and control. “Lean research” is seen as a precondition for a more effective and efficient public research system because it allows universities and research organizations a flexible resource allocation and organization according to the quality and promise of researchers, research areas and topics and to develop own research profiles according to their strengths and weaknesses (BMBF 1996a: 8; BMBF 1998: 88). Thus, the present research policy is based on the presupposition that the best way to promote scientific excellence and productivity is to give inner-scientific competition and “self-responsibility” (Selbstverantwortung) priority over political guidance and control. At the same time the orientation of PSR to economic and societal needs and demands is to be ensured by a close dialogue and collaboration between science, industry and public interests in “innovation networks”. These networks shall (1) identify strategic research areas of central importance to scientific, economic and social advancement, (2) concentrate PSR capacities accordingly and (3) improve the transfer of research findings into new products and problem solutions (Rüttgers 1996a). In this context the state no longer claims superior knowledge concerning which will be the future social needs or technologies promoting economic growth marking a radical departure from the planning and steering optimism in the seventies: “The state is neither the more knowledgeable scientists nor the more innovative entrepreneur.” (Rüttgers 1996a). Instead, its task is to organize and moderate the coordination between researchers, producers and users and to direct its support to research areas and projects which are identified as being of central importance for the future scientific or technological development (Rüttgers 1996b). For this purpose the federal research ministry took several initiatives for introducing and improving research foresight, to identify strength and weaknesses of German science and technology, and to establish procedures for corresponding research planning (Grupp et al. 1996; Cuhls/Uhlhorn/Grupp 1996).

Starting in the mid eighties the BMFT commissioned several surveys and reports on future scientific and technological developments to identify promising and innovative research areas which could serve as outlooks and “basic elements for a comprehensive R&D strategy” (Grupp 1995: 3). Since 1984 the Federal Reports on Research contain a expanded section on “the technological competitiveness of the Federal Republic, which gradually expanded in subsequent reports with the establishment and improvement of instruments and methodologies for systematic foresight activities. The first major project sponsored by the BMFT was a report on “Technology at the Beginning of the 21st Century” (Grupp 1995; Cuhls/Uhlhorn/Grupp 1996: 66-70). Its objective was to assess technologies critical for the German economy in the future. In 1992, this approach was followed by a German Delphi study modeled after the regular five year Delphi exercises carried out in Japan. It is an instrument for long-term forecasting by which experts were asked to give an assessment of the future priorities and development of their field in more than 1000 special topics of science and technology. In a second round the same experts were to comment on their original recommendations on the basis of the results in the first round. A regular repetition of the Delphi exercise is planned to evaluate and adapt forecasts in the light
Political regulation and guidance 93


In 1995 a “Council for Research, Technology and Innovation” was set up by the federal chancellor. It consists of 17 eminent representatives from science, industry, trade unions and governments and has the task to draw up reports on strategic S&T areas assessing strengths and weaknesses of the Federal Republic and making proposals for future action. By now two reports on information society and biotechnology have been published (BMBF 1996a: 27).

A new instrument for implementing a strategic R&D policy based on the common identification of priority fields and problems by science and industry are the so-called “guiding projects” (Leitprojekte): “Leitprojekte shall ensure that marketable ideas in technologically important, strategic research areas are more quickly than by now transformed into products, processes and services” (BMBF). For this purpose the BMBF selects in coordination with expert committees of scientific and business representatives thematic fields. Formulation of concrete research questions and projects is left to applying research teams. In an “open competition” mixed peer review committees choose the 15 proposals with the best ideas and most promising approaches for problem-solving, whereby collaboration between public research institutions and industry is a precondition (Rüttgers 1996b: 295-296).

In the latest conceptual policy documents of the federal research ministry the contribution to innovation, that means economic and social development, as the paramount function of PSR is confirmed. The “Guidelines on the Strategic Orientation of the German Research Landscape” (Rüttgers 1996b) and the “Petersberg Theses on the Globalization of R&D and Technology Markets” (Rüttgers 1997) regard the internationalization of production, research and communication networks and the transition to a “knowledge society”, in which the “creation and availability of knowledge” are the central elements for “social, cultural, economic and political development” (Rüttgers 1996b), as the dominating trends and challenges for research policy at the outgoing 20th century. In consequence, productive and innovation-oriented “national and regional educational, research and innovation systems” are conceived as key prerequisites for stable economic growth and the solution of social and ecological challenges (Rüttgers 1997). For this reason the most important tasks of research policy is to increase the responsiveness of PSR towards the needs of industry and society and to promote

“a more intensive cooperation at all levels, between knowledge- and application-oriented researchers as well as between science and industry. All measures of innovation policy serve the common goal to make Germany ... a turntable of information, know-how and communication and thus a center in the world-wide competition for knowledge and innovation.” (Rüttgers 1996b).
Thus, like in many other countries societal “relevance” of PSR as the guiding principle of research policy is evident. Promotion of curiosity-oriented basic research, however, has always remained an equally important goal in official research policy. In this respect, continuity with former times, when this kind of research promotion was dominant, is explicitly articulated. Responsibilities of fundamental research to orient more strongly towards “relevant” scientific fields and to give closer attention to potential applications of its findings are stressed and resources have been distributed towards strategic application-oriented research. At the same time, however, the freedom and self-government of science within this framework is also underlined (BMBF 1996a: 8). “Value for money” is rather understood in the sense of the obligation of universities and research organizations to ensure a high level of research quality and productivity than in a narrow utilitarian sense. Accordingly public research funding shall be following “inner-scientific competition rules” in basic research to achieve “a maximum of scientific excellence and own responsibility” (ibid.; Rütegers 1996a). Even though reality partly deviates from this rhetoric when in the same breath a stronger linking of basic and application-oriented research is demanded and all scientific fields selected for priority funding are key technologies (ibid.), but the increased will to strengthen fundamental research cannot be dismissed despite its strong utilitarian underpinning: “Research needs a long staying power. Technology oriented research is based on broad basic research. They are two sides of the same coin.” (BMBF 1996a: 9). Not a “colonization” of basic by applied research and external interests is intended, but to improve the “transitions and linking points” (ibid.).

This distinguishes Germany from some other countries where the redistribution of resources from transition from the “science-push” to a “demand-pull” model of PSR has been more far-reaching. The Kohl government regards it as one of its major accomplishments in research policy to have increased the share of basic research in the federal science budget and in international comparison Germany devotes relatively more resources to basic research than most OECD countries (Uhlhorn 1997: 441). In the eighties it have been mainly university departments and research institutes operating large research installations which have benefited from the new emphasis on basic research (Table 16A). For this purpose the Federal Ministry of Research and Technology had set up two scientific advisory committees on large investments (Maier-Leibnitz 1975) and big projects (Pinkau 1981) in basic research whose recommendations have been completely implemented in subsequent years in the first case and on a reduced scale in the second case due to the number and costs of proposals (Uhlhorn 1997: 442). Since the late eighties it have been universities, Max-Planck-Society and German Research Society which have especially profited from additional public R&D efforts and enjoyed privileged funding partly reversing their disadvantaging since the mid seventies. For example, the share of

---

69 According to official data which, however, have to be treated with care due to the well-known problem to differentiating between basic and applied research, the share of basic research in the federal science budget has increased from 24% in 1981 to 29% in 1992 (Bundesbericht Forschung 1996: 81).
MPG, DFG, university programs in the federal science budget rose from 11% in 1989 where it had stayed throughout the eighties to 16% in 1995. Overall core funding for basic research including investments for large equipment of basic research increased correspondingly from 18% to 22% (Table 16A, own calculations). Thus, only after a considerable time lag the Christian-democratic research minister was able to fulfill its promise to redirect science promotion towards basic research to a meaningful extent.\(^70\)

In March 1989, Bund and Länder agreed on a “special university program” (*Hochschulsonderprogramm I* (HSP)) for securing the openness and productivity of particular strained disciplines. Until 1995 Bund and Länder provided annually 150 million DM creating about 1600 additional positions for scientific staff and about 16900 new student places to prevent new or lift existing restrictions of student admission. Accordingly, priority was given to vocational study courses and the *Fachhochschulen*. Thus, the HSP I was dominated by teaching needs and benefited research only indirectly (BMBF 1996a: 141; BMFT 1993a: 135).

The HSP I was followed by a summit of federal and state governments in December 1989 leading to a “Joint Declaration on Principal Questions of Education and Research Policy”. Its main points were (1) the commitment of Bund and Länder to realize as quick as possible the planned number of 850000 student places and to provide the means for additional 50000 places at *Fachhochschulen*; (2) to intensify efforts for modernizing university infrastructure, supporting (post)doctoral students and creating career opportunities for younger scientists and, most importantly for basic research, (3) to increase the budgets of Max-Planck-Society and German Research Society by 5 percent for the following 5 years. This so-called 5x5 decision even was kept under the difficult financial conditions after reunification.

To implement the university part of the joint declaration Bund and Länder set up a second special university program (*Zweites Hochschulsonderprogramm* (HSP II)) for securing the productivity of higher education and research in October 1990. The program which supplements and expands the HSP I and for which the federal and state governments provide 4 billion DM runs until 2000 and concentrates on the promotion of younger scientists through the establishment of graduate colleges and positions for doctoral and postdoctoral students at universities and non-university research institutes (BMFT 1993a: 33/135-136; BMBF 1996a: 141-142)). In 1991, a “university renewal program” (*Hochschulerneuerungsprogramm* (HEP)) for the East German Länder completed the emergency measures. Its mission

---

70 The BMFT was quite realistic in this respect. Already in 1983 the minister had warned of exaggerated expectations concerning the speed and extent to which its new priorities will show in actual research funding: “Research policy is a heavy tanker which cannot be driven around the corners like a speed boat. Unless one accepts that it breaks into pieces. Thus, one must change directions cautiously.” (Riesenhuber 1983: 55). Vested interests, long-term commitments, iron triangles between research administration and recipients of funding, the constraints of Federal-state cooperation and not the least instrumentalization of research policy for other policy objectives impede the reorientation of federal research policy until today; see chapter two and Stucke (1993) as well as the regular critical surveys of a leftists, but independent group of
is to support the renewal of scientific staff and infrastructure of universities and research institutes in East Germany (BMFT 1993a: 136). All three programs were merged and expanded in 1996 (BMBF 1998: 93).

But although basic research has maintained a prominent role in research policy and funding, it has not remained unaffected from the policy changes emphasizing quality, accountability and relevance of PSR which have taken place between the sixties and seventies and the eighties. The gradual shift of the definition of basic research from curiosity-driven to application-oriented research has been already mentioned and is also clearly visible in the special university programs, new federal priority programs for biotechnology, the information society or mobility (BMBF 1996a: 39-52) and the restructuring of universities by the Länder. New teaching and research capacities were created especially in the technical and engineering disciplines, while humanities and social science departments or “orchid disciplines” have been subjected to rationalization measures. The blurring of disciplinary boundaries and clear separations between basic and applied research in favor of interdisciplinary and problem-oriented research in many of the most dynamic scientific fields contributed to this conceptual change in the promotion of basic research. This is captured in the scientific and political debate on a new mode of knowledge production replacing the traditional “academic” and “disciplinary organized” organization by a “transdisciplinary and heterogeneous” one operating in a “context of application” (Gibbons et al. 1994). Here research questions are no longer formulated according to cognitive disciplinary priorities and norms and the linear model of innovation breaks down. Instead “mode 2” is defined as “dialogue-oriented, recursive and closely linked to social, economic, political and cultural contexts. Knowledge develops and is used in networks. This makes the former ideas of a more linear sequence from knowledge production to innovation questionable. Decisive developments result from the parallel collaboration of researchers, developers and users” (Rüttgers 1996a; BMBF 1996a: 6). Under these conditions the production of scientific knowledge has to be carried out from the beginning with a view towards potential application (ibid.).

“Networks between science, industry and users have to be developed in which creative product and process ideas emerge in a constructive debate between the needs of users, the knowledge of researchers and the commercial interests of firms.” (Rüttgers 1996b: 293)

A second major concern of research policy actors during the eighties, but especially in the nineties has become quality control in basic research. Whereas with respect to application-oriented and applied research the judgment of those extra-scientific actors who are interested in a particular kind of research is by and large accepted as reliable, this is no longer the case with respect to the mechanisms of inner-scientific peer-review which instructs the allocation of resources in fundamental research. Here, gov-
ernments were disappointed by the slowness and even outright inability of the self-governed science organizations, but especially universities, in the seventies to redirect and concentrate resources on the most promising and productive research areas and researchers. Although the straitjacket of financial and bureaucratic regulation and political control is recognized as a major cause of this development (BMFT 1984: 33-40), governments see the installations of additional and tighter inner-scientific mechanisms of quality control as an indispensable complement of the efforts to grant universities and science organizations more autonomy and flexibility in structural planning and budget and staff management.

Major initiatives have been started to strengthen “competition and self-control in the science system” (BMBF 1996a: 28; 1998: 88; Rüttgers 1996a), whereby two approaches dominate. Firstly, the reduction of institutional funding in favor of a program-oriented and competitive resource allocation. Secondly, the establishment of regular and systematic evaluation of research institutions by independent external experts. A first opportunity to implement systematic quality control offered reunification. Bund and Länder commissioned the Science Council to evaluate all research institutes of the East German Academies of Science. Only institutes and researchers receiving a positive evaluation were continued. Simultaneously the Länder established structural and evaluation commissions for higher education institutions with a similar mission. This undertaking in the former GDR was used as a means of exerting pressure and justification to carry out a similar overhaul of PSR in West Germany. A first step was the agreement of Bund and Länder to subject the Bund-Länder-Institutes to a Science Council evaluation with the declared objective to continue joint funding only in case of a favorable assessment (Wissenschaftsrat 1993d). If one takes into account that in the previous fifteen years such a decision often was preceded by long disputes and not implemented (see chapter 2) this amounted almost to a revolutionary event in the consensus- and status quo-oriented German public research system.

In a joint decision Bund and Länder agreed in 1997 on a set of measures and instruments implementing these principles. Max Planck Society, German Research Society and Fraunhofer Society were committed to carry out “system evaluations” in order to improve procedures for research planning, allocation of grants and the quality of the supported research institutions and scientists. For the national research center an external evaluation in five year intervals was introduced and analogue to the practice of the Max Planck Society it shall be proofed if and under what conditions institutes and departments will be continued when their heads leave or retire. In addition, a “strategic fund” at the “Helmholtz-Association of National Research Centers” is established to which the centers have to provide 5% of their institutional block grants and for which they can apply on a competitive basis. A similar arrangement is set up for the Bund-Länder-Institutes which have to give 2.5% of their base funding to the DFG. In turn they get access to the DFG-programs where they have to compete with university researchers for project grants. As a compensation the research organizations is granted more flexibility in the use of budgets and staff (BMBF 1998: 88). In the university sector most state minis-
tries of culture have experimented with similar instruments to introduce competition and quality control and a general debate to make the level of professorial salaries, infrastructure and resources dependent on regular evaluations of research and teaching performance is underway.

The general political goals described have oriented German research policy from the beginning of the eighties until today, and they will probably not change very much in the next years. They reflect clearly the challenges sketched in the preceding chapter. We will now turn to the relevant actors on the political level to see how they have implemented these declarations and how successful they have been. In general, it is clear that at least three factors may lead to far-reaching deviations of actual policy measures and their outcomes from declared intentions. First, specific interpretations of these rather diffuse goals and priorities in particular situations may differ between political actors. Accordingly, wherever a particular science policy actor has independent powers of action, he may act in a way that does not fit to that of other political actors. The coordination problem is aggravated when the political actors interpret common decisions differently. This may either produce conflicts about what to do blocking implementation or can result in compromises which - due to their declarative character and lack of substance - satisfy no one or do not lead to real reforms. Second, if decisions have to be implemented besides stated goals often undeclared interests of the relevant political actors come into play and may be sometimes stronger than goals. For example, one can support evaluation as a criterion for joint resource allocation in principle, but exercise a veto if one’s own research institutions are negatively affected. Third, political actors are limited in their capacity to implement policy objectives by manifold institutional restrictions and by the possible resistance of other actors, especially those which are the subjects of the particular measures. This last aspect turns attention to actors on the performing level of PSR whose perspectives will be dealt with in the next chapter.

All three factors are strongly built into the basic structures of German PSR, as already stated in the preceding chapters. On the political level, science and technology policy is characterized by a high degree of vertical and horizontal decentralization due to the federal state structure and the involvement of different ministries in research policy making at the federal level. The most important policy actors in the PSR system are (see also chapter one and Figure 3):

The “Federal Ministry for Education, Science, Research and Technology” (BMBF) which has the overall responsibility for higher education and research policy within the central government. It was created through the fusion of the Federal Ministry for Research and Technology and the Federal Ministry for Education and Science. Thus, for the first time since the early seventies responsibilities for university and non-university research are united in one department. About 65% of federal expenditure on R&D and most of the federal funding programs for specific areas of science and technology are administered by the BMBF. In addition, the BMBF represents the interests of the Bund towards Länder and science organization.
Besides the BMBF most of the federal ministries pursue own research activities within the framework of their specific mission and independent from the research ministry. For this purpose, most of them operate own Federal Research Institutions.

The “ministries of education and cultural affairs” (Kultusministerium) of the 16 federal states that are primary responsible for the organization and financing of universities and - together with the Bund - the jointly funded non-university sector according to their constitutionally guaranteed autonomy in cultural and educational affairs. Together the Länder account for almost half of overall public spending on R&D and dispose of important legislative powers in research policy.

A special role in funding arrangements for PSR plays the “German Research Association” (Deutsche Forschungsgemeinschaft (DFG)). The DFG is the largest public funding agency in the Federal Republic besides the federal and state ministries themselves from which it receives its budget. Established as an autonomous, self-governed organization of German its function and activities can be compared to that of a national research council which represents the interests of the scientific community to and advises governments. Its most important task, however, is to provides financial support mainly for university research in all branches of sciences and the arts. Jointly financed by Bund and Länder the DFG operates no own research facilities, but distributes grants for individual and collaborative research projects. In addition, the DFG administers special funding programs for thematic and structural priority setting and (interdisciplinary) cooperation of university research and the promotion of younger scientists. The DFG accounts for almost 40% of total “third-party funds” and 11% of total R&D expenditure of universities.

This decentralized structure of government and funding arrangements produces many differences, how to interpret jointly agreed goals, and conflicting interests about how to implement these goals. On the other hand, the room for independent action in research policy is extremely small, because most decisions need the consent of the federal and at least a majority of the state governments. For this reason, decisions often are based on the lowest common denominator and omit controversial issues in order to avoid a blocking of policy making. It requires extreme convergence of interests or favorable political circumstances that ambitious reforms can be agreed and implemented under these conditions (see chapter two). Moreover, this must be seen in combination with the high level of scientific autonomy which universities and non-university institutions enjoy. They dispose of a considerable potential for obstruction and non-compliance if political measures run counter to their interests making a hierarchical and direct political control of most PSR sectors largely impossible. This applies especially to universities and the non-university organizations (DFG; MPG) oriented towards (basic) research for the

---

71 In most Länder the competence for education and science has in the meantime been split between a “science ministry” (Wissenschaftsministerium) responsible for universities, science, and culture and an “education ministry” responsible for primary and secondary schools and vocational training. In the following the general term ministry of culture will be used for all Länder.
advancement of knowledge, where the self-government of science has an old and powerful tradition. But over time also, if to a lower degree, mission- or application-oriented research institutions like the Fraunhofer-Society, the National Research Centers and the Blue-List-Institutes have acquired a considerable degree of freedom from external interference. The only exception to this rule are the Federal Research Establishment, which are subject to directives and direct control of the responsible ministry, even in matters like the selection of research topics and publication of research results.

3.5 Guidance of PSR

Guidance of PSR policy in Germany has traditionally a strong “bottom up” dimension based on a partnership between science and state and scientific “self-control” ([Selbststeuerung](#)) which delegates structural and thematic priority setting and allocation of public research funds largely to the scientific community. This philosophy concerning the relation between policy-makers and scientists in Germany is reflected in the concept of the “cultural state” ([Kulturstaat](#)). According to this “implicit theory” or “policy paradigm” of science is conceived as a “self-regulating sub-system” ([Blankenagel](#): 55) that fulfills its societal functions best, if it is granted the freedom to operate according to its own laws and internal logic. In consequence, the role of the state is seen to be primarily an enabling and supervising one “to make possible and to support ... the cultivation of free science and its transmission to future generations through the provision of personnel, financial, and organizational resources. That means, that it has to provide properly functioning institutions for free science.” The doctrine of the cultural state is institutionalized in the constitutionally guaranteed freedom of “art and science, research and teaching” ([Art. 5 (3) of the Basic Law](#)) and the organization of universities and most non-university research organizations and institutes as “self-governed corporate bodies of science” ([Selbstverwaltungsorganisationen der Wissenschaft](#)). It is also this tradition which secures basic research such a prominent place in public sector research ([BMBF](#): 8).

---


73 These terms describe general ideas about the nature of problems and the adequate patterns of problem solving “which are more or less accepted by the actors in a given policy.”. They have therefore a “meaning giving” ([sinnstif fend](#)) and “action-guiding” ([handlungsleitend](#)) effect ([Braun](#): 140).

74 Already Wilhelm von Humboldt (1993: 260) argued that “the state must nor ever demand from universities that which would serve its purposes directly, but should hold to the conviction ... that if they achieve their ultimate purpose, they also fulfill its [the state’s] purposes but from a far higher point of view from which far more can be comprehended and totally different forces and leverage can brought to bear as it [the state] can set in motion.” Although the origins of the “cultural state doctrine” reflect the objective to legitimize the establishment of the “Humboldtian” as a “republic of scholars” based on free inquiry and speech within an authoritarian state, the doctrine of the “cultural state” had from its inception wider implications, namely protecting PSR institutions against direct political guidance towards political, economic or social aims or practical problem-solving.

75 Quoted according to the “University Decision” of the “Federal Constitutional Court” ([Bundesverfassungsgericht](#)) which explicitly took up the concept of the cultural state in this landmark decision from 1973 concerning the interpretation of Art. 5(3) guaranteeing the freedom of research.
Government and funding arrangements for PSR

Funded exclusively or predominantly by the state, universities, which are simultaneously state and corporate institutions, and science organizations and public research institutes, which mainly are private-non-profit institutions, enjoy a legally and institutionally guaranteed distance to government agencies. With the exception of direct project funding distribution of public research grants is delegated to these research institutions which operate on behalf of government, but through a relatively independent administration (Braun 1996: 19). In consequence, they have a high level of scientific autonomy within the framework of their general mission comprising four central elements (Meusel 1992; 1996b: 1275):

- planning and implementing of research and funding programs;
- (self-)evaluation of research activities through scientific peer-review;
- co-optation of research staff;
- self-management with regard to the deployment of budgetary and staff resources.

With these general considerations in mind we will now take a closer look at government arrangements for regulating, guiding, and financing of PSR.

4 Government and funding arrangements for PSR

As chapter 2 has shown over time the Bund could advance its responsibilities and powers in higher education and especially research and technology policy making the federal research ministry the most important and influential policy actor in the PSR system, although research policy still shows a strong regional dimension. But the active role of the federal states in science policy is rather limited on the higher education sector, which has remained a domain of the states and where since the sixties teaching needs and aspects have dominated. Even though the Länder developed regional research and technology policies in the eighties by setting up own strategic programs, targeted research and technology promotion is still a prerogative of the BMBF. Instead, the state ministries of culture use their extensive participation rights and veto positions in Federal-state cooperation to ensure that their regional interests are taken into account in structural and thematic priority setting. Mainly, this means to preserve a regionally balanced distribution of research capacities and federal research grants (see chapter 5.2).

Accordingly, a division of labor between Bund and Länder has emerged, whereby the Bund plays the dominant role in the (1) institutional support for non-university research organizations, (2) priority and project funding both in the university and extra-university sector (3) targeted program funding in strategic research areas and especially technology promotion and is exclusively responsible for (4) the funding of international research organizations and programs.
But over time even for university research federal grants have acquired a central importance. While the general university funding by the Länder have stagnated since the mid seventies university researchers are increasingly dependent on the acquisition of external grants from public and private sources. It is, however, the Bund which bears the bulk of costs for the various regular and special funding programs for academic research and training and promotion of younger scientists and which provides the overwhelming share of government project grants at universities. For example, in 1990 the volume of project funds by the central government was seven times higher than the combined volume of the Länder (Table 19a). That the dominant financial position of the Bund for university research sometimes is overlooked follows from the fact that most federal university grants are channeled via the autonomous German Research Society to which Bund and Länder have delegated the administration of most university programs and which accounts for about 40% of third-party-funds of universities. Besides Bund and Länder and before the European Union the DFG is therefore the third most important funding agency for PSR in the Federal Republic. It is not the least the considerable influence and financial powers of this self-governed organization of science that is responsible for the unique and envied autonomy which German science enjoys towards governments (see for the DFG ???).

In 1995, the central government accounted for 53% and the federal states 47% of public research spending (Table 1A). This convergence of federal and state shares in the overall public science budget, however, is mainly an effect of reunification increasing the number of federal states from 11 to 16, while a corresponding expansion of the federal research budget did not take place due to financial problems. From 1975 to 1989 the central government financed about 60% of government expenditure on R&D (Table 1A). Figure 8 and 9 show the different focuses of research funding by Bund and Länder. the Bund focuses on the support of non-university, industrial and international research facilities, whereas the Länder concentrate on university research.

---

76 In reality the share of the Länder is lower because official statistics overestimate the share of general university funds going to research. The assumption of a stable proportion of research expenditure is unrealistic due to the gap between the growth of regular university budgets and student numbers (Wissenschaftsrat 1988: 54-55).

77 According to official statistics the financing of the “German Research Society” (DFG) is assigned to the non-university sector, although the DFG spends more than 90% of its grants for university research. If one includes the DFG funds, the share of universities rises to about 14% and the share of non-university research declines to about 45% (BF 1996: 80).
Figure 8: R&D expenditure of the Bund by sector of performance in 1995


Figure 9: R&D expenditure of the Länder by performing sector in 1995

4.1 The Federal Government (Bund)

Formulation and co-ordination of federal S&T policy is the responsibility of the Federal Ministry for Education, Science, Research and Technology (BMBF). At the same time the BMBF is the most important public source of funding for R&D in the Federal Republic. With 10.8 billion DM the BMBF administered in 1995 almost two thirds of federal R&D funds corresponding to about one third of total public research funding (Table 14A). Next to the science ministry only the Federal Ministry of Defense (BMVg) (17%) and the Federal Ministry of Economics (BMWi) (6%) have considerable own research budgets (Figure 10).

Figure 10: R&D expenditure of the Bund by spending ministry

Source: Table 14A.

During the eighties the BMBF had experienced a relative decline in favor of the BMVg showing the priority given to defense research by the new conservative-liberal government (Table 14A and 18A). The end of the Cold War reversed this development, but from 1993 to 1995 the share of defense research and the defense department in the federal R&D budget rose again (ibid.). In international comparison, however, only Japan spends a lower proportion of public research funds for military purposes amongst the large OECD countries (BMBF 1998: 71-75). Although most other federal departments operate research programs and government laboratories in the framework of their policy responsibilities, their combined share in the federal science budget is only about 10%. In addition to its budgetary powers the BMBF is in charge of the overall coordination of departmental R&D activities to ensure a

---

78 See for the development of the federal science administration the previous chapters.
consistent federal research policy. This is the task of an “Interdepartmental Committee Science and Research” (Interministerieller Ausschuß Wissenschaft und Forschung (IMA)) under the chairmanship of the BMBF, that comprises the heads of research departments of the individual ministries.

Focusing in the following on the federal research ministry one can distinguish three general types of financing and two funding instruments with which the BMFT/BMBF pursues and implements its policy objectives. These different funding arrangements reflect the dual mission of the ministry. The first type of funding is the institutional funding of universities and research organizations following the responsibility for general science promotion which the Bund share with the Länder. According to this purpose and the government arrangements of Federal-state cooperation support is mainly provided in the form of non-earmarked block grants. Decisions on the annual volume and distribution of these block grants to the different groups of research institutions are taken in the Bund-Länder-Commission for Research Promotion and normally based on recommendations of the Science Council. In 1995, institutional funding accounted for about 40% of overall federal expenditure on R&D, whereby the sixteen national research centers alone absorb almost 40%, while DFG, MPG and FhG together receive only one third and universities only 13% (Table 17A). The institutional support of the BMBF is concentrated on three areas (Table 16A). A first one is the institutional funding of research organizations reaching from 100% for the federal research establishments, 90% for the national research centers and the FhG to 50% for university construction, DFG, MPG and Bund-Länder-Institutes. The influence of the BMBF on the allocation of the block grants varies. It is lowest in the case of university construction on the one and DFG and MPG on the other hand. With regard to the former the Bund reimburses half of the cost for projects which the Länder register at the Science Council responsible for drawing up a rolling framework plan coordinating and ranking these proposals according to need and priority. Thus, the influence of the Bund is largely restricted on determining the overall volume of funds available for university buildings and large scale equipment. Concerning MPG and the various grant programs of the DFG Bund and Länder grant these self-governed science organizations far-reaching autonomy in research planning and program formulation due to their focus on basic research. Although government representatives take part in decision-making scientists have a majority and decisions on new institutes or grant distribution are based on scientific peer-review. But also in on the Fraunhofer-Society and Bund-Länder-Institutes the influence of the BMBF is rather limited. The research direction of the FhG is driven by the technology market according to its contract research and technology transfer mission. In the case of the BLI it is the Länder which keep an eye on the federal representatives regarding the institutes as part of their regional research system in the first place. Formally and practically strongest is the position of the research ministry towards the national research centers where no major financial or substantial decision can be taken against the will of the federal representatives. But as has been shown in previous chapters a political direction of the research centers proofed rather difficult and disappointing.
A second area of federal research funding is a variety of special programs for universities jointly financed by Bund and Länder. The most important one are the Collaborative Research Centers where the federal share is 75%. Next were several programs for supporting the research training and employment of qualified younger scientists. In the late eighties finally emergency programs to counteract the overcrowding and worsening infrastructure of universities followed (see chapter 4). The administration of these programs is mostly delegated to the DFG or the Science Council. Thirdly, the federal research ministry operates a special support program for large-scale research installations at the national research centers and universities following recommendations of scientific expert commissions on future needs (see chapter 4; Uhlhorn 1997).

The third area of federal expenditure on R&D are targeted research and technology programs which can be classified in three broad groups (Table 16A): (1) classical big science programs already established in the fifties and sixties (defense; atomic energy; aeronautics); (2) key technologies and innovation (information technologies; biotechnology; new materials; technology transfer) and (3) precaution or public research (public health; environment; living and working conditions). In contrast to the institutional or delegated funding of research organizations and university programs in the framework of the *Fachprogramme* support is provided in the form of earmarked project grants which accounted for over half of federal R&D expenditure until the nineties (Table 17A; see below). Industrial laboratories, universities and research institutes can apply to the individual (sub-)programs, whereby industry clearly predominates showing the character of the federal project funding as instrument for technology promotion. In contrast to general science promotion the federal technology policy is thematically focused and user-directed having two general objectives: the stimulation of public and private R&D in strategic research areas and technologies and the application and diffusion of research finding and new technologies in the economy. Pre-selection of projects is in most cases delegated to the so-called *Projekträger* located at national research centers or industrial research associations operating for this purpose peer review committees composed of scientists and administrators. Final approval of projects lays with the ministry. Looking at the federal priority programs in the eighties and nineties one can observe several interesting developments.

A continuing disparity between official rhetoric and reality concerning priority setting within the technology programs can be observed in the eighties. While the BMFT declared key technologies and innovation on the one hand and health and environmental research to be the dominant priority of research and technology policy the federal research budget reveals a different picture. Although the programs for biotechnology (156%), information technologies (87%), new materials (63%), public health (58%) and environment/climate (104%) showed strong absolute growth rates from 1981 to 1989 their relative importance in total expenditure remained rather low. For example, in 1989 the biotechnology program accounted for only 2% of the federal R&D budget and also the shares of information technologies (5%) and health research (4%) were far from impressive compared to the classical civil big
science programs which officially were to be reduced in favor of more innovative and promising fields (Table 16A). Instead, the relative weight of the space and civil aviation program even increased in the eighties. Only in the case of nuclear research the long promised reduction could be realized in the second half of the eighties. But even in 1989 the atomic program (6%) was still larger than any of the programs for public research or key technologies. However, with reunification the redistribution of resources accelerated. For example, the shares of nuclear energy and civil aviation in federal R&D spending were halved while support for information technologies, biotechnology, the environment and health continued their strong growth (Table 16A).

Besides a programmatic reorientation the BMFT undertook several measures to improve the quality and efficiency of its program funding. This has to be seen in the context of the declared retreat of S&T policy “from the promotion of applied technologies and the objective of an sector-oriented industrial policy” in favor of basic research as the “typical task” of the state (BMFT 1993a: 7) and the “promotion of pre-competitive research in key technologies” (BMFT press release 20.7.1993: 5). In accordance with these objectives funding was to be concentrated on (1) a smaller number of “larger and more costly projects” (BMFT 1990: 55) and “research areas with a long-term and international perspective” (BMFT 1988: 19-21). In addition, preference was to be given to “indirect” and “indirect-specific” over direct support for individual R&D projects of companies. “Indirect funding measures” are directed towards “solving general R&D or innovation problems of industry or strengthening its overall innovation potential” (BMFT 1984: 28) by initiate and stimulate private R&D without influencing its topic or content. This includes tax deductions for R&D investments, subsidies for research personnel and venture capital for high tech start-up companies. Indirect-specific measures in contrast want to accelerate the diffusion and use of new technologies for promoting industrial innovation by providing broad, but temporary support in important technology fields (BMFT 1984: 29). Corresponding programs for example were established for microelectronics, production technologies and biotechnology to which companies could apply with any research project which fits into these broad thematic framework and aims at using one of these technologies for product and process development (BMFT 1986: 42-43; BMFT 1988: 88-89).

With these instruments the BMFT wanted to strengthen the diffusion of generic technologies over the promotion of specialized products or production technologies whose market chances are uncertain. In addition, by abstaining from formulating specific research problems and objectives the participation of small and medium sized enterprises was to be improved because they could apply with projects tailored for their interests and needs. But the official priority given to indirect funding never corresponded much to reality. A short period of expansion after the government change in 1982 was followed by a rapid decline and in 1989, the absolute volume of indirect project funding was lower than in 1981 and its share in overall project funding had declined to 5% (1981: 8%), although this was one of the major innovations which was to distinguish the “new” federal research policy from its social-
democratic past. Only in the nineties the importance of the indirect support increased again, because tax exemptions and general grants to companies performing R&D were the central instruments to create and preserve private R&D capacities in the East German economy.

A second and more successful innovation in federal program funding in the eighties became the change from the support for R&D projects of individual companies or public research institutions to “collaborative research” (Verbundforschung), that means projects in which two or more companies or consortia of private and public research teams participate. The objectives of collaborative research projects, which have become the main funding instruments in most technology programs of the BMFT during the 1980s (Lütz 1993: 20), are (1) “a better use of scarce research capacities through a concentration of resources”, (2) “acceleration of technology transfer between economy and science”, (3) the development of “synergetic effects” and (4) the reduction of “selective” in favor of “broad” technology promotion benefiting not only individual or large companies, but whole industrial sectors and also public research (BMFT 1988: 95; 1993a: 100).

As has been already hinted at several occasions and the path-dependency of federal research funding shows the actual ability of the BMBF for a centralized hierarchical direction of federal research policy is more limited than the formal and budgetary powers would suggest both for reasons of inter-departmental and intra-departmental coordination.

Although the research ministry is in charge of most special programs (Fachprogramme) and its professional administration can mobilize superior expert knowledge, these programs are formulated in most cases by inter-departmental committees in which other interested ministries have seat and vote (Stucke 1993: 71-72). In 1991 for instance, the BMFT only was responsible for 13 of the 21 federal priority programs and in 3 programs it was not involved at all (Grande 1993: 56-57). Through this requirement for inter-departmental coordination external considerations flow into federal S&T policy. A prominent example is space research. While the research ministries would have preferred a curtailment of expenditure for this program in the eighties to free resources, the chancellor and the foreign and defense ministry insisted on a German participation in European and international projects for political reasons (Stucke 1993: 246-250). The influence of other federal ministries on research policy is also reflected in their representation in the Science Council and the Bund-Länder-Commission for the Promotion of Research as well as in most decision-making and supervisory bodies of science organizations and non-university research institutes. While in most cases the federal representatives had to give a block vote and the final authority for formulating their position lays with the BMFT, the other ministries have direct access to the most important planning and decision-making bodies for research policy indispensable for first-hand information and influence.

A special role in the context plays the Federal Ministry of Finance (Bundesfinanzministerium (BMF)) sometimes termed the “secret research ministry” because it has seat and vote in the Science Council and the Bund-Länder-Commission and a veto position on all initiatives involving additional federal
spending. Thus, often political considerations play an equally, if not more, important role in research policy making than scientific ones. It was for example especially the decision of the BMF only to finance research institutes and programs that have received a positive scientific evaluation by the Science Council which gives the non-binding recommendations of the WR authority and ensures the scientific community a decisive influence on structural and thematic priority setting. Another example is the unilateral curtailment of payments for university construction at the beginning of the eighties and nineties. While the federal representatives in the Federal-state planning committee approved the original volume of grants the finance ministry reduced the agreed budget afterwards against the resistance of the science ministry.

Despite the IMA the individual ministries remain autonomous in their research activities because “no decisions can be passed which are binding for the departments” (BMBF 1996a: 27). Information exchange and coordination is voluntary and cannot be forced on other departments by the BMBF, but has to rely on interdepartmental negotiations. In consequence, the research ministry is only a primus inter pares having “merely the possibility ... to make proposals for common action” (ibid.). In addition, the research ministry has only indirect influence on the research activities of the Federal Research Establishments. Only 11 relatively small and unimportant of the 56 Bundesforschungsanstalten are under the control of the research ministry. That means, that the BMFT has no own research facilities, but has to implement its research policy through the indirect means of funding programs offering project grants in specific research areas and for specific R&D objectives.

The conservation of historical spending patterns due to a program-oriented organization of the BMBF and the development of “iron triangles” among program administration and grant recipients is a traditional characteristic and problem of federal research policy as chapter two has shown (Stucke 1993: 136-140). Here, the program for atomic energy provide a striking example. Although no new nuclear power plant was built in the eighties or would have been realistic in the face of determined public resistance, atomic research still accounted for 13,5% of overall R&D expenditure by the Bund, only 3 percent points less than total federal expenditure for general research promotion and 2 percent points less than total spending for key technologies and innovation (Table 16A)! Thirdly, also described in chapter two, was the establishment of Projektträger in the mid seventies to which the BMBF largely delegated program formulation and management leading to a monopolization of information at this bodies and contributing to the fragmentation of overall policy.

Several developments in the eighties indicated a relative loss of importance for the BMFT, the predecessor of the BMBF (Grande 1993). Already mentioned was the declining share of the research ministry in the federal R&D budget. From 1981 to 1989 this figure lowered continuously and in 1991, the BMFT-share for the first time fell under 50% since the end of the 60s when its expansion into a full-fledged research ministry had been completed. In the nineties the BMFT had regained lost territory (Table 14A), but this is mainly an effect of the fusion with the Federal Ministry for Education and
Increasing research funding activities at the regional and European level are a second factor restricting the scope for a flexible and autonomous research policy at the national level. Especially the large and financially strong Länder discovered R&D as a central resource and asset of an independent policy for regional and social development. In consequence, their governments did not longer accept the leadership role of the BMFT in thematic priority setting and technology promotion, which it had acquired in the fifties and sixties, as self-evident. Instead, they started to formulate own research policies and established own funding programs in the late seventies. That does not mean that the new “regionalization” of S&T policy has completely or even largely eroded the predominant position of the federal research ministry in technology promotion. For this the financial means of the states devoted to this purpose are far too low with the exception of the most resourceful Länder like Bavaria and the overwhelming share of their science budgets is still absorbed by general university grants and the institutional funding of non-university research in the framework of Federal-State cooperation. But the BMBF has now to take into account much more critical and assertive regional governments reflected in the debate about the regional distribution of public research capacities and federal research grants and the operation of regional technology programs rivaling with that of the Bund (Grande 1993: 59-61; see 5.2 for the Länder).

A similar development took place in the relationship between the national and the EU level. While from the mid fifties to the seventies international organizations and projects played a central role only in some selected big science and technology fields like nuclear or space research, the eighties witnessed the beginning and rapid expansion of EU research and technology policy institutionalized in the subsequent “research, development and technology framework programs on”. In the long run, the EU has turned out to be a more important challenge for the BMBF than the Länder, because it concentrates on the promotion of strategic technologies and industrial innovation which are the central domains of the federal research ministry. Thus, a replacement of domestic by European programs means a much higher loss of influence and flexibility for the BMBF as an EU involvement in the institutional funding of PSR. But also here, one has to keep in mind that the scope and volume of the EU framework programs are still rather small compared to the number and budgets of the federal Fachprogramme. Only in some technology areas one can speak of a true Europeanization of research policy in Germany by now. However, if the countervailing trends of rising EU and declining BMBF budgets continues a significant “erosion of national capacities for action” in technology policy as in other countries will take place (Grande 1993: 61-63; for the EU see 5.4).
In contrast to the above factors, the reduction of project funding in the overall R&D expenditure of the federal research ministry is at least partly a deliberate strategy reflecting the departure from the concept of an active research and technology policy (see chapter four). A direct and detailed steering of public or industrial R&D activities was no longer intended. The identification of promising new scientific fields and technologies and the formulation of corresponding research programs and projects should be left as far as possible to science and industry themselves. But a gradual retreat from targeted project support meant at the same time a reduced flexibility and autonomy of federal research policy. The project grants in the framework of the Fachprogramme are the central instrument of incentive financing for thematic priority setting in contrast to the institutional funding of universities and research organizations with their long-term and non-earmarked character (Mayntz 1991: 58). Exactly the unsatisfactory results of and disillusionment with a political direction of technology development and diffusion via earmarked R&D grants, however, played a central role in the gradually scaling down of this instrument and the voluntary abandonment of steering claims accompanying it. This applies especially to the promotion of private R&D. Neither had the state-sponsored industry research accelerated structural change in the economy nor had the expected public returns in form of new employment or patent receipts materialized to a significant extent. On the one hand, despite their high share in the science budget the volume of federal grants was too low to bring about a redirection of private R&D. Thus, in many cases the BMBF supported research projects which would have been also carried out without government funding. On the other hand, the BMFT depended on the information and proposals from industry for program formulation and resource allocation. In consequence, rather a subsidizing of a privileged group of mostly large firms developed, instead of a targeted promotion of innovative key technologies.

From 1985 to 1989 the share of project funding in the federal science budget sank from 58% to 53%. Even more pronounced was the decline of industry as a recipient of federal R&D grants. Accounting for 45% of overall and 78% of project funds these figures had fallen to 36% and 67% within 5 years (Table 17A). Both downward trends accelerated in the nineties when the costs of reunification and financial problems forced a concentration of budgetary resources on the built up of the East German research system. In 1995, the share of project funding had been reduced to 45%, the lowest share since the late sixties when the expansion of comprehensive technology promotion took place, while the proportion of overall (project) grants going to industry was just 28% (62%) in the same year (Table 17A). But the redistribution of budgetary resources from direct project grants to more indirect means of general research and technology promotion and diffusion by the BMFT was only partly successful. This is shown, by the fact that the defense ministry could increase its share in federal project funding at the

79 “The R&D promotion in industry by the federal government has in all areas with the exception of aviation and space travel a low volume in relation to the own expenditures of industry. Generally, it is not suited to influence the allocation of company resources for R&D significantly through a change of cost relations.” (BMBF 1996a: 98-99).
expense of the research ministry. While the share of the latter declined from 59% in 1981 to 38% in 1995, the share of the former increased from 25% to 38% (BMBF 1998: 384-385). Thus, to a considerable extent only an inter-departmental shift of federal project grants and has taken place implying a severe weakening of the BMFT whose project budget was in 1995 lower in nominal terms than in 1981, whereas the total federal project budget had increased by more than a fifth (ibid.). Instead of having more resources freed for long-term institutional and priority funding in PSR the research ministry had to relinquish control over a large part of these resources counteracting a real substantial change of federal S&T policy.

In summary, the BMBF has to cope with a dual challenge in the nineties. Firstly, a stagnating budget. In 1989, the BMFT budget was only 150 million DM higher than in 1981. The financial situation worsened further in the wake of unification. In 1995, the budgetary resources of the federal research ministry had just increased by about 4-5% in real terms while territory and population of the Federal Republic had expanded by a fifth and the reconstruction and modernization of East German PSR required special efforts by the Bund due to the unwillingness of the old and the inability of the new Länder to bear the costs. While the Kohl government permanently emphasized the central role which S&T policy occupied in its overall policy, this was not matched by new competencies or additional finances for the BMFT. Moreover, when its fusion with the BMBW in 1994 made it “the ministry for the future” in official government rhetoric, the new BMBF had to face over-proportional cutbacks of finances compared to other ministries. Secondly, Länder and European Union started to make inroads in the policy domain which the federal research ministry had built up and stabilized in the sixties and seventies.

In the eighties, the BMFT showed not much initiative or activities to respond to, let alone, reserve these negative trends. This changed at least partly in the nineties when in 1994 with Jürgen Rüttgers a more resolute research minister took office. He used the challenges facing the BMBF as an opportunity to make a virtue out of the necessity of a reduced resource base of the ministry. This offered the opportunity to refocus the activities of the BMBF which had become a “general store” for research promotion instead of a strategic research policy actor identifying and selectively funding innovative scientific fields and technologies. Indicators for a new policy according to the concept “less is more” are the declared policy objectives to continue the redistribution of funding in favor of institutional support for universities and science organizations and targeted research priorities and problems formulated by science and industry. With this measure the BMBF escape from the accusation to subject public and private research to political direction. At the same time, it puts science and industry under pressure to legitimize their public support and autonomy by showing that resources are concentrated on the most productive areas and researchers and that science is more able to redirect resources according to new scientific developments without neglecting socioeconomic relevance than government agencies. By reacting towards initiatives from industry and research institutions or expert bodies for
R&D foresight the research ministry gives up the claim to a thematic steering of R&D, but gains on the other hand a higher freedom to select the projects which it finds most promising.

4.2 The States (Länder)

4.2.1 The regional distribution of PSR capacities

Corresponding to their primary responsibilities for higher education and scientific affairs each of the former 11, now 16 Länder has an own ministry of education and cultural affairs. In addition, the Länder have always accounted for the majority of public science expenditure in the Federal Republic. But as Table 5.1 shows, the federal states lost their near monopoly on public science spending within a decade when their share declined from 92% in 1952 to 59% in 1962 following the increasing involvement of the Bund in PSR funding. This decline continued, if more slowly, during the 1970s and 80s and in 1989 the central government accounted for 52% of total public science expenditure. With the establishment of the 5 East German Länder in October 1990, however, the position of the federal states improved again and in 1995 their share in public science spending had risen to 62% (Table 1A).

The outstanding feature of science spending by the Länder is its concentration on the higher education sector accounting for 85% in 1995 despite a fall during the 1980s reflecting the traditional division of responsibilities for PSR between central government and Länder, whereby the Bund focuses its resources on non-university research and technology programs with an supra-regional economic or scientific importance, whereas the Länder are mainly responsible for the funding of universities following their autonomy in educational affairs. In 1962, non-university institutions accounted for 20% of science spending by the Länder. In 1981, this figure had dropped to 11%, before increasing again to about 15% at the beginning of the 1990s.

The strong regional dimension of German PSR and the university-oriented R&D-expenditure of the Länder are also shown if one looks to the distribution of public expenditure on R&D, although this reveals at the same time the limited possibilities of the Länder for an independent S&T policy caused by several factors. First, due to the high investment, teaching, and administrative costs of higher education the share of funds available for R&D in the overall science budgets of the Länder is considerably smaller than in the case of the Bund (Foemer 1981: 58). The high share of administrative and teaching costs in the basic university funds is also reflected in the distribution of R&D spending according to performing sectors. Whereas universities accounted for about 85-87% of overall science expenditure of the Länder, their share in Länder-expenditure on R&D had declined to about 69-73%

80 For a further breakdown of expenditure on science by the Länder according to non-university and industrial research no data are available.
in the eighties (Table 5.2; BMFT 1988: 82). In contrast, the share of non-university research was 23-27%, almost twice as much as its share in total science spending of the Länder.

Table 5.1: Science expenditure of the Länder according to sector of performance 1952-1995 (in Mio. DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total public science exp.</td>
<td>638</td>
<td>3501</td>
<td>13862</td>
<td>27261</td>
<td>48084</td>
<td>54931</td>
</tr>
<tr>
<td>Länder</td>
<td>588</td>
<td>2070</td>
<td>7735</td>
<td>14963</td>
<td>26417</td>
<td>34286</td>
</tr>
<tr>
<td>In %</td>
<td>92,2</td>
<td>59,1</td>
<td>55,8</td>
<td>54,9</td>
<td>56,9</td>
<td>62,4</td>
</tr>
<tr>
<td>Basic university funds</td>
<td>1691</td>
<td>6720</td>
<td>13321</td>
<td>22346</td>
<td>29100</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>81,7</td>
<td>86,9</td>
<td>89,0</td>
<td>84,6</td>
<td>84,9</td>
<td></td>
</tr>
<tr>
<td>Non-university / industry</td>
<td>420</td>
<td>1015</td>
<td>1642</td>
<td>4071</td>
<td>5186</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>20,3</td>
<td>13,1</td>
<td>11,0</td>
<td>15,4</td>
<td>15,1</td>
<td></td>
</tr>
</tbody>
</table>


Table 5.2: R&D-expenditure of the Länder according to sector of performance (in Mio. DM)

<table>
<thead>
<tr>
<th></th>
<th>1985</th>
<th>1990</th>
<th>1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>University research</td>
<td>5471</td>
<td>6684,6</td>
<td>9753</td>
</tr>
<tr>
<td>in % of Länder</td>
<td>71,0</td>
<td>73,0</td>
<td>72,0</td>
</tr>
<tr>
<td>Non-university</td>
<td>1849</td>
<td>2106,1</td>
<td>3116</td>
</tr>
<tr>
<td>in % of Länder</td>
<td>24,0</td>
<td>23,0</td>
<td>23,0</td>
</tr>
<tr>
<td>Industry</td>
<td>385</td>
<td>366,3</td>
<td>677</td>
</tr>
<tr>
<td>in % of Länder</td>
<td>5,0</td>
<td>4,0</td>
<td>5,0</td>
</tr>
</tbody>
</table>

Source: Table 2.2; BMBF (1996a): 84; BMFT (1993a): 85; BMFT (1988): 82; own calculations.

Secondly, since decisions concerning the level and allocation of public funds for (non-)university research are mostly taken in the framework of Federal-state cooperation or delegated to the internal decision-making bodies of universities and research organizations, the scope for independent structural and thematic priority setting by the Länder is rather small. It is highest in the case of universities where the state ministries of culture have the final authority on the establishment, closing and reorganization of departments including the appointment of professors on vacant chairs. But even here a far-reaching
centralization has taken place through the transformation of university construction into a joint task of Bund and Länder and the passing of the federal “Framework Act for Higher Education” containing detailed regulations for the organization and administration of universities. In addition, personnel and teaching costs of universities are largely fixed and can only be shifted in the long term. In summary, non-earmarked block grants to universities and non-university university research whose allocation is decided outside the state ministries to a large extent bind the science budgets of the Länder and limits their resources for an independent regional research policy. This is reflected in the low share of project funding in the budgets of universities and non-university institutions financed by the Länder. 81

Table 5.3: Share of the Länder in grant-based funding of university research (in Mio. DM)

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1985</th>
<th>1989</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total project funding</td>
<td>1567</td>
<td>2242</td>
<td>2740</td>
</tr>
<tr>
<td>Länder</td>
<td>65</td>
<td>82</td>
<td>100</td>
</tr>
<tr>
<td>in %</td>
<td>4,1</td>
<td>3,7</td>
<td>3,7</td>
</tr>
</tbody>
</table>


Due to this limited scope for unilateral action in S&T policy and the ever increasing importance of R&D for economic development the Länder made the regional distribution of teaching and research capacities through the joint funding arrangements of Bund and Länder and the Federal Ministry of Research and Technology a central issue of national research policy (BMFT 1984: 17). 82 For this purpose they could use their extensive veto powers in the Science Council and Bund-Länder-Commission concerning the founding or dissolving of jointly funded research institutes and programs. Especially, the uneven regional distribution of the prestigious Max-Planck-Institutes and Fraunhofer-Institutes was increasingly criticized by the “disadvantaged” Länder. This issue was already a matter of conflict when in 1949 the Länder agreed on a joint funding of supra-regional research institutes and resurfaced

---

81 Reliable data for non-university institutions are only available for the German Research Society and the Max-Planck-Society. Between 1987 and 1995 the share of the Länder in project funding of the MPG declined from 13% (20 million DM) to 2% (4 million DM). In the case of the DFG for which earmarked project funding plays only a minor role, the share of project grants in total DFG-spending of the Länder never exceeded 0.1%. Project funding by the states is far higher for the Fraunhofer-Society which are closely linked to universities and companies in their regions. In 1995, the only year for which detailed data are available, the share of the Länder in FhG-contract research was 17% totaling 121 million DM, 20% more than the Länder spent in 1989 for project funding at universities, but still only a small volume compared to federal project grants to the FhG.

82 The Federal Reports on Research of 1979 and 1981 had both detailed information on this issue trying to show that overall R&D-capacities are “relatively balanced” distributed in the FRG, especially that no North-South-divide exists (BF 1979: 151). Both reports revealed, however, a very uneven distribution of capacities and federal research grants according to urbanized centers and rural peripheries following typical “agglomeration effects”. Only in the urbanized centers universities, non-university institutions and companies find the “information, service, and communication networks” necessary for a research stimulating environment (BF 1979: 152).
in 1975 when the list of the Bund-Länder-Institutes was drawn up (Osietzki 1984: 249-263; Hohn/Schimank 1990: 147-148), although the imbalance largely reflects historical circumstances and the different level of socio-economic development of individual Länder. In 1981, 60% of the MPI were located in Bavaria, Hesse, and Baden-Württemberg and almost three quarters of the FhI in Bavaria and Baden-Württemberg alone, whereas 4 (7) Länder had no or only one MPI (FhI).

If one looks at the regional distribution of the overall PSR resources, however, the “North-South-divide” largely disappears. One reason is that new research facilities for the natural sciences which are normally larger and costlier have been concentrated in the urbanized and industrialized North-West of Germany and in the three city states (Osietzki 1984: 243-244). A second reason is, that every Land has traditionally at least a minimum infrastructure for higher education and PSR reflecting their position of independent states before 1871 (Pfetsch 1974). Thirdly, the jointly financed Bund-Länder-Institutes are more even distributed reflecting the consent of Bund and all Länder that was necessary or drawing up the original list of BLI. In addition, decisions with regard to admitting new or excluding existing BLI have de facto to be taken unanimously in the Bund-Länder-Commission for Research Promotion giving regional considerations a central role, whereas individual Länder have no direct influence on the private MPG and FhG concerning the founding and closure of institutes. But even in these research organizations state governments have an indirect veto, because the Bund-Länder-Commission has to approve the overall budgets of MPG and FhG and especially additional posts for (scientific) personnel. Fourthly, the central government paid at least partially attention to regional considerations by locating National Research Centers and Federal Research Establishments as Tables 2.4 and 2.5 show. In general, therefore, only Baden-Württemberg and Berlin can be said to have more PSR capacities than their share of population and GDP would predict, whereas Saarland and Rhineland-Palatinate are the only clearly disadvantaged Länder.

83 The concentration of Max-Planck-Institutes in Bavaria, Baden-Württemberg and Lower Saxony is a result of the evacuation of many former Kaiser-Wilhelm-Institutes to Southern Germany at the end of the Second World War. In the case of the Fraunhofer-Society Bavaria founded the FhG in 1949 as a regional research organization, whereas Baden-Württemberg supported the FhG during the 50s and 60s when the German Research Society and the Max-Planck-Gesellschaft prevented its transformation in a national research organization (Hohn/Schimank 1990: 191-193). Berlin was advantaged by its former position as capital of the Reich and Prussia where universities and non-university institutions like the Kaiser-Wilhelm-Gesellschaft were concentrated. West-Berlin benefited also from its role as “frontier city” and “showplace” of the West during the Cold War. A striking example is also the Saarland which re-joined the FRG in 1955 and has as only Land neither a Bund-Länder-Institute nor a Federal Research Establishment.

84 The most striking cases are Berlin and Hamburg as city states and political, economic and cultural centers.
Table 5.4: Regional distribution of non-university institutes according to sectors 1981 / 1995

<table>
<thead>
<tr>
<th>Region</th>
<th>MPI</th>
<th>FhG</th>
<th>GFE</th>
<th>BLI</th>
<th>BFE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baden-Württemberg</td>
<td>15</td>
<td>13</td>
<td>14</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Bavaria</td>
<td>9</td>
<td>12</td>
<td>7</td>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Berlin</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Berlin East</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Brandenburg</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bremen</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Hamburg</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Hesse</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Lower Saxony</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Mecklenburg-Vorpommern</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>North Rhine-Westphalia</td>
<td>6</td>
<td>10</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Rhineland-Palatinate</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Saarland</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Saxony</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Saxony-Anhalt</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Schleswig-Holstein</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Thuringia</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>69</td>
<td>32</td>
<td>47</td>
<td>13</td>
<td>49</td>
</tr>
</tbody>
</table>

Source: BMFT (1981); BMBF (1996a); own calculations; only permanent institutes counted.
Table 5.5: Regional distribution of PSR resources in the FRG in 1981/1991 (in %)

<table>
<thead>
<tr>
<th>Region</th>
<th>Population</th>
<th>Universities</th>
<th>state/pnp</th>
<th>GDP</th>
<th>R&amp;D-personnel (FTE)</th>
<th>R&amp;D-expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1981</td>
<td>1991</td>
</tr>
<tr>
<td>Bad.-Würt.</td>
<td>15,0</td>
<td>12,6</td>
<td>19,0</td>
<td>14,5</td>
<td>22,7</td>
<td>17,6</td>
</tr>
<tr>
<td>Bavaria</td>
<td>17,7</td>
<td>14,6</td>
<td>11,0</td>
<td>12,1</td>
<td>15,0</td>
<td>13,4</td>
</tr>
<tr>
<td>Berlin</td>
<td>3,1</td>
<td>4,3</td>
<td>8,1</td>
<td>6,6</td>
<td>12,5</td>
<td>12,3</td>
</tr>
<tr>
<td>Brandenburg</td>
<td>3,1</td>
<td></td>
<td></td>
<td></td>
<td>3,6</td>
<td>1,7</td>
</tr>
<tr>
<td>Bremen</td>
<td>1,1</td>
<td>0,8</td>
<td>1,2</td>
<td>1,1</td>
<td>0,6</td>
<td>1,2</td>
</tr>
<tr>
<td>Hamburg</td>
<td>2,7</td>
<td>2,1</td>
<td>5,0</td>
<td>3,5</td>
<td>3,6</td>
<td>4,0</td>
</tr>
<tr>
<td>Hessen</td>
<td>9,1</td>
<td>7,3</td>
<td>9,9</td>
<td>7,4</td>
<td>11,1</td>
<td>4,9</td>
</tr>
<tr>
<td>Meckl.-Vorp.</td>
<td>2,3</td>
<td></td>
<td></td>
<td></td>
<td>2,1</td>
<td>1,1</td>
</tr>
<tr>
<td>Lower Saxony</td>
<td>11,8</td>
<td>9,4</td>
<td>11,7</td>
<td>9,2</td>
<td>10,6</td>
<td>8,9</td>
</tr>
<tr>
<td>North.-Wstph.</td>
<td>27,7</td>
<td>21,8</td>
<td>25,3</td>
<td>19,4</td>
<td>19,4</td>
<td>18,7</td>
</tr>
<tr>
<td>Rhinel.-Pfalz</td>
<td>5,9</td>
<td>4,8</td>
<td>4,4</td>
<td>3,4</td>
<td>1,5</td>
<td>1,5</td>
</tr>
<tr>
<td>Saarland</td>
<td>1,7</td>
<td>1,3</td>
<td>1,3</td>
<td>1,5</td>
<td>0,2</td>
<td>0,5</td>
</tr>
<tr>
<td>Saxony</td>
<td>5,7</td>
<td></td>
<td></td>
<td></td>
<td>4,9</td>
<td>2,8</td>
</tr>
<tr>
<td>Saxony-Anhalt</td>
<td>3,4</td>
<td></td>
<td></td>
<td></td>
<td>1,3</td>
<td>1,7</td>
</tr>
<tr>
<td>Schlesw.-Hlst.</td>
<td>4,2</td>
<td>3,3</td>
<td>3,1</td>
<td>2,6</td>
<td>2,8</td>
<td>3,1</td>
</tr>
<tr>
<td>Thuringia</td>
<td>3,1</td>
<td></td>
<td></td>
<td></td>
<td>1,8</td>
<td>1,5</td>
</tr>
</tbody>
</table>


During the 1980s all state governments discovered a well-endowed research infrastructure as a central instrument of modernization and economic development (see below) and the competition for pure research institutes intensified because they are considered as central elements of regional competence centers around which science-based industries and innovative start-up companies group. It is therefore no coincidence that Bavaria and North Rhine Westphalia, both pursuing a particularly active industrial policy, could increase the number of Max-Planck-Institutes located in their territories significantly, whereas Baden-Württemberg lost two institutes and that two of the few institutes set up at the end of
the 1980s were located in Saarland and Bremen which had no MPI before. Since 1981 also the Fraunhofer-Society developed into a more national research organization. Whereas the number of Fh-Institutes did not increase in Bavaria and Baden-Württemberg, the FhG established more institutes in Länder which had no or only one institute before (see Table 5.4). In 1988, the Federal Ministry of Research even warned of an “overemphasis on regional considerations” with regard to the location and expansion of research capacities fearing a dominance of political over scientific criteria that would lead to a fragmentation of resources (BMFT 1988: 36).

A new situation emerged with reunification and the decision to incorporate the institutes of the East German Academy of Science that underwent a successful scientific evaluation into universities or the West German non-university organizations. This reconstruction of PSR in the new Länder according to the West German model led to structural features that diverge from the West German pattern. Several factors were responsible for this outcome. First, the East German Länder were not able to integrate as much research institutes and groups into universities as the Science Council had originally proposed due to organizational and financial problems. But also the fact that the Länder have to bear the regular budgets of universities alone, while the central government finances at least half of the budgets of non-university institutes contributed to this unintended outcome. Second, the Bund resisted the establishment of a large number of National Research Centers (GFE) or Federal Research Establishments (BFA) for which it has to provide 90% and 100% of funding respectively. Third, whereas the Fraunhofer-Society saw reunification as an opportunity for expanding its activities in the area of new technologies, the Max-Planck-Society resisted “hurried and half-baked” plans for new institutes that would compromise the character of the MPG as an organization of “scientific excellence” and made the establishment of Max-Planck-Institutes in the new Länder dependent on a corresponding increase of its budget. Fourth, PSR facilities in the East were heavily concentrated in the Berlin area and Saxony as the industrial centers of the former GDP.

The resulting research landscape in East Germany reflects these factors. While the Science Council originally had intended to make the reconstruction of the East German public research system a signal for a general strengthening of universities reversing the emigration of research into the non-university sector, the opposite outcome emerged (Table 5.6). From 1995 to 1991 the shares of universities in public research capacities have declined in West and East Germany, but more stronger in the latter part of the country. In consequence, universities account for a lower proportion of PSR in the new than in

---

85 The initiative towards the setting up of both institutes came from the two state governments and in its Annual Report 1989 (MPG-Jahrbuch 1989: 66/68) the Max-Planck-Society itself referred to the overall political importance of both projects with regard to the lack of MPG-facilities in Bremen and Saarland. In the case of the MPI in Saarland the Society even stuck to its plans when the designated director turned down the offer.

86 See Krull (1992); Mayntz (1994a); (1996); Meske (1993) and Stucke (1992) for detailed accounts of the transformation process and its outcome on which the following is based.
the older Länder in 1995. The wider gap between staff and financial resources in the new states shows even a worse financial situation of university research than in the West. While universities employed 57% of R&D personnel they spent only 50% of R&D expenditure in the public sector. In the Western states this difference has been halved in recent years due to the efforts of state governments to improve research and teaching conditions at universities for which their East German counterparts lack the budgetary means. For example, the subsequent special university programs established since 1989 and funded jointly by Bund and Länder (see chapter two) have a far higher volume than the university renewal program for the East, although the old Länder have far higher financial powers and the in-

<table>
<thead>
<tr>
<th></th>
<th>1991</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>non-university</td>
<td>University</td>
</tr>
<tr>
<td>West Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D-personnel</td>
<td>41,1</td>
<td>58,9</td>
</tr>
<tr>
<td>R&amp;D-expenditure</td>
<td>46,3</td>
<td>53,7</td>
</tr>
<tr>
<td>East Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D-personnel</td>
<td>38,3</td>
<td>61,7</td>
</tr>
<tr>
<td>R&amp;D-expenditure</td>
<td>48,4</td>
<td>51,6</td>
</tr>
</tbody>
</table>


The distribution of PSR capacities according to the different non-university sub-sectors shows also specific characteristics. In 1995 the MPG had only 11 of its 69 institutes in the new Länder and the are only three National Research Centers and Federal Research Establishments, whereas the Fraunhofer-Society operated 9 of its 47 institutes and several outstations in East Germany. The most striking features, however, are the high number of 33 Bund-Länder-Institutes (BLI) on the one hand and the concentration of research facilities in or around Berlin, Leipzig-Halle and Dresden on the other hand. These three agglomerations host all three National Research Centers in the East, 10 of the 11 MPIs, 6 of 9 FhIs, and 24 of the 33 Bund-Länder-Institutes, while Thuringia has only 1 Fraunhofer-Institute, 1
Max-Planck-Institute and 1 Bund-Länder-Institute and Mecklenburg-Vorpommern only 4 Bund-Länder-Institutes.

An even more important difference to the old states is the predominating position of the Bund-Länder-Institutes in East German PSR. In the West the inclusion of a research institute in the “blue list” is more a “stopgap” for institutes which due to their size or mission have outgrown their university or regional framework, but for one or the other reason cannot be included in the Max-Planck- or Fraunhofer-Society (Wissenschaftsrat 1993d: 466-467). On this background it has been a tacit understanding among the main research policy actors to limit this heterogeneous collection of research institutes on their existing number and capacities as far as possible. In the former GDR, however, the transformation into a Bund-Länder-Institute unintentionally became a general compromise for all institutes of the Academy of Sciences that received a positive evaluation by the Science Council, but could not be incorporated into universities, as originally planned in most cases, Fraunhofer- or Max-Planck-Society, while the Bund blocked a setting up as national research center or federal research establishment for financial reasons. Looking for an escape route from this blockade which threatened the West German commitment to continue competitive East German public research capacities at an adequate level the status as a Bund-Länder-Institute proofed as an “instrument with which the new research structure could be organized quickly, flexibly and properly” (Wissenschaftsrat 1993d: 467) and even more important was acceptable to all parties involved. Firstly, it meant a balanced cost sharing between federal and state governments making the compromise tolerable for their finance ministries. Secondly, the research facilities received a stable institutional and financial basis without ruling out a later transfer of departments or whole institutes to universities if their financial situation had improved.

But this intention gradually to reduce the number of Blue-List-Institutes through an incorporation into universities turned out to be unrealistic for the foreseeable future. For this reason, Bund and Länder commissioned the Science Council to develop long-term plans for this massively expanded public research sector. The resulting report recommended measures to strengthen the profile and to develop an own identity for the Bund-Länder-Institutes through establishing common organizational structures and forming sections of institutes active in the same research areas. Analogue to the Max-Planck- and the Fraunhofer-Society these central bodies shall take over long-term research planning for the whole group of institutes, take over political and budgetary negotiations with Bund and Länder and ensure the renewal and quality of research through regular external evaluations (Wissenschaftsrat 1993d: 466-473). First steps in this direction have been the founding of the “Science Association Gottfried Wilhelm Leibniz” (Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WBL)) in 1995 in which almost all Blue-List-Institutes participate. It is organized in five sections and acts as an interest representation towards Bund and Länder. The growth of the Bund-Länder-Institutes is probably the event of

87 In the meantime the MPG, however, has accelerated the foundation of new institutes. In 1997 already 15 of
reunification with the most significant long-term effects on the German public research system. No longer constituting a negligible rest category the BLI have developed into a serious competitor for the other non-university research organizations also for other reasons.

Firstly, the BLI in the East and in the West have been subjected to a systematic external evaluation by the Science Council certifying the quality and relevance of their research activities providing them with a favorable bargaining positions towards governments and DFG, MPG and national research centers with regard to resource allocation or the distribution of budgetary cuts. Secondly, the Bund-Länder-Institutes traditionally have close contacts to universities. Many of the institute and department heads are simultaneously chair holders and docents at the local university. Improving the collaboration between university and non-university research, however, is one of the priorities of current research policy. Thirdly, many of the BLI operate in the area of mission- and application-oriented basic research, carry out contract research for state and industry or provide scientific services. These makes them attractive research partners for governments and companies while their collaboration with universities ensures contact with new scientific developments. Although not all institutes use these opportunities as the evaluations of the Science Council revealed, this potential corresponds largely to the declared policy objectives of Bund and Länder, namely flexible collaboration between and smooth knowledge and technology transfer from theory to practice.

The political conflicts resulting from the uneven regional distribution of non-university institutes in East Germany and the still existing imbalances in West Germany became apparent in December 1996 when the disadvantaged Länder pushed through a reform of the joint funding system of the non-university institutions. This reform increases the share which the so-called “host Land” (Sitzland), i.e. the Land in which the institute is located, has to provide for the financing of “its” institutes. In the future the host Länder will have to bear a larger proportion of these costs. For example, by now 50% of the regular budget of a Max-Planck-Institute have been financed by the central government. From the remaining 50% the Sitzland had to contribute only one half, the other half was financed by all Länder. Through this fiscal equalization system the science budgets of the states in which many Max-Planck-Institutes are located were relieved. An overall balance among the Länder was to be realized through similar arrangements for the National Research Centers, the Bund-Länder-Institutes and the Fraunhofer-Institutes. For the Max-Planck-Institutes the own share which the host Land has to bear in the states’ share will rise from 25% in 1998 to 50% in 2000 and for the Bund-Länder-Institutes from 50% to 75%. In addition, instead of 50% of the construction costs for BLIs the Sitzland will have to provide investment costs completely.

71 MPI are located in the new Länder.

88 § 4 of the “Ausführungsvereinbarung zur Rahmenvereinbarung Forschungsförderung über die gemeinsame Förderung der Max-Planck-Gesellschaft” (AV-MPG). In addition, Mecklenburg-Vorpommern and Saxo-
4.2.2 The “regionalization” of research policy

Over the last two decades one can observe renewed interest and activities of the Länder in science and technology policy. This “regionalization” was started by the larger and financially stronger states North-Rhine-Westphalia, Bavaria and Baden-Württemberg. Their governments regard the built up and preservation of a competitive PSR infrastructure as an instrument for modernizing traditional and establishing new science-based industries. Accordingly, research policy plays a central role in their economic policy (Grande 1993: 59-60; Bräunling 1986: 273-274). For this purpose, these Länder use the scope for unilateral action which Federal-state cooperation leaves in research promotion. Universities constitute the most valuable asset and instrument for the regional S&T policies. Here, the state governments could decide almost completely on their own on resource allocation and structural planning. But also in the non-university sector the Länder have opportunities for independent action. An important instrument in this respect is the right of the Länder to offer jointly funded research institutes located in their territory with special means. In this way, the Länder can escape the growth trap of the “convoy principle” (see chapter two) and attract research capacities by offering for example the Max-Planck-Society favorable conditions for establishing a new or expanding an existing institute. By now many state governments have established think tanks and advisory bodies dealing with the structural and thematic development of their regional research and technology system. The three large states have also developed systematic funding programs for the support of technology and innovation. Baden-Württemberg and Bayern, for example, use privatization proceeds for “innovation funds” financing projects for the improvement of the regional technological and research infrastructure. Common focuses of the research and technology policies of all Länder are:

- the promotion of new technologies (biotechnology; new materials and production technologies; microelectronics; new information and communication technologies) in order to improve the competitiveness of their economies (BMFT 1984: 164). On the one hand, the resulting competition for research facilities and companies in these key technologies is advantageous, because it leads to a

---

89 See for an overview on the research and technology policy of the Länder the Federal Reports on Research which contains since 1984 a chapter with a short account for each Land. The following examples are meant as an illustration, because a comprehensive and comparative report on the regional R&D activities does not exist and would be beyond the possibilities of this report.

90 Bavaria and Baden-Württemberg, for example, have set up so-called “Foresight Commissions” (Zukunfts- kommission) drawing up reports on issues regarded as central for the future development of state, economy and society at large. In the case of Baden-Württemberg this commission has given detailed recommendations on science and technology policy that led in 1994 to the establishment of a “Research Advisory Council” (Landesforschungsbeirat) consisting of 19 scientists from universities, non-university institutions and industry that is discussing basic questions of scientific research and draws up reports on specific research areas. In parallel an “Innovation Advisory Council” (Innovationsbeirat) comprising representatives of science, industry and state with the task to advice the government in the strategic orientation of its research, technology and economic policy.
polycentric system of regional competence centers specialized in certain technologies and sectors. On the other hand, this competition involves the risk of a fragmentation of R&D capacities.92

- the promotion of R&D efforts of regional, especially small and medium-sized companies, to make them more innovative and competitive;

- technology-transfer and collaborative research among universities, non-university institutions and industry in order to accelerate the transformation of scientific research in product and process innovations and the broad diffusion of key technologies. For this purpose, all Länder have set up extensive networks of offices responsible for technology-transfer and “technology centers” providing infrastructure, financial support, and privileged contacts to universities and research institutes for innovative start-up companies.93

A second major area of PSR policy of the Länder is the setting up of specific research funds providing additional financial means, equipment and manpower for structural and thematic priority setting at universities and non-university institutes. The common denominator of these strategic funds is to create (international) competitive “centers of scientific excellence” whose research and training conditions will attract the best scientists and students and provide the infrastructure and knowledge base sought after by innovation-oriented industries. In the case of non-university institutes state governments use specific research funds for offering central government or carrier organizations to take over an additional share of the investment and operational costs if institutes are located within their territories.94 For universities central pools are established where universities, departments or individual scien-
entists can apply for additional resources. Grants are as a rule awarded only temporarily and allocated through a competitive evaluation procedure based on peer-review by (external) scientists. The central research funds have the objective to increase the overall quality of research and teaching and to help universities to develop specific research profiles through a privileged funding of first-rate departments, institutes and scientists. A central element in this strategy is to enable universities to apply successfully for external grants, especially for the prestigious pluri-annual “priority programs” and “collaborative research centers” of the German Research Society whose acquisition is regarded as the proof of scientific excellence. In both cases, universities and ministries of culture have to prove their ability to provide the necessary infrastructure, to commit themselves to preserve the organizational structures and concentration of resources created by the priority programs and research centers and to continue privileged funding after the DFG has terminated its grants.

The Länder play also an important role concerning university construction including large-scale equipment. Although this is a joint task of Bund and Länder, universities and ministries of cultures are responsible for drawing up and putting forward proposals to the Science Council whose approval is required for including new projects in the list of jointly financed projects. Thus, state governments can enhance the chances of their proposal by a thorough and convincing university planning and by undertaking own efforts to modernize their universities. For example, even in times of a stagnating overall number of professorships the Länder can “re-dedicate” vacant chairs to new disciplines or change their task description, for example to set up interdisciplinary centers. The third domain of regional research policy is the reform and modernization of the higher education sector. All Länder have established structural commissions for higher education (Hochschulstrukturkommissionen) developing proposals for university reforms. The main objectives of all reform initiatives is to improve the quality of research and teaching by

- allowing the universities more autonomy and flexibility concerning the use of budgets and personnel posts. Instead of having to negotiate with university administration on these matters, universities shall (re-)distribute posts and funds according to own perceived needs and priorities as a requirement for ensuring an allocation of resources towards departments, institutes and professors with a high quality of research and teaching. In turn, universities have to proof to the state ministries of culture the efficient and effective use of their public funds. For this purpose, Länder like Lower Saxony, Berlin and Baden-Württemberg have introduced so-called “global budgets” (Globalhaushalte) on an experimental basis providing universities with a non-earmarked lump sums without making detailed instructions how to distribute them on specific departments and items. Universities are allowed to transfer money from one item to another and from one year into another. In turn, they conclude contracts with the state government specifying their tasks providing

[cited the setting up of a new MPI with special means of 16 million DM and of a new Fraunhofer-Institute]
the opportunity for a regular evaluation of teaching and research output as criteria for further funding.

- introducing evaluation systems for research and teaching as basis for a competitive resource allocation according to performance both in research and teaching. Until now internal budgeting of universities follows largely established distribution patterns and bureaucratic formulas like the ratio of professors and students. While strategic funds for research have been established since the late seventies, which are distributed on a temporary and peer-review basis, de facto no instruments and mechanisms for an evaluation of teaching exist. Only recently the Science Council published a pilot study on the assessment of teaching quality and a corresponding resource allocation (Wissenschaftsrat 1996c).

- increasing the decision-making powers of university management (rector; deans) concerning research planning and deployment of budgets and staff at the expense of the corporate university bodies. Since in these bodies also the disciplines, departments and professors are represented that will loose from a competitive budgeting system or organizational changes they are regarded as one of the main obstacles preventing universities from distributing resources according to actual needs and quality of research and teaching and not to established spending patterns. Thus, a strengthened university management capable of developing and implementing a coherent and consistent research policy top-down is considered as a necessary counterbalance to the existing bottom-up procedures tending to preserve existing structures (Wissenschaftsrat 1993c; 1996a).

The issue of university reforms, however, shows also the limited scope for independent action in higher education and scientific research of the individual Länder produced by the joint decision trap of cooperative federalism. Before basic reforms concerning content and forms of studies or the organization of universities can be implemented, the federal Framework Act for Higher Education has to be changed requiring at least the consent of the central government and the majority of state governments. For example, the introduction of student fees is forbidden by the present framework act. But also horizontal self-coordination among the Länder in university, especially teaching, matters restrict autonomous and flexible reform attempts by individual or groups of Länder. This horizontal self-coordination is institutionalized in the “Standing Conference of Ministers of Education and Cultural Affairs of the Länder” to which we now turn.

with 33 million DM (BMBF 1996a: 301).
4.2.3 Horizontal Self-Coordination: The Standing Conference of Ministers of Education and Cultural Affairs of the Länder

Already before the Bund was constituted in April 1949 the Länder had set up the “Standing Conference of Ministers of Education and Cultural Affairs of the Länder” (Ständige Konferenz der Kultusminister der Länder (KMK)) in February 1948. The KMK has a dual mission following from the autonomy of the Länder in cultural and educational affairs. It serves as the central consultation and coordination body of the federal states in matters “which concern all or several Länder and are of supra-regional importance” and has the role of an interest representation of the Länder vis-à-vis the Bund with the task to ensure that the cultural autonomy of the Länder will not be restricted through measures of the central government.

With regard to the first task the KMK has concentrated on drawing up uniform and comparable minimum standards concerning the organization of (higher) education and the structure and content of curricula and examinations in order to allow a mutual recognition of school and university diplomas. In this way, the Länder fulfilled the constitutional obligation to guarantee the rights of free movement and the free choice of places for academic teaching and vocational training which would have offered the Bund a pretext to intervene in educational policy by using its commitment to maintain legal and economic unity and the uniformity of living conditions (Art. 72(2) Basic Law). In higher education the KMK has set up a “university committee” that is dealing with structural questions of the university system and content and form of study courses and examinations. In this context, the KMK has passed important recommendations and agreements for the organization of higher education, for example on the “Principals for a Modern University Law and the Structural Reform of the University System” (1968), the “Procedures concerning the Appointment to University Chairs” (1968), and the “Standardization in the area of Fachhochschulen” (1968) establishing colleges of professional higher education as a second practice-oriented pillar of the university system.

Far reaching effects for universities had the “State Treaty on the Allocation of Study Places” in 1972 and the so-called “decision on the opening of universities” in 1977 guaranteeing in principle every entitled applicant a study place of her or his choice (see chapter two). In consequence, universities and Fachhochschulen were no longer allowed to restrict the admission of students. Instead, for dealing with the rapidly growing number of students the Länder set up a “Central Office for the Allocation of Study Places” (Zentralstelle für die Vergabe von Studienplätzen (ZVS)) for all studies in which the total number of applicants exceeds the number of available places. For this purpose the Länder drew up so-called “capacity regulations” determining for each study course in each university the number of

---

95 See for the KMK which has not been the object of much attention in German science studies Hardt-Schulz (1996).

96 In 1970 for example the KMK agreed on “General Regulations for Diplomprüfungsordnungen”. A “Diplom” is comparable to the bachelor or master degree.
students which have to admitted (Schimank 1995a: 85). In studies where these capacities are to low
the ZVS restricts the number of students by allocating available student places centrally according to a
ranking list of applicants based on the quality of the A-level, the waiting time up to now and, only
implemented for medicine, the results of a specific ability test. If no study place at the preferred uni-
versity is available, the ZVS offers the applicant a place at another university and turned down appli-
cants are put on a waiting list. In studies where no overall imbalance between places and applicants
exists, a system of local “numerus clausus” ensures that students are distributed evenly over existing
universities in order to prevent a crowding of students at popular universities.

In the opinion of universities and commentators nothing has contributed more to the university crisis
than the opening decision and centralized and bureaucratic system of student admission. On the one
hand, the Länder determine teaching capacities very generously to avoid the public and political resis-
tance which would follow from a strict restriction of admission. Instead, they tolerate rather an over-
crowding of universities more or less regardless of the negative consequences for research and teaching
conditions (Schimank 1995a: 82-89). On the other hand, the universities have almost no influence
on the selection and composition of their students limiting the interest of professors in teaching. The
ZVS even leads to the dysfunctional effect that applicants who gain not immediate access to their pre-
ferred study enroll in another discipline to enjoy the material benefits of the student status. Thus, in
some disciplines university teachers have to deal with a considerable share of students not really inter-
ested in the subject which is increased by students not finding a training place or job.

In national research policy the KMK plays an indirect, but central role by coordinating the position of
the Länder in their negotiations with national or European authorities. Through forming a “common
will” and putting up a united front the ministers of culture especially want to prevent a policy of “di-
vide and conquer” by which the central government uses disagreements of the Länder for playing them
of against each other and usurping powers in educational and scientific matters. The KMK for example
prepared the various administrative agreements of the Länder and later of Bund and Länder institu-
tionalizing the organization, funding and supervision of PSR. In the case of research policy at the EU-
level the Bund is required according to the new Art. 23 of the Basic Law to take into account the posi-
tion of the Länder since the domestic distribution of responsibilities devolves higher education and
scientific research primarily to the Länder. In matters where Länder have an exclusive competence the
central government has to transfer the bargaining and decision-making rights in the (European) Coun-
cil to a ministerial representative of the Länder. It is the task of the KMK “Commission for EC-
Affairs” to formulate the position of the Länder and to represent it at the European level.

Decision-making: The decision-making rules and the powers of the KMK reflect its status as an in-
strument of voluntary self-coordination whose aim is not to replace the cultural sovereignty of the
Länder, but to strengthen it by finding solutions for problems of supra-regional importance. In conse-
quence, decisions have to be taken unanimously and in the form of non-binding political declarations.
Exceptions are administrative agreements which bind the ministries of culture within the framework of their responsibilities. Actual decision-making is based on a two-stage process. First, the groups of A- and B-Länder coordinate their positions independently before trying to find a compromise between each other. If no agreement can be reached the matter is normally delegated to the responsible (sub-)committee for further negotiations. Thus, the conference has not only to balance the regional interests of 16 governments, but also the political and ideological cleavages between the two broad political camps in Germany.

Accordingly, the balance sheet of the KMK is rather mixed. On the one hand, the KMK has enabled the Länder to preserve their autonomy in educational affairs and at the same time to guarantee the minimum amount of uniformity and comparability concerning the organization and curricula of schools and universities that is required for the operation of a supra-regional (higher) education system. On the other hand, the KMK remained predominantly a passive and reactive actor that has never become a major actor in science and research policy. The unanimity principle meant in practice that controversial issues either have to be left aside or have to be solved by compromises which are acceptable for all participants, leading to very slow decision-making on the level of the lowest common denominator. Since the end of the 1960s, for example, ideologically motivated political conflicts have blocked almost all efforts to reform the structures and curricula of schools or universities.

A growing number of commentators therefore see the KMK as a symbol for the immobility of German politics in general and the reform-averting effect of cooperative federalism in particular. Chancellor Helmut Kohl, normally a known supporter of federalism, called the KMK the “most reactionary institution of the Federal Republic” and a former federal education minister compared its decision-making with the “speed of an Greek land tortoise.” The KMK with its more than hundred commissions, committees and sub-committees and its cumbersome decision-making is regarded as an embodiment of the “joint decision trap” (Politikverflechtungsfalle) in which the participating governments are “incapable of reaching effective agreement”, but at the same time “loose the independent capabilities for action of their member governments. As a consequence, their overall problem-solving capacity may decline - certainly in comparison to a unitary state ... but possibly also in comparison to smaller states.” (Scharpf 1988: 310). In this way a “false federalism” is produced blocking its potential for innovation and its ability for flexible problem solving, because the Länder have to keep the often de-

---

97 The position as an A- or B-Land follows from the party composition of its government, that means if they are ruled by social-democratic or Christian-democratic dominated governments. Following from the diverging majorities in the Bundestag and Bundesrat in the seventies when the social-liberal coalition faced a majority of conservative state governments, the group of social-democratic states were called A-Länder due to their political correspondence with the central government and the opposition Länder B-Länder. These labels have been preserved even when the majorities changed. Thus, if a commentator speaks of the A-Länder in German federalism, she or he normally mean the SPD-ruled states.

tailed uniform standards established by voluntary agreements in the past which proof difficult and sometimes even impossible to reform. Thus, the development and testing of regional solutions and the innovative competition of these decentralized solutions is constrained.

As a consequence, the KMK lacks at the same time the flexibility and decisiveness of a true unitary state in which the central government can push through reforms by majority decisions and hierarchical direction and of a true federal state in which regional governments pursue their own policies. In the state conference no decision can be taken as long as at least one minister of culture rejects a proposal. Even though for example all Länder agree on the necessity of university reforms, steps in this directions have been very slowly and mostly under the pressure of state governments which used the remaining scope for successful innovations in their higher education systems forcing other governments to follow. But regional and political disagreements are pervasive in the KMK blocking any attempts to tackle such complex problems like the structure and content of study courses. For example, the amendment of the “Framework Act for Universities” (Hochschulrahmengesetz) is blocked by the conflict over tuition fees between SPD-ruled and CDU-ruled Länder. In consequence, if a decision is finally taken in such controversial issues, their practical impact is mostly limited by a “wall of footnotes” granting individual Länder exemptions or compromise formulations omitting subjects on which no agreement could be reached.99

Comparable to the replacement of horizontal coordination among the Länder in favor of vertical coordination between Bund and Länder in PSR, the KMK lost importance in S&T policy making to the Science Council (1957) with regard to substantial issues like the structural development of and thematic priority setting for the public research system and later the Bund-Länder-Commission for Research Promotion (1975) concerning Federal-state cooperation in the administration and funding of PSR. For example, the KMK played only a minor and largely reactive role during reunification concentrating on the recognition of school and university diploma of the former GDR and ensuring that the central government does not acquire new powers in PSR at the expense of the Länder, whereas institutional and financial decisions were left to the Federal Ministry of Research and the Science Council (Kreyenberg 1994).

Chapter two has shown that Federal-state cooperation and coordination between governments and autonomous science organizations institutionalized in a complex set of Bund-Länder agreements regulating the organization, funding and administration of PSR and a densely populated intermediary layer of formal and informal bodies linking policy actors and science today are the central policy-making arenas for public research of which the self-coordination of the Länder is only one element. It is through institutions like the Science Council and networks of personal relations that Bund, Länder, 99 According to a former member “party membership book overrides expertise” within the KMK and no effective decision-making is possible due to the need to balance the interests of A- and B-Länder (Die Zeit, No. 10/1998, 26.2.1998: 16).
and science organizations mediate their interests, and coordinate their research policies and funding activities. Thus, Germany shows since long the characteristics of a “post-modern research system” in which interlocking and bargaining among governments, research institutions and users of scientific knowledge have replaced a clear separation of responsibilities and hierarchical political direction (Rip/van der Meulen 1996): “the institutional structure of this sector [PSR] has rather the character of a inter-organizational network, in which research policy decisions are often negotiated.” (Mayntz 1994a: 34). With the Bund-Länder-Commission and the Science Council the two most important intermediary institution in German PSR will be shortly described in the following paragraphs.

4.3 Vertical cooperation and government-science coordination: The BLK and the Science Council

4.3.1 The Bund-Länder-Commission for Research Promotion (BLK)\textsuperscript{100}

The developments leading to the establishment of the Bund-Länder-Commission which is responsible for carrying out the tasks of the Framework Agreement on Joint Research Promotion (RV-Fo) between Bund and Länder has been dealt with in chapter two. For this reasons, the following paragraphs will concentrate on a short description of the Commission’s organization and a summarizing assessment of its work.

The BLK is the most important government commission for questions of educational planning and research promotion. Almost all major decisions and measures in these areas are prepared by or have to go through the Bund-Länder-Commission to become effective. This is reflected in its composition with high ranking officials from both level of governments. Formal decisions even are taken at the ministerial level. The federal delegation is composed of permanent representatives from the chancellery and the ministry for research (BMBF), finance (BMF), the interior (BMI), economics (BMWi) and labor and social affairs (BMA), whereby the research ministry determines the final position of the federal representatives which have sixteen votes to be given in a block. For the 16 Länder having each one vote the ministries of culture and finance are represented. Decisions require a minimum of 25 votes. Thus, formally decision-making in the BLK is not subject to the constraints of the unanimity principle. In fact, however, decisions have to be taken in most cases unanimously, because to come into force they need the consent of at least 13 (of 17) heads of government and bind only the governments which have agreed. But important matters like the inclusion and exclusion of research facilities in the joint funding system or the annual volume and distribution of the jointly provided research budgets cannot be taken against the will of an affected government (Schlegel 1996: 1690-1691).

\textsuperscript{100} See for the BLK on which the following is based Schlegel (1996).
Due to its high thresholds for decision-making and the difficulty to reconcile the interests of seventeen governments with diverging political priorities and financial capacities the BLK could never develop into a body for educational and research planning as originally envisioned. Instead, the BLK mostly takes up initiatives and proposals developed by the Science Council or science organizations for new research capacities or priorities and delegates tasks like the evaluation of jointly financed institutes and programs to these institutions. The domain of the commission is to coordinate these activities and to transform them into political decisions. Examples are the “Heisenberg-Program for the promotion of highly qualified younger scientists” (1977), the “Program for the promotion of selected researchers and research teams” (1985), the so-called Leibniz prize, and the “Implementation of the recommendations of the Science Council concerning graduate colleges” (1989). For this purpose, the BLK holds regular meetings at the ministerial level to which the heads of the Science Council and national science organizations are invited for discussing research policy issues. As the composition of the BLK shows financial and administrative considerations are the main focus of its work. Here, the central and state ministries responsible for research negotiate amongst each other and with the finance administration how much money will be provided for the individual groups of research institutes and research programs. In addition, basic principles guiding the governance of PSR are decided in the BLK. A prominent example is the decision on the “Safeguarding of the Quality of Research” from November 1997 in which Bund and Länder agreed on competition and systematic evaluation as the cornerstones of future research promotion (BMBF 1998: 88; see chapter three). A central concern in the mid nineties have become implementing decisions following from the Science Council evaluation of the Bund-Länder-Institutes.

Drawing up a balance sheet for the work of the Bund-Länder-Commission is difficult. On the one hand, it is a valuable and indispensable instrument of Federal-state cooperation in research policy. As long as the interlocking and sharing of responsibilities is not been reversed there is no realistic alternative to its activities. From this perspective, the BLK has clearly proved its worth. Under sometimes difficult financial conditions and major political differences the commission was able to ensure a reliable and stable support for non-university research institutions and funding programs covered by its activities. This is shown by the more favorable budgetary development of the jointly funded research organizations compared to universities which were subject to much higher fluctuations and cuts in their funding (chapter two). Furthermore some important institutional innovations in PSR like the programs for the promotion of younger scientists or the graduate colleges have been set up by the BLK. Thus, the adaptation of PSR to new scientific and social challenges has been possible even under the conditions of unanimous decision-making. In this context, two measures proved especially valuable. Firstly, the delegation of substantial issues to the neutral expertise of the Science Council leading to a de-politicization of decisions. Secondly, the integration of the finance ministries at an early stage. Even though it sometimes complicates and slows down decision-making the final decisions have a
high authority because they can rely on the consent of all relevant policy actors. In consequence, “the jointly developed principles and programs have been implemented without exception” (Schlegel 1996: 1697). On the other hand, the BLK had been plagued by the same problems as the KMK if problems arise which cannot adequately be solved in the typical “give and take” policy or through lowest common denominator bargaining or lead to fundamental political or ideological conflicts. Although such problems are relatively rare in research policy the debates within the BLK which research institutes are to be closed to free resources for new activities following reunification are a typical example. Thus, the Bund-Länder-Commission contributes to the working of Federal-state cooperation. At the same time, it is part of the problem by limiting the scope for structural reforms.

4.3.2 Self-regulation of science and the Science Council

In between the policy level, discussed so far, and the performing level of PSR, which we shall deal with later, several organizations for the self-regulation of science play an important role for German research policy. Chapter four has shown that German universities and research organizations enjoy a high level of scientific autonomy and far reaching rights to self-government which are constitutionally and institutionally guaranteed, but can also rely on a high acceptance by policy makers. Respect for the freedom of research and the inner logic of science is a constant element of official rhetoric and although sometimes a tension between rhetoric and reality emerges, governments mostly respect the autonomy of research institutions (Mayntz 1992).

Several organizational safeguards stabilize this:

- German universities are traditionally Janus-faced organization being at the same time state institutions as well as self-administrated corporate bodies under public law having the right of self-administration within the legal framework of the federal “Framework Act on Higher Education” (Hochschulrahmengesetz (HRG)) and the university laws of the individual Länder establishing principles for the organization of universities, study courses and examinations (§ 58(1) HRG). Government supervision is strong in “staff affairs, economic management, budgetary and financial matters, teaching capacities and admission quotas” (§ 59(2) HRG), but university bodies or professors are free in “the choice of the line of questioning to be adopted, the principles of methodology, as well as the evaluation of research results and their dissemination” and “the holding of courses, shaping of course content and methods used as well as the right to voice professional opinions on scientific and artistic issues.” (§ 3(2) HRG).

To coordinate their positions in matters of common concern and to represent them effectively towards governments and the general public, universities are associated in the “West-German Conference of Rectors” (Westdeutsche Rektorenkonferenz (WRK)), renamed into “Conference of Uni-
versity Rectors” (Hochschulrektorenkonferenz) after reunification. The WRK gives recommendations on fundamental problems of (higher) education policy and cooperates with the cultural ministries of the Länder in these matters. Regular meetings with the federal and state ministries and the other science organizations ensure that the interests of universities are heard and taken into account in science policy making. However, the influence of the WRK has been constrained by two factors. Firstly, it can only give recommendations to its members and has only limited administrative capacities. Secondly and more important, until 1963 membership in the WRK was limited to the 30 “scientific universities” which could rely on a common “worldview” and similar problems. Since then participation was gradually opened to other institutions of higher education, especially the Fachhochschulen. In 1989, the number of members had grown to 189 reaching almost 250 in the mid nineties through the accession of the East German universities (Erichsen 1996: 1643-1645). With this expansion the heterogeneity of interests within the conference and the difficulties of building majorities for decisions have significantly increases. For this reason, a united position towards external actors concerning questions of higher education policy and especially university reforms often has to paid by rather modest compromise proposals. However, in 1992 the rector conference agreed unanimously on a “Concept for the Development of Higher Education in Germany” as a major contribution to the ongoing debate on the future of the higher education system which presented the opinion of universities on the reform of research, teaching and study courses and declared their willingness to provide transparent data and to accept more competition if Bund and Länder fulfil their financial responsibilities.

- The three large research (funding) institutions of the Federal Republic - Max-Planck-Society (MPG), German Research Association (DFG), Fraunhofer-Society (FhG) - are private-non-profit organizations in the form of registered associations under private law (eingetragener Verein). Their centralized organization makes the “trinity” of science organization powerful corporate actors in the PSR system which do not execute research programs defined by governments, but to a large extent define the thematic priorities and structural development of their research themselves. Although representatives of Bund and Länder are members of their decision-making and supervisory bodies, their are in a minority position compared to scientists (DFG; MPG) or scientists and representatives from industry (FhG). In addition, despite a rising share of program and project funding, long-term institutional funding in the form of non-earmarked “global budgets” (Globalhaushalt) still constitute the bulk of funds for DFG and MPG. Only in the case of the FhG as an organization for applied contract research the share of core funding is only about 30%. A third institutional safeguard against direct political guidance is the operation of a peer-review system in the case of the DFG and the statutory autonomy of Fraunhofer- and Max-Planck-Institutes. Within their general research area or mission they develop and implement their research programs freely.

101 See for the WRK Erichsen (1996).
Government and funding arrangements for PSR

and independently from directives or interventions by the central bodies or external actors (Art. 1(2) of the MPG-Statutes; Art. 21(2c) FhG-Statutes).

- The influence of the state on structural and thematic priority setting is higher in the case of the 16 “National Research Centers” (GFE) reflecting their mission-oriented character. Despite their different legal status - most GFE are limited companies (Gesellschaft mit beschränkter Haftung), some are foundations under public law (Stiftungen des öffentlichen Rechts), one belongs to the Max-Planck-Society and one is a private association - they have common structures concerning the distribution of power between state actors and scientists. The GFE are run by an executive body that is accountable to a supervisory body in which representatives of Bund and Länder have either the majority of votes or the decisive vote and whose consent is needed for the adoption of the research program, the founding and dissolving of research facilities and the appointment of the management and leading scientists. This formal power for a direct, hierarchical “control” or “guidance” (Steuерung) of the GFE, however, is counterbalanced by the principle of “global steering” (Globalsteuerung). According to these guidelines the state “lays down the overall research goals and the overall financial contributions. It sets priorities, coordinates the activities of the research institutions, ensures an objective and effective evaluation and takes care for an economic and efficient use of public resources … within this framework applies the principle of independence and autonomy of the research institutions; in scientific and technological questions the decisive weight of the representatives of science and technology shall be ensured.” (BMFT 1974). In practice, all decisions concerning scientific matters like the formulation of research programs or the appointment of scientists are prepared by an independent “scientific council” composed of members of the scientific staff and external scientists.

- Like the National Research Centers, the Bund-Länder-Institutes lack an uniform legal status. But most of them are also constituted as private associations or public foundations and show organizational arrangements similar to the GFE.

In summary, although the “power of the purse” guarantee policy-makers an influential say in the governance of universities and public research institutes, their organizational structures make a hierarchical and detailed political direction of research activities impossible. Instead, a close coordination between government agencies and science organizations characterize German policy-making for PSR. The central institution of this coordination is the Science Council. At the strategic level, linking the self-governed universities and research organizations and policy-makers the “general assembly” and the various commissions and committees of the Science Council dealing with specific issues and preparing decisions play a central role. Only here representatives of Bund and Länder meet regularly with representatives of PSR institutions and independent experts to discuss science policy matters at a su-

102 For the establishment of the Science Council see chapter two.
pra-regional and supra-organizational level. Its composition, organization and decision-making rules allow the council both to bridge the vertical and horizontal fragmentation of political responsibilities for higher education and scientific research and to mediate between political interests and the autonomy of self-governed universities and science organizations.

**Organization:** The Science Council (WR) consists of two commissions which together form the “general assembly” (Vollversammlung) being the formal decision-making body.\textsuperscript{103}

- The “administrative commission” comprises 22 members, of whom 6 are representatives of the central government, whereas every Land has one representative. Its task is to prepare decisions of the WR according to “administrative and financial viewpoints”. In the administrative commission mainly the financial implications are discussed and coordinated with the finance ministries of Bund and Länder. Thus, it serves as a first clearing house for different political and financial interests. Final decisions on measures recommended by the Science Council, however, is the domain of the Bund-Länder-Commission (see above).

- The 32 members of the “scientific commission” are formally appointed by the President of the Federal Republic, whereby 24 are scientists chosen from a jointly proposed list of the large science organizations\textsuperscript{104} and 8 are “respected public figures” proposed jointly by Bund and Länder.\textsuperscript{105} Normally, the period of membership for scientists is limited to 6 years in order to ensure a permanent replacement of personnel and a change in the disciplines and research institutes represented in the WR. The task of the Scientific Commission is to prepare decisions according to “professional and scientific viewpoints”.

The actual work of the Wissenschaftsrat takes place in a system of permanent and ad hoc committees and working groups to which the preparations of documents and decisions is delegated forming a “Science Councils en miniature”. Normally these bodies are composed of a representative of the Bund, a

---

\textsuperscript{103} See for details and quotations the “Administrative Agreement on the Science Council” printed in Röhl (1994).

\textsuperscript{104} These consist of the (HRK), (MPG), (DFG) and Helmholtz Association of National Research Centers (HGF). Final decisions on the joint list of candidates are taken during the annual meetings of the presidents and general secretaries of the national research organizations, the so-called “Holy Alliance”. In this way, also representatives of the Fraunhofer Society are informally involved in the nomination procedure. That means that the interests of universities and all non-university sectors with the exception of the Federal Research Establishments (BFE) and the Bund-Länder-Institutes are more or less directly represented within the Science Council. Although the scientific members are not subject to any directives and are expected to act in the interest of “science” and not their parent institutions, this appointment procedure gives the large science organization a safeguard that their “vital interests” will be respected in the recommendations of the WR (Hohn/Schimank 1990: 363).

\textsuperscript{105} As a rule all or most of these “respected public figures” are industrialists. The “proportional thinking” dominating the organization and work of the Science Council is reflected in the rule, that 2 of the public representatives proposed by the Länder are nominated by SPDruled and 2 by the CDUruled states and that specific Länder have an informal right on a representatives of their Land in order to ensure a regional balance (Röhl 1994: 13).
few representatives of the Länder and the scientific commission and external experts. In this way, two problems are solved. Firstly, the General Assembly and the two commissions are too large to discuss details of a proposal. Their function is rather to coordinate the individual proposals according to general considerations and to reach a consensus on the final content and formulation among the main actors in PSR. Secondly, for preparing reports and recommendations on specific structural or thematic matters the Science Council needs the advice and collaboration of external experts. In addition, in the committees conflicting positions can be dealt with at an early stage before reaching the more politicized and public arena of the general assembly where the search for compromises is more difficult. Delegating controversial questions to “neutral” experts also make it easier for political and scientific representatives to justify their consent to disputed decisions towards their parent organizations (Röhl 1994: 17-19). Formally decisions can be taken by a two third majority. But normally the unanimity principle prevails. As a mere consultative body which can only give non-binding recommendations and statements a broad consensus is an indispensable requirement to provide decisions with the necessary authority for having a chance to be implemented. This holds especially for recommendations involving financial commitments for Bund and Länder or resource allocation to and internal organization of universities and research organizations. De facto all draft documents on which no consensus can be reached in the general assembly are not passed or transferred back to the responsible committee until unanimity on its content and formulation is reached (Benz 1996: 1673; Röhl 1994: 24-26).

Originally, the Science Council had the comprehensive task to elaborate a general plan for the promotion of scientific research and the structural development of universities and public research institutes. This role as a central planning body and de facto national funding agency for PSR could the Wissenschaftsrat never fulfill. It failed not only on the lack of information and reliable research plans of Bund and Länder on which such a national plan could be based, but would have required that governments and research institutions accept a leadership role of the Science Council in S&T policy, a rather unrealistic assumption. From the beginning the council concentrated its activities on the drawing up of recommendations for the development and problems of specific research areas and institutional sectors of PSR, whereby universities became a special domain of the Science Council (see chapter two). They lacked a strong organization at the national level like the Max-Planck-Society which could formulate priorities and objectives for future development. In 1975, Bund and Länder confirmed this more appropriate mission by changing the task description of the council centered on the “elaboration of recommendations on the thematic and structural development of universities, science and research corresponding to the requirements of the social, cultural and economic life.” Accordingly, the Science Council took measures to improve the performance of and coordination among the existing research institutions and to ensure an adaptation of PSR to new scientific priorities and social demands.106 All

---

106 See for a detailed account of the WR-activities the annually published volume of its recommendations and Röhl (1994).
major organizational innovations and new funding instruments for university research are based on proposals of the Science Council. This applies for example to the (1) “Collaborative Research Centers” introduced in 1968, (2) the establishment of clinical research groups in 1986 to improve clinical research and the (3) establishment of graduate colleges in 1988 to improve doctoral training. At the same time the Science Council developed the principles and instruments for a university reform improving the quality of research and teaching (see chapter two and six).\textsuperscript{107}

A second major area of activities are tasks assigned to the Science Council by Bund and Länder. The most important one is the annual drawing up of the rolling 4-year “Framework Plan on University Construction” providing an assessment on existing teaching and research capacities and giving recommendations on the necessity and urgency of new building projects and large-scale equipment registered by the Länder at the Science Council. On this background the Committee classify the projects into four categories according to importance and urgency with the objective to reconcile the scientific necessary with the volume of financial means provided by Bund and Länder. Normally, the proposals of the Wissenschaftsrat are taken over by the responsible Bund-Länder body without changes. Deviations emerge only when governments for financial reasons provide a lower volume of funding than the council considers as necessary. Over time the Science Council also developed in a national evaluation body for Bund and Länder. In most cases, decisions concerning the founding, closing or restructuring of a state-financed research institution are based on evaluations by the Wissenschaftsrat. This key role in thematic and structural priority setting owes it primarily to the policy of the Federal Ministry of Finance to support only institutes and projects which receive a positive vote of the council. A special focus of the evaluation activities have been the Bund-Länder-Institutes which the WR evaluates in regular intervals. The peak of its influence reached the Science Council during unification when it was commissioned to take over the re-organization of the East German research system and its integration into an all-German science system. Accordingly, the Science Council carried out the evaluation of all former research institutes of the Academy of Sciences and gave recommendations on their future institutional affiliation. With regard to universities its competence was more limited, but also here its recommendations had a major impact on the number and profile of higher education institutions.

Comparable to the KMK and the BLK the judgement on the Science Council is mixed. On the one hand, it is like the BLK an indispensable institution in a highly decentralized, even fragmented research system in which powers for research planning, priority setting and resource allocation are distributed among central and regional governments and autonomous universities and research organiza-

\textsuperscript{107} The most important are the recommendations on the “Size and Structure of the Tertiary Sector” (1976), the “Tasks and Position of Fachhochschulen” (1981), “Competition within the German University System” (Wissenschaftsrat 1985), the “Structure of Studies” (1986), the “Perspectives of Universities during the 90s” (Wissenschaftsrat 1988) and the “Development of Fachhochschulen during the 90s” (Wissenschaftsrat 1991). The main elements of this reform model are summarized in the “10 Theses on Higher Education Policy” (Wissenschaftsrat 1993c) and the “Theses on Research in Universities (Wissenschaftsrat 1996a).
Government and funding arrangements for PSR

tions. Only through such an intermediary body the minimum level of coordination for PSR and a productive dialogue between science and state on priorities and problem-solving can be ensured. The strong impact which the recommendations and reports of the Science Council had on the structural and thematic development of the research system are a clear indicator for this. On the other hand, the WR shows the disadvantages of the “joint-decision-trap” in full force. The need to balance the interests of Bund, Länder and representatives of universities and non-university research organizations reduce decisions often to the lowest-common-denominator: “The consequence is a haggling over expressions, a tenacious struggle about the polishing of formulations which is inconceivable for outsiders and not always comprehensible for insiders. … The result are recommendations which come along so finely and smoothly cut, which are whetted so shiny and thin, that they can pass any professional crack of administrative regulation without notice – and still can be praised as “completely implemented” and “literally binding”.” Recommendations of the Science Council therefore are rather status-quo oriented and unable to deal with fundamental structural problems. The most prominent example is the deepening crisis of universities since the mid seventies despite the vast number of Science Council documents proposing approaches and possibilities of its solution.

4.4 The European Union (EU)

4.4.1 Importance and impact of the EU on German PSR and research policy in the 1980s

The EC has developed into a major actor in European research policy since the beginning of the 1980s both with regard to the thematic scope and volume of funding programmes. In 1980, overall EC expenditure on R&D was 280 million ECU of which only about 55% were used for research promotion in the member states and the European Community had no general mandate for research policy and its activities were restricted on the narrow functional domains of nuclear energy, agriculture and coal and steel (Grande 1994: 202-204). Nevertheless, European collaboration has played a significant role in the post-war development of German public sector research, but this mainly took place outside the Community framework. The three sectors of big science nuclear energy, aeronautics, and defence research became not only the core and driving force for the federal research and technology policy (see Chapter 1.2), but also for cross-national cooperation in R&D due to their complexity and costs which exceeded domestic means and made a pooling of infrastructure and resources attractive for


109 According to the European Union Treaty research policy formally is still a competence of the European Community (EC). In the following, however, European Union and European Community will be used synonymously.

110 For a historical account of European collaboration and integration in R&D see Guzzetti (1995) and Peterson/Sharp (1998: Chap. 2).
both policy-makers and researchers (Sharp/Peterson 1998: 26-28). The most important of these European collaborations are the “Centre Européen Recherche Nucléaire” (CERN), the “Joint European Torus” (JET), the “European Space Agency” (ESA), the “European Molecular Biology Laboratory” (EMBL), the “Institute Max von Laue – Paul Langevin (ILL) and the “European Synchrotron Research Facility” (ESRF) (Wissenschaftsrat 1993e: 433). Industrial policy has been at least as important as a motive and driving force for German involvement in European R&D cooperation as scientific considerations. Projects like Airbus in civil and military aviation or Ariane in space research aim in the first place at maintaining a competitive European knowledge base and industry in certain key technologies which require massive investments and the exploitation of economies of scale at a level beyond the capacities of national firms, markets or governments (Sharp 1991: 394).

In the eighties and nineties the internationalisation and intensification of scientific and technological competition together with the ever increasing need for sophisticated and costly infrastructure in many research areas led to an expansion of European research collaboration far beyond the big science sector and increased its importance for national research systems. This is reflected in the new emphasis given to international, especially European, cooperation in German research policy (BMFT 1988: 25-26; Wissenschaftsrat 1992; 1993) which in turn is a response to the panoply of new initiatives both inside and outside the EC framework. The aim to stop and reverse the widening of the perceived "technology gap" and decline in the competitiveness of European industry compared to the US and Japan through targeted EU programmes in strategic high tech sectors was actively supported by government and industry in the Federal Republic. In this context, the German position can be characterised as “constructive pragmatism” (Reger/Kuhlmann 1995: 27). On the one hand, Germany has

---

111 The Federal Republic and her state-financed research institutions are members of more than 30 international research organisations and programs and have concluded more than 50 bilateral agreements on scientific-technological cooperation with other states. In the following we concentrate on the European, or more precisely the EU, level which is most important in terms of money and the number and density of research collaborations; see for an overview on international collaborations Bundesbericht Forschung (1996: 339-391).

112 In 1995, ESA (64%) and CERN (15%) alone received almost four fifths of total federal expenditure on international collaboration excluding the German contributions to the EU Framework Programmes (BMBF 1998: 385/390-391). Also not included in these figures are international funding activities of universities and research organisations like student and staff exchange and investigator-initiated day-to-day collaboration in collaborative projects (Wissenschaftsrat 1993e: 439-440).

113 See Sandholtz (1992) and Peterson/Sharp (1999: Chap. 4-6) among others on the development of European research and technology cooperation in the eighties and nineties

114 In 1988, the Federal Report on Research devoted for the first time a specific section to international, especially European, collaboration whose main theme was the establishment of a "European technology community" guided by the aim to preserve the "integration and self-assertion" of Europe in the competition with the United States and Japan for "scientific-technological leadership" and "free access to scientific capacities and results" in high tech areas, while the "necessity of international cooperation in basic research" occupied a rather secondary rank (BMFT 1988: 15-16/25-29).

115 Other commentators describe the German policy to participate in collaborative projects, but to limit their scope and resources more unfavourable as wavering and inconsistent. As one EUREKA official puts it: “the Germans always eventually come up with the money. They kick and scream and then they do it.”
agreed to and taken part in most collaborative programmes and projects initiated at the European level. On the other hand, the German government has taken a reserved attitude with regard to a general research mandate for the EU which would include responsibility for basic research and would require a transfer of funding powers at the expense of domestic support (see below).

With the establishment of rolling "Framework Programmes on research, development and technology" (RDT) combining the various independent R&D activities in a gradually better co-ordinated and more coherent overall EU research strategy and the extended powers conferred by the Single European Act and the Maastricht Treaty to the Commission in research policy matters, policy makers and research performers gradually have been "forced to integrate the European dimension into their strategies." (Fabisch 1996: 130). According to Article 130f of the EC Treaty the Community is now responsible for "strengthening the scientific and technological bases of Community industry and ... promoting all the research activities deemed necessary by virtue of other Chapters in the Treaty" (Art. 130f EC-Treaty). Article 130h commits member states and Community to "co-ordinate their research and technological development activities so as to ensure that national policies and Community policy are mutually consistent" and empowers the Commission to undertake "useful initiative" to realise this aim.

The new material dimension of EU research policy is reflected in the strongly increased volume and number of research areas in the successive Framework Programmes. While the first had a budget of 3.8 billion ECU, this has grown to 13.2 billion ECU in the Fourth Framework Programme (1994-1998). In 1995, EU expenditure on R&D amounted to about 2.3 billion ECU and was eight times higher than in 1980. At the beginning of the period the annual research budget of the European Community accounted for only about 4% of domestic government support for science in Germany. At the end, this figure had risen to 15%. Had the First Framework Programme focused almost exclusively on three areas, energy, information technologies (ESPRIT) and industrial technologies (BRITE/EURAM), its successors extended activities on environment, life sciences, transport, socio-economic research and the stimulation of cross-border training and mobility of students and researchers (Peterson/Sharp 1998: Chap. 4 and 6).

(quoted in Peterson/Sharp 1998: 170). This reflects the fragmented authority and decision making power in German research policy allowing different interests to influence decisions in European matters. While for the federal research ministry and especially the Länder European programmes mean a loss of power and autonomy, because with the exception of the Framework Programmes German contributions are taken from the budget of the former, while the domestic prerogative of the latter in science policy is undermined, there are other actors more interested in European collaboration. At first these are the foreign ministry and the chancellor supporting research collaborations for political reasons. From the beginning participation in European projects has been an instrument of foreign, especially integration, policy often overriding scientific considerations; see Stucke (1993) on space and nuclear research and Sandholtz (1992) for information technologies. But also the finance ministry advocates European collaboration as an instrument to relieve domestic science budgets (Sandholtz 1992: 154; Peterson 1996: 235; Starbatty/Schäfers/Vetterlein 1990: 140).
To assess the influence of the EU on German research policy and PSR, however, one has to point out to their still modest role in research funding for most universities and public research institutes. In addition, due to their utilitarian approach, orientation towards industry, and thematic selectivity the importance of EU programmes and grants varies according to the area and type of research performed. Thus, on the one hand the Community disposes today of an extensive network of programmes for research which have become "an integral part of the national research system mobilizing almost all major R&D players" (Larédo 1997: 34; Grande/Peschke 1999: 46). On the other hand, "their impact clearly is limited and should not be overstated" (Peterson/Sharp 1998: 209). The importance and influence of the EU RDT policy on the German research system seems to be modest, if not marginal, at least from a macro view and in quantitative terms (Grande 1994: 216-217; Peterson/Sharp 1998: 11). In 1995, expenditure on R&D by Bund and Länder was still seven times higher than total EU funding which is distributed to 15 member states. Accordingly, the share of the EU and other international sources in gross domestic expenditure on R&D in Germany is very low, though it has almost doubled from 1% in 1981 to 1,8% in 1995. From 1987-91, the only period for which official data are available, the Federal Republic obtained 1,3 billion DM from DG XII and DG XIII administering most of the EU programmes. This accounted for 0,4% of total domestic, 0,7% of civil public and 2,3% of civil federal spending for R&D. Even, if one compares EU funding only with project funds allocated by the federal government, which is a better measure because EU grants do not provide for basic infrastructure and institutional core funding, the quantitative role of the former is not impressive. In the period 1987-91 EU grants amounted to about 6% of civil project funding by the Bund. A similar picture emerges if one looks at the performing level.

At the beginning of the nineties the European Union did not constitute a meaningful source of income for the sub-sectors of public research for which data are available. In 1991, the share of EU grants in the overall research budget of universities was estimated to about 1,6% and less than 1% for the Max-Planck-Society (Reger/Kuhlmann 1995: 12; Krull 1993: 87). Even the Fraunhofer-Society with its focus on applied contract research for industry and public authorities obtained only 3% of its payments from the EU and for the National Research Centres EU funding amounted only to about 2% of total

116 The most important source of information on the effect of EU research and technology policy on the German research system is the German contribution to a comparative series of national impact studies ordered by the Commission Reger/Kuhlmann (1995). In addition, there is a detailed analysis of the EU and EUREKA programmes in information technologies (Grande 1994).


119 That the Fraunhofer-Society and Max-Planck-Gesellschaft included EU funding only in 1990 and 1992 as a separate item in their official financial statistics is in itself an indicator for the marginal role assigned to this source of income.
research income in 1990, although big science and complex technologies are their traditional domains. In 1995, no fundamental changes in this picture have taken place. For the MPG the share of EU funding has moderately increased to 1.6% and the FhG reports a stagnating share of 3%.

This is not to say that German research policy and public sector research has remained unaffected by the expansion of EU activities. But in contrast to other countries especially the negative effects, that means the loss of autonomy for domestic science policy-makers and the dependence on EU funding for PSR institutions, are felt only in recent years. Until the early nineties neither the Federal Ministry for Research and Technology nor the research organisations devoted much attention to the European Union or tried to exercise a strong influence on European research policy. Two factors, one following from the structural features of the EU programmes, the other from the national organisation and situation of PSR, were responsible for this. According to their utilitarian approach and official rationale the Framework Programmes were mainly regarded as additional and complementary sources of funding for industry or industry-oriented research and for the stimulation of voluntary international collaboration (Reger/Kuhlmann 1995: 178-180) with only limited relevance for the majority of universities and research institutes.

Firstly, the EU still concentrates support on energy research and a few strategic high tech areas: information and communication technologies (ESPRIT; RACE; TELEMATIC), industrial technologies (BRITE; EURAM) and biotechnology (BAP; BRIDGE; BIOTECH). In contrast, the programmes on “environment”, “life sciences and technologies”, “targeted socio-economic research” and “training and mobility” which are more oriented towards basic and public research account only for about 30% of the overall EU-budget.120 Secondly, funding patterns reflect the central mission of EU research policy to strengthen the technology base and international competitiveness of European industry. Even though its share has continuously declined from almost two thirds in the first Framework Programme, even in the mid 1990s industry received about 40% of total EU grants (European Commission 1997: 32).121 In Germany, participation rates of industry are particularly strong. Firms received almost two thirds of total EU payments to Germany in Framework II (1987-1991) and about 50% under Framework III (1990-94) (Peterson/Sharp 1998: 149; Reger/Kuhlmann 1995: 25). Thirdly, even after Maastricht the EU has no mandate for general science promotion, but operates technology programmes (Larédo 1997: 33-34) or supports problem-oriented research in the public interest, while the share of basic research is, at least officially, restricted on 10% of total funding in most programmes (Strub 1993: 30; Wissenschaftsrat 1993e: 436).

120 See for the development of spending patterns in the successive Framework Programmes the respective tables in Peterson/Sharp (1998: 82/84/120).
121 In Framework Programme III (1987-91) 34% of total expenditure went to large firms and 16% to small and medium enterprises. Higher education establishments obtained 25% and research centres 22% (Peterson/Sharp 1998: 148). Only in the Fourth Framework Programme universities (27%) and public research centres have for the first time overtaken the business sector (42%) (European Commission 1997: 32).
The organisation of the German public research system, which follows a functional differentiation according to research functions and domains (Hohn/Schimank 1990), increased the selective impact of EU programmes on PSR in Germany. In the view of the German Science Council their objectives corresponded in the first place to the "task profiles" of Fraunhofer-Institutes, technical universities and Fachhochschulen concentrating on applied research and technology transfer. For universities, Max-Planck-Institutes and National Research Centres with their focus on fundamental and long-term strategic research the relevance of EU programmes was seen to be restricted on a few institutes and departments which are active in high tech areas and “pre-competitive” research (Wissenschaftsrat 1992: 66-67). This disinterest in European research policy was reinforced by a widely held perception that EU funded research is of rather low quality and that policy formulation and grant procedures are non-transparent, politicised and overbureaucratised leading to “motivation deficits” of German researchers to apply for EU grants (Wissenschaftsrat 1992: 68-69; BMBF 1996). Insufficient and untimely information on programmes and conditions for application and very short time intervals between calls for and submitting of proposals are held responsible for the “rather low participation of German research institutions, particularly universities, in EU programmes (Wissenschaftsrat 1992: 69; Benz 1993: 11). These problems make it very difficult or even impossible to search for partners and to prepare detailed project designs in a foreign language in the required time.

The phenomenon of “closed shops” following from the reliance of the Commission on a selected group of research institutions and scientific experts for program formulation and resource allocation is an additional problem reported by German impact studies (Grande 1994: 234; Reger/Kuhlmann 1995: 141). Such “insiders” have privileged access to information concerning topics and objectives of programs and superior experience with organizing research consortiums and formulating project proposals disadvantaging “outsiders”. Especially small university departments and research institutions in Germany often lack the financial and managerial resources to apply to and participate in EU projects. But even for larger institutions the costs of application and project administration when compared to the low success rates and volume of funding lower the attractiveness of the EU programmes significantly (Reger/Kuhlmann 1995: 103-105/140-142). In average, the Commission has to reject four of five project proposals, while applicants to the German Research Society (DFG) and the Federal Ministry of Research and Technology (BMFT) have far higher chances of success. For example, although the DFG had to turn down a growing share of positively evaluated proposals due to budgetary constraints, it was still able to approve 75-80% of applications during the eighties. For this reason, the “clear concentration” of EU funding on a limited number of priority and problem areas has been a constant and prominent demand of Germany in the negotiations to the successive Framework Programmes, because the “spreading of funds over too many areas and topics” is regarded to lower the impact of support and lead to “a disproportionately high rate of good-quality proposals” (BMBF 1996: 4; Strub 1993: 28-29).
In the opinion of German officials more focussed programs and calls for proposals could reduce the “flood of applications” and increase the chances for success and the budget of individual projects, while at the same time limiting the discretion of the Commission in project selection (Reger/Kuhlmann 1995: 181). This follows from the sometimes harsh German critique of the programme management by the Commission which is accused of giving political considerations far too much weight at the expense of scientific and technological excellence and “European added value” (Reger/Kuhlmann 1995: 180). The rejection of positively evaluated projects for non-scientific reasons is not only seen as “inacceptable”, but also as a cause for the lower success rates of German applicants compared to competitors from other countries (Strub 1993: 29).

Especially the lasting conflict “excellence versus cohesion” (Starbatty/Schäfers/Vet-terlein 1990: 138) as the goal of EU research policy is held responsible for this. Germany has always firmly rejected any undermining of quality as the overriding criteria for resource allocation by the demands of the less developed member states that the Framework Programmes should also be used to contribute to social and economic cohesion. For the German, as well as the French and British, government the R&D programmes are strictly an instrument for the promotion of “cutting-edge technologies and outstanding research results of strategic significance for industry and the service sector of the Community” or “furthering decisive advances in the safeguarding and improvement of living conditions” (BMBF 1996: 7) and not “development aid” for the research systems of the poor member states which is regarded as a mission of regional policy: “Research support cannot perform the tasks that are specific to the structural funds.” (ibid.). Thus, only if the scientific excellence of projects has been proven in a later phase their contribution to internal cohesion could be taken into account (Strub 1993: 30-31; Wissenschaftsrat 1992: 72). Summing up this paragraph, one could say that by the early nineties the approval of German science for the EU research policy has been rather limited and its position characterised by a “certain reserve” (Benz 1993: 11).

On this background the federal research ministry and the science organisations practised a policy of “benign neglect” towards the EU until the end of the eighties. This policy mainly consisted of a general support for the stronger role of the European Union in research promotion, which in Germany was mainly defined as technology promotion, while preventing developments that could harm important domestic interests or lead to a undue restriction of national autonomy. Thus, German officials followed a reactive rather than a proactive approach in European research policy (Reger/Kuhlmann 1995: 179). Only very slowly administration and research organisations established institutional structures providing systematic information on EU programmes and supporting researchers in applying for and administering EU grants in order to stimulate and increase participation rates. At the European level German representatives were not very active in “networking” and lobbying activities to safeguard the interests of German science and research policy. Response rates of German researchers to calls for proposals and participation in advisory and review committees by the Commission were low compared
to other countries leading to a self-inflicted loss of influence on program formulation and resource allocation (Wissenschaftsrat 1992: 70).

Only in two issues Germany has made its voice clearly heard. However, both of them show the defensive approach in matters of EU research policy and lack a positive vision. Firstly, the German government has been together with the UK the strongest opponent against the increases of the EU research budget proposed by the Commission reflecting its position as the largest net contributor to the Framework Programmes (Peterson 1996: 229/234; Peterson/Sharp 1998: 81/139-143). Taking the - scarce - information on this sensitive issue, Germany receives much less EU funding than would correspond to her financial contribution to the Framework Programmes and the size of her research system (Mayntz 1993: 27). Although German representatives are ready to concede that lacking interest and involvement of German researchers in EU matters is at least partly responsible for this, “the Commission cannot justify the low German return”, as one German official put it (quoted in Peterson/Sharp 1998: 171).

The redistributive effects reinforce the determination of German science policy actors that at all costs a development as in other countries like France is to be prevented in which a zero sum game between domestic and European funding emerges whereby the expansion of the latter leads to the reduction of the former. There is a broad consensus that the EU “has to support and promote national efforts in the common interest, but must not lead to an impairment of established and proven structures of research and research promotion in the member states.” (Wissenschaftsrat 1992: 71) and European activities “must not lead to a weakening of the material efforts for the support of basic research and the infrastructure of universities and research institutions in the Federal Republic of Germany” (ibid.: 73-74; Wissenschaftsrat 1993e: 445). In the view of politicians and scientists this can be best guaranteed if the

---

122 “Detailed information” on “the result of the individual call for project proposals and the distribution of funds among the individual Member States” is one of the measures to “enhance the efficiency of European research funding” demanded by the German government (BMBF 1996: 8).

123 In 1995 German participants received 10.8% of total R&D payments to member states, while her contribution to the EU budget is 27.6%. Reger/Kuhlmann (1995: 24-25), however, come to a different conclusion. Based on the volume of newly signed research contracts in 1991, the share of EU RDT payments to Germany was about 22%. According to their view, it is the fact that universities and non-university institutions are underrepresented compared to industry which is responsible for the general impression that the return from the Framework Programmes to German research is too low. The results of the analysis of German participation and returns in the ESPRIT and RACE programmes lay somewhere in between these positions. On the one hand, more than 60% of the projects in ESPRIT I had at least one German partner and German participants received 21% of funding and were only second to France. In ESPRIT II participation rates and payments even increased (Grande 1994: 239-244). On the other hand, if one compares actual financial returns with the “hypothetical juste retour”, the German contributions to the EU budget, a “clear redistribution among the member states” emerges in which the balance of Federal Republic is negative (ibid.: 240-241). This balance is worsened even more if one takes into account that the German research community and industry in information technologies is much larger than that of France and the UK.
Government and funding arrangements for PSR budgets of European programmes and organisations is held at a level which gives the ministry of finance no pretext for budgetary cuts in national efforts (Wissenschaftsrat 1992: 72-73).\footnote{In this respect there is no disagreement among research administration, industry and science; see the contributions in Kommission der Europäischen Gemeinschaften (1993).}

Secondly and following from the view that research policy has to remain a “primarily national task” the principle of subsidiarity has been the cornerstone of German research policy towards the EU (Grande 1996). Already on the occasion of the First Framework Programme the then German research minister insisted on establishing the principle as a general guideline of EU research policy in order to prevent an “EC-automatism” by which national programs are gradually superseded by European ones (Grande 1994: 213; 1996: 131-134). Instead the EU programmes and also other European initiatives like EUREKA and the European research institutions shall be strictly complementary to national research activities and restricted on selected scientific and technological fields where an “European added value” can be expected (Benz 1993: 12; Grande 1994: 213-214). In addition, “EU research promotion must stay mainly application-oriented and pre-competitive” (Strub 1993: 31). An extension into general science promotion, especially basic research, is firmly rejected by the German government and science organisations (Wissenschaftsrat 1992: 71-72; Strub 1993: 30).

Thus, European collaboration shall focus on three tasks: (1) “access” to and “joint utilisation” of large-scale facilities for topics and problems which are so complex or costly that only international collaboration can provide the critical mass of intellectual and material resources needed for competitive research; (2) strategic technologies whose development and diffusion aims at improving the technology base and competitiveness of European industry as a whole; (3) support for cross-border collaboration following a bottom-up approach (BMBF 1996: 6-7; Wissenschaftsrat 1992: 74-75). The latter type of decentralised cooperation, in which program formulation and selection of research topics and partners is based on the initiative of industry and science, is seen as a general model for the organisation of collaborative research, because it is “more heedful of national and subnational autonomy” (Scharpf 1994: 239) than the centralised top-down approach of the Framework Programmes. German officials make no secret of their preference for EUREKA, because its organisation does not imply a transfer of policy making and funding powers to supranational agencies (Grande 1994: 279-288; Peterson 1996: 235; Peterson/Sharp 1998: 167-172). EUREKA formulates only very broad themes for which interested companies and research institutes can form research consortia and submit proposals. Participation is based on the principle of “variable geometry”. It is left to the member states to decide in which programmes they will take part, which projects will be supported and how much money will be made available. Thus, “EUREKA harmonises national R&D policies only marginally.” (Peterson 1996: 233; Grande 1994: 282-283).
One could not say that Germany has been very successful in achieving her objectives. The balance of payments had worsened, not improved during the eighties (Peterson 1996: 232-233), the proliferation of programmes could not be stopped, let alone reversed, and a clear and controllable division of responsibilities between national and EU activities according to the principle of subsidiarity has turned out to be impossible to implement in practice (Grande 1996). Even the budgetary expansion of the successive Framework Programmes could only partly be limited. That this did not lead to major concerns of research administration and scientific community and a more proactive policy towards the EU until the early nineties can be explained by their relatively comfortable domestic situation compared to other countries. They simply could afford a certain disinterest in EU affairs, because most German researchers were “not under pressure to apply for support at the European level (the need factor)” (Mayntz 1993: 27) in contrast to the UK or France where budgetary cuts in or even the dismantling of national research and technology programmes forced research ministries and institutions to orient themselves more strongly to the EU (Peterson 1996: 235-239). Although the science budgets of Bund and Länder grew only slowly in the eighties, the level of government support for PSR was still one of the highest internationally and the Federal Ministry for Research and Technology (BMFT) still operated a “close, comprehensive network of (national) public research programmes” (Grande 1996: 138) providing an adequate level of project funding in most research areas. In addition, industry allocated a growing share of its increasing R&D spending to PSR institutions and the more active role of the Länder in research policy opened an additional source of external income compensating at least partially the stagnation of institutional core funding under which especially universities suffered. Thus, general statements that European activities “have in fact effectively eclipsed national programmes of high technology support” (Sharp 1991: 395) and that “it is increasingly difficult in many areas to conceive of ... science policy independently of the European Community” (Gummett 1991: 36) do not hold for Germany.

For such a development to take place in Germany an independent national science and technology base is held far too important despite the tight situation of public budgets. Public sector research still can rely on a well-developed infrastructure and historically grown and powerful institutions both at the policy and the performing level. Thus, while in the poorer and less developed member states (Spain; Portugal; Greece; Ireland) EU funding can add up to over half of total government expenditure and these countries lack the critical mass of human and financial resources as well as the institutional structures and managerial capacities to operate complex research programmes, Germany is much less dependent on the EU for establishing and maintaining a competitive innovation system. Only in a few areas European have replaced German programmes and funding agencies completely (Grande/Peschke 1999: 46) and mostly with the active support of German officials and scientists because their nature

---

125 See for detailed impact studies of EU activities on the French and British research systems Larédo (1995) and Georghiou et al. (1993).
and scale make national options untenable or too costly. Prominent examples are fusion, space and climate research where the national efforts are closely co-ordinated with or incorporated into European or international programmes and sometimes the volume of funding at the domestic level is smaller than contributions to organisations and projects abroad.

Even in the high tech areas where the BMFT has recognised that “the national framework has become to narrow for research cooperation” (Grande 1994: 282) and EU activities are strongest, Germany has until recently maintained considerable national capacities. Neither the Federal Ministry for Research and Technology nor industry have been willing to hand over technology policy to Brussels (Grande 1996: 138-139; Peterson 1996: 234-235; Sandholtz 1992: 154). Although the European Union has acquired a significant role, it remains nonetheless a limited one. This could be illustrated by the influence of the EU programmes for information and communication technologies, the largest item in the EU research budget, on German research in this sector (Grande 1994). The European programmes led only in some instances to a replacement of domestic activities and thus a “partial reorientation of national funding policy”. Support by the BMFT was reduced or terminated in several areas “where European cooperation is the better way due to the costs, necessary critical mass or the need for common standards” (Grande 1994: 246). But in most areas one can observe either national and European activities operating in parallel or a competition between the EU and the BMFT for competence and influence and national funding was still predominant, although the importance of EU grants increased quickly (Grande 1996: 135-136).129

126 The federal programme for fusion research is “integrated into the EU-programme” (BMBF 1996: 167) and the two national centres active in the field, especially the Max-Planck-Institute for Plasma Physics (IPP), receive about one third of their budget from the EU. While domestic expenditure on controlled thermonuclear fusion has stagnated by about 200 million DM in recent years, the volume of the EURATOM programmes has increased from 562 million ECU (1,1 billion DM) in the Fourth Framework Programme to about 790 million ECU (1,6 billion DM) in the Fifth one.

127 In the early nineties about two thirds of the federal expenditure on space research and technology was allocated to the ESA and international collaboration and a national program which corresponds with ESA objectives were formulated as the guidelines of the German space policy (BMBF 1996: 154-158).

128 Most German projects on climate research are supported by the Federal Ministry for Education and Science and the German Research Society in the framework of large international programmes like the EUREKA project EUROTRAC and funding activities are co-ordinated in the International Group of Funding Agencies for Global Change Research (BMBG 1996: 170/180).

129 According to Grande (1994: 245-246) payments from the ESPRIT I to German participants amounted to 17% of project funding for information technologies by the BMFT. For ESPRIT II this figure had more than doubled to 38%. However, one has to take into account that investments for infrastructure and institutional funding make up a significant part of national support. A survey based on interviews in the group of German participants in ESPRIT and RACE 1987-91 therefore comes to lower figures according to which EU grants still make up only 20-25% of the funds received alone from the Bund (Reger/Kuhlmann 1995: 22). While some analyses conclude from the stronger influence of project funding on the direction of actual research due to its determination of research problems and objectives that the impact of the EU on national research systems tends to be underestimated (Eberlein 1998: 459), one could object that capital investments decide on the general priorities and direction of research which project funding has to follow.
Taking the case of ESPRIT the function as an "add-on"-program complementing national efforts with European collaboration is reflected in the fact that “German participation in ESPRIT was strong precisely in the areas where at the same time also the BMFT put the main emphasis of its support in information technology.” (Grande 1994: 245). On this background, a national impact study concluded that in information technologies the national research administration “has left open a wide field for its funding activities” and that both the EU and the BMFT pursue research promotion “on a relevant scale” (Grande 1996: 134-135). This is reflected in the statement of a national expert “I’m not sure that the major decisions in Germany to support IT or not are really influenced deeply by the things the Community is doing. And I think I could say the same about … all areas of R&D.” (quoted in Peterson 1996: 235).

Summing up this discussion concerning the influence of EU policy and funding on German research policy and public sector research on the basis of available data and studies, one has to reject both types of generalisations which can be found in the literature (Grande 1995: 461). On the one hand, there is no evidence for Germany that the EU has replaced or is in the process of replacing national and regional governments as the most important policy actors and source of public support for R&D. The focus of research policy has not moved from Bonn and the Länder capitals to Brussels. On the other hand, it is equally flawed to conclude from the modest overall importance of EU funding that the role and effects of the EU is marginal. Instead, the Europeanisation of research policy has progressed unevenly and one has to differentiate between scientific and technological fields and groups of institutions. It has been already shown that research areas exist where Community and other European institutions have “become a leading if not the decisive state actor” (ibid.). For PSR this applies especially for basic research requiring large-scale installations or an international network of observatories and laboratories and problem-oriented research in the service of industry and public policies. However, one has to keep in mind that most EU programmes still focus on the development and diffusion of key technologies. In the Federal Republic the influence of the European Union therefore is particularly strong with regard to government support for industry research from which the BMFT deliberately withdraw during the eighties (ibid.).

But a closer and more detailed look into the public research system also reveals that, although a majority of PSR institutions still does not or does only marginally participate in EU projects, there is a group of universities and research institutes that has close contacts to the EU, participates continuously in various collaborative project consortia and receives a significant share of research income from European sources. These PSR institutions form a stable “community” confirming the thesis that the EU programmes are dominated by rather closed research networks whose intense communication and interaction with each other and with the Commission leads to constant involvement in European re-
search policy. For example, in the Framework II the ten leading institutions accounted for 43% of all university and 62% of all non-university participants (Reger/Kuhlmann 1995: 34-36).

In 1989/90, only 41 of the about 70 universities participated in EU projects. However, only ten universities got payments of 1 million ECU or larger, but accounted for two thirds of total EU research funding to German universities. Even more revealing is that six of these ten universities were technical universities confirming the strong technology- and industry-orientation of European research policy.

A survey of participating university institutes in Framework Two showed that the European Union provided on average 17% of the research budget and was already the most important source of external grants after the Federal Ministry of Research (28%). In addition, almost two thirds of the interviewed university researchers expect that the importance of EU funding will rise in the future, while a majority anticipates the share of third-party-funds from Bund and Länder to decline (Reger/Kuhlmann 1995: 89-91).

A similar picture emerges for the non-university sector. Here, EU funds contributed in average about 11% to the research budgets whose significance is expected to rise. Of 50 Max-Planck-Institutes in the natural and life sciences, 22 never had participated in an EU project until 1990 and a further 17 only in one or two. In contrast, there were 4 Max-Planck-Institutes with 9 or more project collaborations amounting up to a volume of several million DM. The Max-Planck-Institutes for Meteorology (19 projects; 2.5 million ECU), for Plant Breeding Research (13 projects; 1.9 million ECU), for Chemistry (11 projects; 1.2 million ECU) and for Biochemistry (9 projects; 1.1 million ECU) accounted for half of all EU projects in which Max-Planck-Institutes had participated and received more than 50% of overall payments.

In 1990, the then thirteen national research centres received about 79 million DM from the EU. But only 16 million came from the Framework Programme, whereas 63 million were payments from Euratom. The Max-Planck-Institute for Plasma Physics alone accounted for 34 million DM or more than 40% of overall EU funding. It is one of the key research performers in the programme for thermonuclear fusion that could serve as an outstanding example how a convergence of interests between a research community whose needs and resource demands could not be satisfied at the national level and a European research administration looking for fields of activity and social support can lead to the entrenchment of a large research programme. Together the share of the three centres focusing on nu-

---

130 In the non-university sector the classification is too general, because all Fraunhofer-Institutes and Max-Planck-Institutes are treated as one institution. But also within these organisations there is a strong concentration of EU involvement on few institutes.

131 Data are based on information provided by DG XII.

132 Data include only programmes administrated by DG XII.

133 In the Fifth Framework Programme (1998-2002) the programme for controlled nuclear fusion still has a budget of about 750 million ECU compared to 1280 million ECU for the whole programme on “improving the human research potential and the socio-economic knowledge base”, although the building of a fusion
clear physics and energy amounted to more than three quarters of total EU research funding to the national research centres.\textsuperscript{134}

A detailed impact study on ESPRIT shows a strong concentration of German participants in the non-university sector. Fraunhofer-Institutes alone accounted for 60 of the 125 projects with German collaborators from extra-university organisations and the National Research Centre for Mathematics and Data Processing was involved in another 26 projects. In contrast, institutes of the Max-Planck-Society were involved only in 6 projects. Participation by universities was more widely spread, but also here the five leading universities had a share of 40\% (Grande 1994: 243-244).

Moreover, an assessment of EU influence based solely on quantitative and institutional analysis risks to underestimate the impact of European collaboration on national research system, because such an approach could not grasp its qualitative and dynamic dimension (Larédo 1997; Grande/Peschke 1999). Through the expansion of EU competence, programmes and budgets in research and technology domestic policy actors are now enmeshed in an “integrated bargaining system” following from an institutional as well as material interlocking of responsibilities in S&T policy (Grande 1995). National research ministers and administrators meet regularly in Brussel to discuss and co-ordinate research strategies. At the same time, a “process of transnational institution building has been flourishing since 1987” (Grande/Peschke 1999: 46) with which industry and science reacted to the increasing relevance of the European Union for research promotion (ibid.). These policy networks mostly formed around individual programmes in turn feed back to the national arenas by influencing the perceptions, interests and strategies of politicians, administrators and researchers. Even more important for this Europeanisation process are the research networks created through the Framework Programmes or EUREKA. In order to be successful research partners have to establish and maintain close relations of communication and interaction in which the national and institutional perspective has to be supplemented by a European and collaborative orientation. It is through these networks that the principles and objectives of EU RTD policy are communicated to and incorporated at the national level. Participation in EU projects leads to a more positive attitude to international collaboration and to a significant expansion of collaborative activities. Since existing contacts and experiences of former cooperation are the most important factors for selecting partners and many partners continue their collaboration after the initial project European research networks develop. Once the horizon of research planning and cooperation has been widened to the European level, this could not remain without consequences for domestic strategies for research and resource acquisition (Reger/Kuhlmann 1995: 100-103).

The “leverage” of EU programmes is also increased by the principle of shared-cost meaning that the company or public research institution provides the same amount of money than the Commission.

reactor still is not within scientific or technological range. On the other hand, Europe has acquired a leading position in fusion research.
Thus, domestic funds are indirectly directed towards and used for European programmes (Eberlein 1998: 452/459). Another function of EU grants emphasised by German scientists is the filling of gaps in national funding systems. Two thirds of the participating university and non-university institutes surveyed in an impact study regarded the EU projects as a necessary supplement to domestic funding and more than half maintain that the projects would not have been carried out without EU support (Reger/Kuhlmann 1995: 89-91/122-123). In this context, however, the main effect of European programmes seems not to lie in the development of new scientific fields. Only about one fifth of the participants used the EU projects to establish and develop a new research area, whereas more than half used them to expand existing research areas and to strengthen their technological competence in these fields. Besides the mere pecuniary reason to acquire an additional source of funds, the most important motive for German scientists to participate in EU projects is the improvement of the knowledge base through collaboration with other European research teams. Thus, EU support seems not to compete with domestic programmes in the first place, but to lead to additional research activities for which no adequate funding is available (ibid.). This applies especially for cross-border collaboration for which national funding agencies are reluctant to provide financing.

4.4.2 The German research system between reunification and Europeanisation: the 1990s

If the EU was regarded by German research actors as an established, but not central player in research policy in the eighties, this attitude changed significantly during the nineties (Reger/Kuhlmann 1995: 179-180). The main reason for this development has been the severe financial problems in the West German public research system following reunification which accelerated the opposite trend in domestic and European science funding. Confronted with the task of reorganising and modernising the research system of the former German Democratic Republic with a budget that has been increased only modestly for this purpose and de facto frozen since 1991 the federal research ministry was forced to cut back the level of support in the West to pay for the "built-up East". Especially the targeted project funding of the federal priority programmes, the counterpart to the Framework Programmes was strongly reduced. From 1990 to 1995 the proportion of EU grants in relation to federal project funds doubled from 6 to 12%. At the same time, the increases of the institutional support for the research (funding) organisations (DFG; MPG; FhG; GFE) was by far inadequate to finance the establishment of new facilities in East Germany. In consequence, the success rates of applications to the DFG sank and Max-Planck-Institutes and National Research Centres had to decrease staff and even to consider the termination of institutes. This budgetary squeeze forced universities and research organisations to look for alternative sources of income and the only public one whose resources was expected to rise was the European Union (Reger/Kuhlmann 1995: 89-91/119-121).

134 Data are based on information of the Association of National Research Centres.
The relative low participation rates in and returns from EU projects compared to other countries made such a Europeanisation strategy attractive, because it showed that German research institutions had not yet exhausted the opportunities offered by European programmes. In addition, the federal finance ministry intensified its pressure on the BMFT and the research organisations to participate in EU projects by putting the principle of “additionality” concerning European funding increasingly into question (ibid.: 179-180). Already before reunification the research ministry had to consent to an informal agreement which allows the finance ministry to reduce the volume of BMFT programmes if a corresponding programme is established at the European level (Starbatty/Schäfer/Vetterlein 1990: 140). Even though the principle of attribution practised in the UK, according to which the treasury cuts the research budgets of government departments by the estimated national contributions to the Framework Programmes, is not introduced in Germany, the BMFT is now subject to significant constraints following from international commitments. While the German share of the EU research budget is still financed through general block grants to the EU budget, the absolute volume of specific collaborative projects and programmes, which are mainly taken from the BMFT budget, has reached 1.6 billion DM in 1995, accounting for about 12% of total expenditure. As a response the research ministry has tried to reduce its contribution to several European research organisation, but largely failed due to the resistance of other member states and the affected research community. Thus BMFT and research institutions have to proof that European programmes are inadequate and cannot replace national efforts. For this purpose, however, the latter have to show to the finance ministry that they exploit opportunities for EU support systematically and successfully (Peterson 1996: 235).

The financial and political pressure to take European research policy more seriously is reflected in several developments. A rough quantitative indicator is the increase in the number of German participants in EU-funded projects. While in Framework II Germany (2130) lacked behind France (2603) and the UK (2423) concerning the number of participants, although its research community is much larger, in Framework IV (1994-1998) Germany (3287) provided the highest number of participants (France: 3220; UK: 3244). At the same time, a significant shift of weight from private to public institutions has taken part (Peterson/Sharp 1998: 149) which cannot completely attributed to the extension of EU programmes in new research areas which are a domain of PSR. Instead, at least partly this is the result of increased acquisition activities by universities and research institutes.

Federal research ministry, state ministries of culture and research organizations have established institutional structures and administrative capacities to increase their influence in Brussels and to improve the incentives and chance for researchers to apply successfully for EU grants (Reger/Kuhlmann 1995: 29-30; Grande/Peschke 1999). To inform scientists systematically and timely on new programmes and calls for proposals and to support them in application for and administration of EU projects the BMFT

---

135 “European Labs Brace for German Cuts” In: Science, vol. 273, 9 August 1996; Alison Abbott & David
has created so-called EU co-ordinators for companies and research institutes. These are supplemented by internal EU offices and administrators in universities and research institutions. In 1990, the national science organisations founded the “Association for the Promotion of European and International Co-operation” which operates the “Co-ordination Agency EC of the Science Organisations” (Koordnierungsstelle EG der Wissenschaftsorganisationen (KoWi) with offices in Bonn and Brussels. KoWi has a twofold task. It serves as a “modern information manager” both for the science organisations and individual researchers and lobbies for German interests in EU decision-making. At the same time, the research organisations have built up or intensified links at the European level to further their interests. DFG, MPG, FhG and the Helmholtz Association of National Research Centers are active members of the “European Union Research Organizations – Heads of Research Councils (EUROHORCs) founded in 1993, the “European Science Foundation” (ESF) and various specialised EU research organisations, while universities are members to the “Conferderation of EU Rectors’ Conferences” (1996) and “All European Universities” (1994). Paralleling this development was the establishment or expansion of EU departments and liaison offices in Brussels by the state ministries of education. This new interest in building up an intermediary layer of institutions linking the domestic and the European level shows a change in the German strategy towards the EU. While it was defensive in the eighties, it became more and more offensive in the nineties, because science administrations and scientists realised that the importance of the European Union in research policy and funding will rise in the foreseeable future while the power of domestic agencies declines.

On this background the perceived incompatibility between the utilitarian and top-down approach and politicisation of EU programmes on the one and the “established” government arrangements and principles of research promotion in the Federal Republic on the other hand becomes a major concern for German actors reflected in symposia and reports related to this problems (Wissenschaftsrat 1992; 1993; Max-Planck-Gesellschaft 1993). For the German Science Council it is “out of question” to transfer the model of the technology programmes to the promotion of basic research, because it does not correspond to the principle of scientific autonomy and self-government which are constitutive for the German public research system (Wissenschaftsrat 1993e: 444). Accordingly, the Science Council and the research organisations demand to make scientific self-government and peer-review the condition for an expansion of the EU into basic research.

For this purpose, they propose to transform the European Science Foundation (ESF) in a European research council modelled according to the DFG that would be independent from the Commission.


As the former president of the Max-Planck-Society put it on a conference concerning the future European research structures: “The administrative process, including decision-making, is dominated overwhelmingly by political forces, societal forces, bureaucracy. ... The competence and autonomy of researchers play such a minor role that the regulation as it now stands cannot be regarded as adequate.” (quoted in Max-Planck-Gesellschaft 1993: 80).
cover all scientific fields and be composed of national research councils and organisations. Its task would be to represent and co-ordinate the interests of “European science”, take part in the formulation of strategic priorities and objectives and, most importantly, take over the actual promotion of research by selecting grants applications and assessing programs and projects strictly according to criteria of scientific excellence and originality. In this way, a bottom up approach shall be ensured in which inner-scientific interests and the freedom of research are protected against mere utilitarian considerations and external direction of research (Wissenschaftsrat 1993e; Zacher 1993: XIII-XV). However, representatives of the German scientific community admit that the chances of success are low since other member states do not know such an institutionalised autonomy of science as it has developed in Germany (Benz 1993). Now as the strategy to keep the EU out of general science promotion is increasingly inadequate, German science has to cope with the negative consequences following from its long disinterest and lack of involvement in EU matters. It shows, that the German research system is not prepared to the Europeanization which has taken place in the last decade and one can speculate if for this reason the structural effects of the EU on Germany will not be much larger than in other countries.

4.5 Reunification and the reconstruction of an all-German research system

When in the fall of 1989 the peaceful East European revolutions and the fall of the iron curtain opened the prospect of a reunified Germany politicians and general public in the Federal Republic were almost totally taken by surprise. Despite the constitutional and rhetorical commitment to the unification goal and the reform efforts in Eastern Europe under Gorbachev the West-German government and society had not anticipated, let alone prepared for this event. Especially one had not prepared for the dramatic sequence of events leading within one year from the crumbling of the Berlin Wall in November 1989, the monetary, economic and social union in July 1990 to the accession of the reconstituted East German Länder on 3 October 1990 to the Federal Republic. Confronted with the perception of a quickly accelerating political, economic, and social implosion of the German Democratic Republic and uncertain how long the historical window of opportunity would remain open, the Kohl government took its chance and wanted to complete reunification before the international climate has changed or a breakdown of the GDR economy would lead to a massive flight to the West and domestic instability. In consequence, lack of systematic and reliable information and careful planning together with extraordinary speed of decision-making due to extreme time pressure characterized the whole unification process (Stucke 1992: 3).

137 The following account of the course and results of the unification and transformation process in the research system is based on the detailed studies of Mayntz (Ed. 1994) dealing with the higher education sector; Mayntz (1994) as the counterpart for the non-university sector; and Stucke (1992); Krull (1992); Gläser (1992). For excellent English overviews see Ash (1997); Mayntz (1996) and Meske (1993).
This was the context in which the merging of the two German science systems did take place. Understandably, scientific matters had not a high priority on the agenda, but had to be dealt with in the framework set by the overall political development and the unification of the research system is a typical example for the “institution transfer” characterizing the whole unification process, but also its follow-up problems. Under the condition to make the transition to democracy and market economy as quickly and effectively as possible, it is not surprising that the main (West German) actors dominating in the unification of the German research systems opted for an almost 1:1 transfer, or more precise extension, of the established and proven institutional, legal and administrative framework of the West to the East. Thus, the opportunity to correct structural problems of the Western system for improving the efficiency of the all-German system was not used (Mayntz 1996: 34-35). Time constraints, the weakness of the East German actors and the determined resistance of West German government actors and research organizations against any measures which could threaten the existing status quo with regard to the delineation of competencies, research domains and resources were the main reasons for this result (Mayntz 1994a). The demand of the Science Council “not simply to transfer the science system of the Federal Republic to the GDR”, but to use the opportunity for a “self-critical appraisal to what extent parts of its education and research system require a reorganization” (Wissenschaftsrat 1990: 10) remained largely unheeded having no chance against these vested interests:138

“The existing institutionalized domain consensus among Bund, Länder and science organizations in West German science policy (sanctioned by the Framework Agreement on Research Promotion of 1975) determined also the action-guiding premises of the participating actors in the process of German unification. The paramount interest of the Western actors was the stabilization of the balance in research policy among these three groups of actors, a goal which they saw most likely ensured in the turbulent situation in the run-up to German reunification by a preservation of the institutional status quo.” (Stucke 1992: 3; Mayntz 1994a).

The introduction of the West German principles of “federally structured” and “pluralistic” public research system in which a political direction of research is rather the exception than the rule and where basic research, particularly at universities, enjoys an institutional guaranteed autonomy meant a revolutionary break with the existing functions, organizational structures and government arrangements in the East (Wissenschaftsrat 1990; Krull 1992: 15; Mayntz 1996: 33-34). Especially in three main respects the East German system differed fundamentally from the institutional set-up and guiding principles of its Western counterpart.

Following the Soviet model R&D capacities were predominantly concentrated in the institutes of several centralized and hierarchically directed academies. By far the largest and important was the “Acad-
The Academy of Sciences” (Akademien der Wissenschaften (AdW) with 60 research institutes, a staff of about 24000 and a budget of 1.4 billion Mark in 1989 (Wissenschaftsrat 1990: 24).\textsuperscript{139} The research of its institutes in most cases was focused on basic and applied research in the service of a particular industry sector.\textsuperscript{140} Although the scientific productivity of universities, measured in publications, was higher than the widely held opinion in the West supposed (Ash 1997: 87-88), they were clearly disadvantaged in terms of research infrastructure and resources compared to the Academy-institutes. Instead, teaching and professional training were the main mission and function of the higher education sector (Mayntz 1996: 40-41). Two other structural features differentiated the East from the West German situation. Firstly, both higher education and research institutions were regionally concentrated in Berlin and Saxony. Secondly, besides 9 universities a multiplicity of rather small specialized polytechnics training professionals for specific industrial occupations. In addition, the Academy-institutes and also some of the polytechnics enjoyed the right to award the doctorate and the habilitation, in the Federal Republic an exclusive – and determined defended – privilege of universities.

The GDR lacked a federal state structure. The former states had been dissolved and responsibilities for higher education and research policy were centralized at the “Ministry for Universities and Professional Schools” and the “Ministry for Science and Technology” (Ministerium für Wissenschaft und Technik (MWT)). Thus, government arrangements were almost diametrically opposed to the strong role of the West German states in science policy and Federal-state cooperation in research promotion and funding.

The Basic Law guarantees the freedom of research and teaching from political, especially ideological, direction and universities and research organizations has been granted a high level of self-government and scientific autonomy in research planning. In contrast, one of the primary function of higher education in the GDR was the development of loyal “socialist personalities” according to the principles of Marxism-Leninism, while public sector research was oriented towards the needs of the planned economy and the development of a socialist state and society. In consequence, scientists were subjected to central planning and close political guidance and control concerning topics, substance and objectives of their research and teaching activities. Ideological or utilitarian criteria dominated in many faculties and Academy institutes.\textsuperscript{141}

To these structural differences one has to add to additional problems facing East German research. Firstly, the need to work with an inadequate and out of date infrastructure and equipment making re-

\textsuperscript{139} The other two academies were the Academy for Building and Architecture and the Academy of Agricultural Sciences. We will concentrate in the following on the AdW.


\textsuperscript{141} See the previous footnote.
Government and funding arrangements for PSR

search competitive at the international level difficult if not impossible. Secondly, the restriction of contacts and communication with Western scientists excluding East German researchers from access to the international scientific community, international literature and research facilities abroad (Gläser 1992: 37-38; Wissenschaftsrat 1990: 12-14).

One can distinguish three phases in the unification process in which the participating actors in West and East tried to deal with these structural differences and problems in order to create an integrated and uniform all German research system (Stucke 1992: 3; Mayntz 1994a; Ash 1997: 89). In a short “cooperation phase” (Stucke) lasting between the peaceful revolution in November 1989 to the last – and first free - parliamentary election in the GDR in March 1990 East German universities and AdW-institutes started uncoordinated internal reform efforts. Simultaneously, the federal ministry of research, science organizations and individual scientists started to establish contacts with and support East German institutions and colleagues. To finance these measures the central government decides in February 1990 to provide 80 million DM in the BMFT-budget for cooperation activities in the GDR (Stucke 1993: 6-8). When in March 1990 the CDU-led “Alliance for Germany” won the parliamentary elections the political situation changed abruptly. Already in April the Volkskammer decides in favor of an accession to the Federal Republic according to Article 23 of the Basic Law. This meant that the GDR will be formally dissolved and the newly formed East German federal states will become new members of the Federal Republic. But this meant also the decision for taking over the institutional and administrative structures of the Federal Republic. In consequence, the research policy actors now had to plan and organize the restructuring of the East German science system in a way to allow its integration into the West German system. For it was almost undisputed in the Federal Republic that unification could take place only on the basis and terms of West German research policy and structures.

This was the result of the “strategic positioning phase” between April 1990 and July 1990. Here the West German actors clearly took the lead, whereby three actors dominated (Stucke 1993: 8-11).

From the beginning the federal research ministry claimed the lead corresponding to the leading role of the central government in the overall reunification process. But the BMFT did not try to use this opportunity to expand its competencies and domain in East Germany at the expense of the Länder as one

142 See for a detailed account of the negotiation processes and the interests of the different actors Mayntz (1994a). In the following the condensed article of Stucke (1993) is cited, which largely corresponds to the Mayntz monography.

143 Even if the East German government would have decided for a different procedure it is doubtful if an outcome giving more attention to East German interests and wishes would have been possible. After all reunification was no negotiation among equals, but characterised by a high asymmetry both with regard to powers and expertise. While the FRG was represented by professional politicians and administrators leading one of the largest and most successful economies of the world, the GDR was at the brink of implosion and led by actors recruited mostly from the former opposition excluded from the high ranks of state and bureaucracy.
could expect from the protracted federal conflict in research policy in the fifties and sixties (see chapter two). Instead, already faced with a tight budget the ministry tried to avoid as far as possible financial burdens “which could not be compensated by additional means” (Stucke 1993: 8). In fact, this meant to prevent that too much East German research facilities would be transformed into types of institutes mainly financed by the Bund, namely national research centers (90% federal funding) and federal research establishments (100%). Additionally, the BMFT wanted a systematic evaluation of all research institutions and researchers which were to be taken over into the all-German system in order to avoid the continuation of mediocre research and to reduce costs.

The old Länder in the West took a rather restrained role in the unification activities. Their main interests were to ensure that the federal state structure and distribution of political responsibilities in higher education and PSR was maintained thus preserving their strong position in science policy vis à vis the central government. In addition, analogue to the Bund they wanted to avoid a financial involvement in the reconstruction and modernization of the Eastern research system as far as possible. For them, this was a task of the central government and the new Länder in the East.

For the science organization it was most important to preserve their autonomy toward governments and to prevent the establishment of research structures in the East which could threaten their domains and resources in an united Germany. However, different strategies can be observed. From the beginning the Fraunhofer-Society and the national research centers developed strong activities in the GDR, because both saw, for different reasons, unification as a chance to expand their research markets (FhG) or increase their weakened legitimation in the West (GFE). In contrast, Max-Planck-Society and German Research Society acted more cautiously. For the former it was imperative that an engagement in the East did not lead to a worsening of the financial situation of its West German institutes. Thus, without wanting to shirk its responsibility in the reunification process the MPG made an intensification of its activities dependent on an at least partly compensating increase of its budget. In addition, the MPG wanted to decide for itself which research institutes or scientists to take over referring to its traditional principles to support only the “best researchers”. Thus, the establishment of an institute and the appointment of its director(s) usually requires an extensive “ex-ante evaluation to ensure that the most promising areas and the best persons are selected ... and usually takes between 18 months and two years” (Trepte 1996: 128). A similar policy pursued the DFG. On the one hand, it started to open its funding programs to East German applications. On the other hand, it demanded a financial compensation for this if it was to take over the role of an all-German funding agency for university research.

In summary, one can say that the strategies of the “West German actors were rather driven by imperatives of avoidance than of active structuring” (Stucke 1993: 10). Under these conditions it was not surprising that the status quo became the lowest common denominator on which all main actors could agree (ibid.: 10-11). By assessing this less ambitious and inspiring outcome one has to take into account that one could not afford fundamental conflicts if not the whole unification process in science
policy should be endangered by a mutual blockade (Mayntz 1994a). In the so-called “fireside talks” in July 1990 in which the West and East German research ministers and the presidents of the West German science organizations took part, the principles for the unification of the research system along the West German lines were agreed:

“1. It is our aim to create an integrated research system in a unified Germany. It will have a differentiated ... structure entailing those elements that characterise the West German research system.

2. The incorporation of the institutions combined under the East German Academy of Sciences into this research landscape will be a central task.

3. It appears essential for future scientific and economic development to preserve efficient East German R&D capacities ... and to create new R&D facilities that resemble structures in other parts of Germany.” (BMFT-press release quoted in Meske 1993: 299).

What did this mean for the East German universities and especially the Academies. Firstly, according to the federal distribution of competencies in the West responsibility for the institutions of higher education was handed over to the East German Länder. Their ministries of culture should organize the evaluation and restructuring of the university sector with the help and under supraregional coordination of the Science Council. Secondly, the Academy of Sciences was to be dissolved after a transition period in which the Science Council was commissioned to carry out a systematic evaluation of all institutes in order to determine which ones should be continued by being integrated into universities or assigned to the different types of non-university institutes in the West. Art. 38(2) of the Unification Treaty confirmed these decisions (Stucke 1993: 10-12). The Academy of Sciences was dissolved by separating the learned society from the research institutes. The Academy institutes were transformed into research institutions of the Länder and received an institutional guarantee until 31 December 1991. Since the West German Länder refused to take over financial commitments exceeding the already agreed “Fund German Unity” (Fonds Deutsche Einheit) the institutes were financed by the Bund during this period. In the meantime the Science Council was to complete their evaluation and their “fitting in ... into the joint research structure.” This fitting in was to be realized through “the application of the proven methods and programs of research promotion” of the Federal Republic (Art. 38(6)). With the access to the Federal Republic the new Länder became parties to the Framework Agreement on and the Bund-Länder-Commision for Research Promotion regulating the joint funding of non-university research and the Science Council and were obliged to pass “higher education renewal laws” later to be replaced by permanent university laws corresponding to the stipulations of the “Framework Act on Higher Education”.

In this context, the entire faculties for Marxism-Leninism, but also of other disciplines in the humanities and social sciences were to be “wrapped up” (abwickeln) and refounded until 31 December 1990 due to the perceived ideological indoctrination and entanglement in the socialist party and state appa-
ratus requiring a complete new beginning (Wissenschaftsrat 1990: 15; Krull 1992: 22-23; Mayntz 1994). Moreover, all staff positions were to be newly advertised and all university teachers were to be subjected to a dual evaluation both according to moral and political criteria and scientific competence by special structure and appointment commissions established for all universities after which, if positive, they could apply again for their position, but had to compete with other East German and especially West German applicants.

What have been the results of the unification process so far? On a general level the research capacities have been drastically reduced if one looks at staff positions.

non-university sector

**Table 5.7: R&D staff of non-university research organizations in West and East Germany (in %)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>National Research Centers</td>
<td>36,6</td>
<td>15,6</td>
</tr>
<tr>
<td>Max-Planck-Society</td>
<td>15,2</td>
<td>5,4</td>
</tr>
<tr>
<td>Fraunhofer-Society</td>
<td>6,7</td>
<td>8,8</td>
</tr>
<tr>
<td>Bund-Länder-Institutes</td>
<td>8,0</td>
<td>41,3</td>
</tr>
<tr>
<td>Federal Research Establishments</td>
<td>13,3</td>
<td>11,5</td>
</tr>
</tbody>
</table>


Although the positive evaluation of most former Academy institutes by the Science Council took the West German actors by surprise and created problems, because now more research institutions had to be continued and thus to be financed (Meske 1993: 305), this meant nevertheless a strong staff reduction. The council recommended to take over about 10000-11000 AdW-employees of which about 2000 were to be integrated into universities (Mayntz 1994a: 185-193). This had to be compared with the 24000 employees in June 1990 meaning a reduction of more than half. However, until November 1991 the size of staff had already declined to about 16000 revealing a far more positive picture. Overall one can say, that the “basic research capacity that met international standards had largely be maintained.” (Mayntz 1996: 37). But with regard to its recommendations concerning the future affiliation of Academy institutes the Science Council was far less successful, mainly for financial reasons, but also due to the own strategies of the West German research organizations (Mayntz 1994a: 198-207).

---

144 See Ash (1997) for an excellent English account of the developments in the higher education sector.

145 “Of the 60 institutes ... 21 were to be continued relatively unchanged, 5 were to become part of an existing West German institute, 28 were to be subdivided, and 6 were to be closed down completely.” (Mayntz 1996: 38; 1994a: 195).
Firstly, as already mentioned the BMFT resisted the establishment of national research centers and federal research establishments. In the end, only three new centers and nine outstations of existing ones and three new government laboratories and outstations were set up. Compared to the old Länder, especially the low share of the national research centers in East German PSR is striking (Table 5.7).

Secondly, also on the Max-Planck-Society the Science Council could not enforce its plans for taking over a higher number of former Academy-institutes and scientists as Table 5.7 shows. The MPG rather insisted on founding new institutes according to its own planning procedures and principles (see above). In the meanwhile, however, more than ten institutes in the new Länder have been founded (see 5.3). The unintended consequence of this veto of Bund and MPG against taking over more research capacities, but also the problems of the universities to integrate former Academy scientists (see 6.2) was a massive expansion of the Bund-Länder-Institutes, formerly a rather “heterogeneous statistical category” (Mayntz 1996: 39), now suddenly a group of research institutes rivaling in size with MPG and FhG. More than thirty Blue-List-Institutes in the new Länder were created as an compromise solution accounting for more than 40% of R&D staff in non-university research (Table 5.7; see 5.3). This has given rise to major conflicts in the research system. Especially, MPG and FhG see the BLI as competitors for scarce institutional funding, while the rector conference of universities demands an integration of the institutes into universities as part of the promised strengthening of university research (Meske 1993: 305-306; Schimank 1994b: 268-269).

**higher education sector**

The influence of the Science Council on the reconstruction of East German higher education was far more limited than in the non-university sector where its evaluation mandate provided it with a key role. Instead, it was restricted on the formulation of guidelines concentrating on the longer term development and the supra-regional co-ordination of the all-German university system. For this purpose, a central “Structural Commission” was established composed of scientists, representatives of Bund and new Länder and the president of the conference of university rectors. This commission co-ordinated the work of 16 specific working groups on the basic sciences and disciplines, course programs like teacher training and groups of institutions like arts academies and Fachhochschulen. Based on their reports the Structural Commission passed “Recommendations on the Future Structure of the Higher Education Landscape in the new Länder and East Berlin” which can be classified into three groups: recommendations on (1) “the establishment of new faculties and disciplines”, (2) “the founding of new universities” and the (3) “adaptation and consolidation of existing disciplines” (Krull 1994: 216). These contained general statements on the regional distribution of faculties and disciplines, the disciplinary and course profile of individual universities and the adequate provision of faculties with student places, staff positions, equipment and funding.

---

146 See for the following Krull (1994); Röhl (1994): 74-80.
However, the Science Council had no direct responsibility for the evaluation of individual scientists and the decision on continuing or dissolving of institutions that lay with the governments of the new Länder. For this purpose, these established own structural commissions for higher education composed of independent experts advising the East German ministries of culture in the reconstruction of their university systems. The renewal of East German higher education was dominated by three factors. Firstly, the need to continue teaching. Secondly, the conflicts linked to the “political” evaluation of university teachers and the dismissal of whole faculties which were often replaced by West German colleagues creating the impression of a “colonization”. Thirdly, the regional egoism of the Länder. In the end, a rather mixed picture can be observed resulting from these interest and actor configurations. Overall, the Science Council was not successful in implementing major structural innovations in the higher education system. Rather the deficient structures of the West German universities were implanted to the East (see 6.1.2).

With regard to the conservation of research capacities it seemed at the first glance that universities have survived reunification much better than the Academy of Sciences. All 16 previous universities were continued and most of the specialized schools were integrated into universities or transformed into Fachhochschulen. In addition, academic staff declined only by about one third between 1989 and 1993 and none at all at the level of professors (Mayntz 1996: 42). However, in the meantime the situation of East German universities had worsened due to the financial problems of the new Länder. Most governments have announced or already started to reduce R&D personnel further and the integration of former Academy scientists largely failed due to the lack of positions and funds. Commentators now regard the situation in the non-university sector to be much more positive, because here joint Federal-state funding makes such budgetary cuts less possible (Simon 1992: 34-35; Meske 1993: 307).

4.6 The DFG

The German Research Society (Deutsche Forschungsgemeinschaft (DFG)) takes a central place in the German research system. It is simultaneously a self-governed organization and interest representation of science, assembling representatives from almost all research specialties, and the most important public funding agency “serving all branches of science and the arts”. For this purpose the DFG is funded jointly by Bund and Länder having a total of 1,8 billion DM at its disposal in 1995. The DFG has no in-house research capacities, but distributes grants to individual and collaborative research projects benefiting mainly university-based researchers and young scientists (about 92% of all grants go to universities). The DFG allocates grants in five areas with different objectives and management procedures (Table 5.8).
Core of the DFG-funding is the so-called “normal procedure” (Normalverfahren) accounting for 30-40% of total grants. In the framework of this funding procedure individual scientists can apply for project grants irrespective of the scientific field or research topic. Submitted proposals are exclusively evaluated by elected peer-review committees according to scientific originality and quality while the volume of approved grants is brought in line with available funding by the “Grants Committee” (Hauptausschuß) composed of 19 academic members, 8 federal and state representative and 2 delegates of the Donor’s Association for German Science, a private foundation collecting funds from industry. However, no ex ante allocation of funds to specific research areas is made, but a balanced distribution is sought in a pragmatic way. In this way a top-down direction of research shall be avoided. The DFG regards this emphasis on a “bottom-up” procedure as one of the central institutional safeguards against an external interference in its funding policy to steer research towards utilitarian criteria. Thus, the DFG-normal procedure is the most important instrument for funding investigator-driven basic research in Germany.

Table 5.8: Allocation of DFG-grants according to funding program 1975-1995

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Grants</td>
<td>535</td>
<td>894</td>
<td>1055</td>
<td>1217</td>
<td>1419</td>
<td>1990</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>60</td>
<td>100</td>
<td>118</td>
<td>136</td>
<td>159</td>
<td>223</td>
</tr>
<tr>
<td>Individual Grants Program</td>
<td>192</td>
<td>369</td>
<td>463</td>
<td>498</td>
<td>600</td>
<td>809</td>
</tr>
<tr>
<td>in %</td>
<td>35,8</td>
<td>41,2</td>
<td>43,9</td>
<td>41,0</td>
<td>42,3</td>
<td>40,6</td>
</tr>
<tr>
<td>Priority Programs</td>
<td>99</td>
<td>138</td>
<td>192</td>
<td>197</td>
<td>186</td>
<td>285</td>
</tr>
<tr>
<td>in %</td>
<td>18,5</td>
<td>15,4</td>
<td>18,2</td>
<td>16,2</td>
<td>13,1</td>
<td>14,3</td>
</tr>
<tr>
<td>Promotion of Young Scientists</td>
<td>13</td>
<td>22</td>
<td>29</td>
<td>80</td>
<td>184</td>
<td></td>
</tr>
<tr>
<td>in %</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Equipment Programs / Central Research Facilities</td>
<td>37</td>
<td>62</td>
<td>34</td>
<td>37</td>
<td>42</td>
<td>47</td>
</tr>
<tr>
<td>in %</td>
<td>6,9</td>
<td>6,9</td>
<td>3,2</td>
<td>3,1</td>
<td>2,9</td>
<td>2,3</td>
</tr>
<tr>
<td>Collaborative Research Centers</td>
<td>185</td>
<td>263</td>
<td>305</td>
<td>349</td>
<td>392</td>
<td>499</td>
</tr>
<tr>
<td>in %</td>
<td>34,5</td>
<td>29,4</td>
<td>28,9</td>
<td>28,7</td>
<td>27,6</td>
<td>25,1</td>
</tr>
</tbody>
</table>

Source: DFG Jahrebericht: Aufgaben und Ergebnisse, various issues.

147 See in the following DFG (1997).
A second area of activities constitute programs for the targeted funding of priority areas and collaborative research. In the case of the “Priority Programs” (Schwerpunktprogramme) accounting for about 14% of DFG-funding in 1995 the DFG takes up initiatives of scientists for formulating a common research program in a specific area. These proposals is submitted to the DFG-Senate which annually decides on the setting up of new priority programs. Individual projects within the program can be funded up to six years. Projects are selected by an open panel review following a public call for proposals which is open to all applicants. Quantitatively most important are the Collaborative Research Centers (SFB; see chapter 2.2.2.4). These are separately budgeted and in contrast to the other funding programs applications have to be submitted by universities and are subject to strategic considerations including political or economic considerations and extensive evaluation including site visits at the applying university. In 1995, the DFG operated more than 200 SFB with a total budget of 500 million DM and accounting for 25% of the overall DFG-budget.

A third major task of the DFG is the administration of various programs for the promotion of younger scientists, especially graduate colleges for doctoral students and measures to support postdoctoral students during their habilitation and finding an academic position. Most of these programs are administrated by the DFG on behalf of Bund and Länder and used about 10% of overall resources in 1995.

Review and award procedures as well as collaboration of professors in the various bodies of the DFG exemplify its character as a self-governed body of academia and contribute to the relatively high acceptance of the DFG in higher education and politics (Neidhardt 1988). Due to the competitive character of the procedures standards are established for excellence in research. Thus, the DFG is especially compatible with the type of not application oriented, basic research conducted at higher education institutions. Due to recent developments, questions related to the self-governing capacities of science and scholarship and the system of peer review are on the agenda. The DFG reacted with a survey among its “customers” which shows a high degree of overall satisfaction with the work of the DFG.

Despite its internationally prestige and envied scientific autonomy the DFG is faced with several challenges in the mid nineties. Firstly, like MPG and universities the DFG had suffered from the lower priority given to basic research. In consequence, the DFG had to refuse an increasing number of grant applicants (Table 5.9).

While at the beginning of the seventies the DFG approved more than 90% of all applications and almost 80% of the requested financial means, these shares show a dramatic decline to 73% and 52% in 1989. The growing gap between the number of approved applications and the volume of grants applied for shows that the DFG lowered the size of individual grants to be able to fund more projects. Because it is not the lessening quality of applications which is responsible for this decline but the lack of funds. A similar problem plagues the Collaborative Research Centers. Supported up to 15 years, new ones can mostly be set up only if an existing one is terminated. Since the first wave of SFB were founded within a few years this leads to periods where a high number of centers can be established, followed
by periods with rather low resources for new initiatives. With reunification the financial situation worsened again. This is not due to a high number of new applicants from East Germany, but to a surge of applications from the old Länder. Faced with cuts in public project funding needed for the reconstruction of the East German research system West German scientists turned increasingly to the DFG for compensation (Meske 1993: 306). In consequence, rate of approvals continued to decline and in 1995 not even half the volume of grants applications could be financed. On this background the DFG has repeatedly warned that without additional resources it will loose its ability to support university research on a broad basis.

In addition, Bund and Länder exert pressure on the DFG to give research foresight and strategic priority setting more importance in its funding policy. This is also an indirect consequence of tighter science budgets. In the view of policy makers, the DFG can no longer effort to rely almost exclusively on the “bottom up” procedure. Instead, it shall concentrate resources on priority areas both according to scientific criteria, but also to relevance considerations. For the DFG this presents a major threat to its scientific autonomy. It was precisely the refusal of an top-down direction of research together with the peer-review procedure which the DFG saw as the guarantee that solely the interest and needs of science determine the allocation of funding. However, scientists have also started to question the funding principles of the DFG or better the practice to reduce the volume of individual grants instead of the number of approved grants applications, because it produces dysfunctional effects. In times of increasing research costs the DFG-grants are less and less able to finance projects at an adequate level for competitive research. At the same time, researchers apply more often to compensate the smaller volume of grants leading to a zero-sum-game. A third challenge constitute attempts of the federal research ministry to assign the DFG also responsibilities in the funding of non-university research. For example, 5% of the institutional funding of the Bund-Länder-Institutes is now given to the DFG which in turn opens its funding programs for BLI-applicants. With this, however, the DFG risks to become a national research council for PSR making it difficult to escape government interference and control.
Sub-sectors

In this chapter, we will look more closely at the effects of political measures on the two sub-sectors of PSR: the universities, on the one hand, and the five groups of extra-university state-financed research institute, on the other. Special emphasis is given to the former. Universities form not only the largest public research sector, but also have been subject to particular severe problems and dominated the science policy debate.

5.1 Universities

The German system of higher education comprised in 1995 326 institutions, whereby two sub-sectors with different missions and organizational structures have to be distinguished (see chapter two). Re-
search and research training is the domain of 112 so-called “scientific universities” (*wissenschaftliche Hochschulen*) composed of 89 classical, technical and specialized universities, 17 theological seminaries and 6 teachers colleges. An independent, but quantitatively unimportant, sub-sector of university-type institutions are the 46 specialized “Colleges of Arts and Music” (*Kunst- und Musikhochschulen*) for training art teachers and awarding state diploma necessary for employment in the public sector. Due to the specific nature of their subjects and the low share of research in their activities the arts colleges are mostly not counted as scientific universities to which they officially belong. Scientific universities are characterized by three distinct features.

Firstly, research is an integral and constitutionally guaranteed part of their mission according to the Humboldtian principle of the unity of research and teaching. The Länder, having primary responsibilities for higher education, but also the central government are obliged to provide universities as the main institutions of “free science” with adequate infrastructure and resources to carry out this research function. Secondly, universities have the exclusive right to award advanced academic degrees, especially the doctorate and the *Habilitation*, the advanced doctoral degree which is necessary to become a full university professor (*Ordinarius*). Thus, universities play a predominant role in

---

148 The following is based on a more detailed analysis in Schimank (1995). Recent English publications dealing with different aspects and problems of the German higher education system are Mittelstraß (1996); Schimank (1996) and Ash (Ed. 1997).


150 This is laid down in the so-called “University Decision” (1973) of the Federal Constitutional Court. According to the *Bundesverfassungsgericht* the state is required “to make possible and to support ... the cultivation of free science and its transmission to future generations through the provision of personnel, financial, and organizational resources. That means, that he has to provide properly functioning institutions for free science.” due to its “de facto monopoly” on the organizational and financial means without which “in wide areas of the sciences, especially the natural sciences, no independent research and scientific training can be carried on.”

151 In contrast to other countries in Germany the doctorate does not confer the right to give lectures. In addition, tenured positions in the academic sector including for example the Max-Planck-Institutes are almost exclusively limited to “habilitierte” scientists. Based on a high-level project of original research the Habilitation thesis shall prove the ability to represent a scientific discipline by independent research and teaching. The awarding of the habilitation is one of the most important corporate privileges of universities allowing professors to control the standards and access to the academic establishment. For this reason it is understandable that university professors resist its abolition, although governments and external commentators regard the habilitation in the meanwhile more as a liability than an advantage of German universities for several reasons. Firstly, it makes the appointment of foreign professors rather difficult impeding the internationalization of universities. Secondly, German scientists are very old in international comparison when they get a professorship and with it the resources and freedom to pursue their own research interests. Thus, if the Science Council speaks of *wissenschaftlichen Nachwuchs* this includes postdoctoral students in their mid thirties or even early forties working on their habilitation. Thirdly, the habilitation normally is an in-depth treatment of a special disciplinary research problem leading to a monolithic publication of 400-500 pages. Today, however interdisciplinarity, team work and publishing in reviewed journals are seen rather more important for innovative and productive research. In view of the uniqueness of the habilitation in international comparison and the productivity of universities abroad the objection of habilitation supporters that its abolishing would undermine academic standards and lead to a dec-
(post)graduate training, although a large number of doctoral students and postdocs also is employed by non-university institutions. Thirdly, to be admitted to universities applicants need A-levels (Abitur), the highest secondary school diploma. However, in the post-war period several alternatives have been established to allow qualified applicants without A-levels to go to universities which has contributed to the high growth of student numbers. The dominance of universities in German higher education is shown by several indicators. In 1995, almost three quarters of students were enrolled at scientific universities (without art academies). Moreover, universities (without medical institutions) accounted for 83% of total expenditure on teaching and research in higher education (BMBF 1998: 404-405) and employed 80% of scientific staff.

The second main sector of higher education form the now 168 Fachhochschulen including 30 advanced schools for public administration which have primarily an educational mission concentrating on short-term vocational study courses (see chapter 2.2.2.4). Although the Framework Act on Higher Education does not discriminate between universities and Fachhochschulen, but only speaks of “specific functions” assigned to the different groups of institutions within the overall mission of higher education to contribute “to the fostering of the sciences and arts through research, teaching and studies” and “to prepare students for occupations which require the application of scientific findings and scientific methods” a clear status hierarchy exists between the more prestigious and better funded universities and the polytechnics exists (Schimank 1995: 67-68).

This privileged situation of universities mainly follows from their research function. The “scientific” character of university studies and degrees grants their graduates a higher social prestige and better career opportunities. Additionally, research and research training serve as justifications for a privileged funding of universities compared to Fachhochschulen. In recent years Bund and Länder have taken measures to strengthen research activities at the Fachhochschulen and to transform them into regional centers for applied R&D and technology transfer. But three factors still limit the possibilities to increase their involvement in research significantly. Firstly, teaching obligations absorb most of

lining quality of research and teaching seems rather questionable and to owe its persistence more to the defense of professorial privileges.

153 Section 2(1) of the Framework Act on Higher Education. An English version is printed in Orsi-Battaglini/Karpen (Eds. 1990): 120-156 together with a selection of other laws and documents central for German PSR.
154 Ironically it is the public administration which up to now denies FH-graduates access to leading positions and pays them a lower salary than university graduates despite the declared objective of federal and state governments to strengthen the Fachhochschulen, while industry has gradually dismantled such disadvantaging (Wissenschaftsrat 1993c: 27).
155 According to the so-called “R&D coefficient” measuring the proportion of research in overall activities of scientific staff at institutions of higher education, the Fachhochschulen devote on average only 5% of their resources to research. In comparison, the coefficient for universities varies between 28,7% in the case of medicine and 42,1% in the case of engineering sciences. Even for university
the working time. FH-professors have to give 18 hours of lectures and courses per week during semesters compared to a maximum of 8 hours for their university colleagues to which administrative and examination duties have to be added leaving almost no working time for research. Secondly, the unity of research and teaching does not apply. Accordingly capital grants and regular budgets of Fachhochschulen provide only to a very small extent for a research infrastructure and the necessary staff and financial resources. Instead research has to be financed almost exclusively through the acquisition of public and private project grants and research contracts. The capacities for such acquisition activities, but also the carrying out of externally funded research projects, however, are rather low. External grants normally to not cover overhead costs. In consequence, the lack of laboratories and equipment limits the type and amount of R&D which can be performed. In addition, inadequate working time and support staff for R&D makes the formulation of competitive project proposals difficult. For this reason, consultancy and short-term development tasks for firms constitute a major proportion of FH-research. Thirdly, while a considerable part of university research is performed in the framework of (post)graduate training this platform and stimulus for academic research is largely closed to the Fachhochschulen not having the right to awards doctoral or other advanced degrees. Furthermore their graduates have to pass additional courses or examinations to be admitted to doctoral studies at universities making Fachhochschulen a rather unattractive alternative for qualified and research interested students. According to this still marginal role of the Fachhochschulen as research organizations we will leave them aside in the following and concentrate on the university sector.

The universities are regarded as the “most important places for research” and “fundament of the overall research system” (Wissenschaftsrat 1988: 29; 1993: 14; BMFT 1984: 33) to which non-university research institutions stand in a subsidiary relation. This prominent role granted to universities in PSR is justified with reference to three central features of universities (ibid.; Wissenschaftsrat 1996a: 28-32). Firstly, universities are mainly responsible for the training of new generations of scientists. It is the quality of their research training which largely determines the future productivity and competitiveness of German science and technology. Secondly, only at universities the entire spectrum of scientific disciplines is represented enabling research in a breadth, depth and variety which is not possible at non-university institutes concentrating on specific scientific fields or research problems (Wissenschaftsrat 1996a: 30). At the same time “disciplinary advancement of knowledge is in most cases the prerequisite for research crossing disciplinary boundaries or initiated by extra-scientific problems”. Accordingly, universities possess an unique potential for interdisciplinary and problem-oriented research being focuses of S&T policy in the eighties and nineties, although “universities use this potential insufficiently” (ibid.: 31). Table 6.1 shows that the research capacities of non-university organizations are heavily concentrated in the natural and engineering sciences, while universities have a far more bal-

hospitals (13.5%) and arts colleges (15%) the R&D coefficient is three times higher than for the polytechnics (BMBF 1996a: 526).
anced distribution. A more detailed look would reveal this advantage of universities even more clearly. In many so-called “orchid disciplines” in the humanities and social, but also in specialties of the exact sciences, only at universities research and teaching capacities exist.

Thirdly, universities, together with the institutes of the Max-Planck-Society, are the traditional centers for investigator-driven fundamental research and originality and quality of research traditionally are the main criteria on which the academic reward and promotion systems have been based. In Germany this orientation towards cognitive problems and inner-scientific criteria in university research is reinforced through the activities of the German Research Society, the main source of external grants for university researchers. In the DFG peer-review committees whose elected members mostly come from universities evaluate project proposals strictly according to their scientific merit. In contrast, most extra-university institutes have a strategic or applied mission and R&D activities are also assessed according to utilitarian considerations. In a recent report on university research the Science Council has summarized its indispensable functions and the outstanding importance of universities for a competitive innovation system.

**Table 6.1: R&D personnel and expenditure in the university and non-university sector according to scientific fields in 1991 (%)**

<table>
<thead>
<tr>
<th></th>
<th>Natural sciences</th>
<th>engineering sciences</th>
<th>Medicine</th>
<th>social sciences</th>
<th>Agricultural sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Staff Exp.</td>
<td>Staff Exp.</td>
<td>Staff Exp.</td>
<td>staff Exp.</td>
<td>Staff Exp.</td>
</tr>
<tr>
<td>University</td>
<td>28,9</td>
<td>28,7</td>
<td>19,6</td>
<td>21,1</td>
<td>24,4</td>
</tr>
<tr>
<td>State/PNP</td>
<td>51,8</td>
<td>53,6</td>
<td>22,6</td>
<td>26,0</td>
<td>6,8</td>
</tr>
</tbody>
</table>

Source: Table 12A and 13A.

“In the German research system universities are the most important places of undirected basic research in its total breadth. Unlike extra-university research institutions university research contributes not only to the advancement of knowledge in selected areas, but safeguards the reproduction of the attained level of knowledge, methods and theories in all disciplines. Through the involvement of students and younger scientists in the research process highly qualified professionals and senior staff for the labor market outside universities including other research institutions are trained. Moreover universities with a high quality of research are also important elements for establishing an attractive research environment for companies.” (Wissenschaftsrat 1996a: 37).

5.1.1 Funding arrangements for university research and the marginalization of research by teaching

The financing of university research still is overwhelmingly the responsibility of governments, although industry funding for universities has continuously increased in the eighties and reached about
9% of total university expenditure on R&D in 1995 (Table 8A). Three main funding arrangements can be distinguished. Each of this “money streams” has a specific function and can be differentiated according to (1) its source; (2) its purpose and (3) its conditions of funding.

Institutional funding for research and teaching in the form of general government grants to universities constitute a first money stream and accounted for about 60% of total university expenditures in 1994 (Table 19A). These regular university budgets are a responsibility of the Länder and cover staff and overhead costs. In addition, they shall provide for “well-founded” research facilities (Grundausstattung), that means a basic research infrastructure and budgetary and staff resources allowing professors and other scientific staff to pursue a minimum of own undirected research and to apply for and carry out externally financed projects. The right to a minimum of infrastructure and resources even falls under the constitutionally guaranteed freedom of research, although here a wide room for interpretation exists which has prevented its practical use in the resistance against budgetary cuts (Schimank 1995a: 124-127).

A second type of general university funding are capital grants for building investments and large-scale equipment which are financed jointly by Bund and Länder. The latter register demands and plans at the Science Council which, based on the listed projects draws up a rolling framework plan setting priorities and bringing proposals into line with existing funds provided by Bund and Länder. For approved projects the central government reimburses half of the costs (see chapter two). In 1994, investment grants accounted for about 16% of overall university expenditure (Table 19A).

The third source of research funding at universities are third-party funds (Drittmittel), that means external grants provided by public and private funding agencies for specific research projects. In contrast to general university funding these project grants have been strongly increased since the mid seventies accounting in 1994 for about 14% of overall university expenditures and more than 30% of R&D expenditure for which they are exclusively earmarked (Table 19A and 19-1A; (Wissenschaftsrat 1988: 257-259; 1993a; 1996a: 22-25; Schimank 1995a: 134-155). Thus, for actual university research in Germany third-party-funds are at least equally important than general government grants. Without external grants many research projects could not be realized because institutional funding has become too low and to absorbed by teaching in order to be able to finance complex and costly projects. This threatens to reverse the original relationship in the “dual funding system” in which project funds are a supplement, but not a substitute, for institutional funding (Wissenschaftsrat 1988: 75-82). The most important funding agency for university research is the “German Research Society” (1994: 35%), fol-

156 “With the means of base funding primarily smaller research projects and the preparation of larger, externally funded projects are financed.” (Wissenschaftsrat 1988: 35).

157 This supplementary function of third party funds for “larger research projects or middle- and long-term research programs” in the “dual principle” of university funding, however, is still regarded as the desired situation by the Science Council (Wissenschaftsrat 1988: 35/79).
allowed by project funds from federal ministries (1990: 29%) and industry (1990: 15%) (Table 19A).
But not only for quantitative reasons the DFG plays such a central role for university researchers. In
contrast to the other sources the DFG selects and promotes investigator-initiated research projects in
all scientific disciplines. Scientific promise and quality are the exclusive selection criteria in the peer-
reviewed grant procedures. These standards apply also for the DFG-programs targeted for collabora-
tive research and priority setting at universities like the Collaborative Research Centers, while projects
funds from governments and industry normally have an utilitarian character laying down topics and
objectives of research.

General university funding in Germany has been in a permanent state of crisis since the mid seventies.
Base funding by the Länder has been stagnating (Wissenschaftsrat 1988: 259-260; 1996a: 22-24;
Schimank 1995a: 72-74/124). From 1980 to 1990 it rose only by 4% in real terms and the strong in-
crease afterwards is mostly owed to reunification. Even worse was the development of capital grants
for university construction and large-scale equipment (see chapter 2.2.2.4), where in 1990 the volume
of funds has declined by 6% in nominal and more than a quarter in real terms (Table 19-1A). In conse-
quence, university resources not only could not keep pace with student numbers, which almost dou-
bled in the same period (Table 20A), but a rapidly widening gap between available means and teach-
ing load emerged leading to seriously and chronically overcrowded and underfinanced universities

As a consequence from the increasing scarcity of general university funds professors have been forced
into an intensified competition for external grants, to compensate at least partially their individual
losses of institutional funds. To some extent, this competition has resulted in a diversification of
sources for these project funds. Private foundations, many ministries on the federal and the state level,
industrial firms, and the EU have gained importance as sources of such funds. The Deutsche For-
schungsgemeinschaft (DFG) and the federal research ministry, however remain the two dominant
sources (Table 19A). But the strong growth of third-party-funds since the mid seventies could ease, but
not compensate the decline of general government funding for several reasons. In its 1988 report on
the situation of universities the Science Council welcomed the rise of third-party-funds as an instru-
ment for strengthening flexible priority-setting, competition and quality control in university research,
but at the same time warned that external grants neither could nor should replace adequate base fund-
ing of universities (Wissenschaftsrat 1988: 78-79).

Firstly, following the original principle of complementary support in the dual funding system program
and project grants in Germany in most cases do not cover basic cost and overheads. Thus, without
adequate base funding providing an up-to-date infrastructure and sufficient resources to formulate
grant proposals and to carry out competitive research university researchers will loose competitiveness
for the acquisition of external grants. Secondly, also industry increased its expenditure for extramural
research strongly and governments partly redistributed support from institutional to project funding
deliberately, because the latter are allocated on a competitive and temporary basis and allow thematic priority setting and a direction towards “relevant” research, the growth of third-party-funds is not unlimited as the slowdown of growth rates has shown in the nineties (Wissenschaftsrat 1996a: 46-47).

Thirdly, the Science Council regarded the growing share of earmarked program and project funding “with concern”, because it restricted the opportunities for curiosity-driven fundamental research: “without an innovative basic research and the fundamental insights and methods resulting from it applied research quickly would loose competitiveness” (Wissenschaftsrat 1988: 76). Fourthly, the administrative and time capacities of researchers to write proposals on the one and the grant committees to review proposals constitute hard constraints and bottlenecks for a functioning program and project funding (Wissenschaftsrat 1988: 78-82).

Fifthly and most important for the actual situation of university research, the scarcity of base funding has led to a race for third-party-funds turning acquisition activities partly in a zero-sum-game (Wissenschaftsrat 1996a: 46-47). To be successful in the competition for separately budgeted funds, professors have had to increase their acquisitive efforts. These efforts consist not only in writing more and more elaborate grant proposals but also include manifold activities of social networking with influential colleagues or officials from funding agencies or firms. Although professors have invested an increasing amount of time into acquisitive efforts, their chances of successful acquisition of project funds have decreased because the demand has increased more rapidly than the supply; and even if a professor is successful, he is usually granted a smaller amount of money for a shorter period of time than in earlier years. But the competition has held its grip on the professors, each one being under pressure from all others to redouble his efforts. Thus, the competition has become ruinous, individual coping with the troublesome situation has resulted in collective frustration. A growing number of professors has been unable to keep pace, and those who still do find themselves devoting more and more time and energy to an intrinsically unsatisfactory activity, becoming "professional application writers" to secure the jobs of their research assistants (Schimank 1995a: 123-175; 1995b: 68-72; 1996: 114-115).

Admittedly, to some extent this competition for separately budgeted funds has had results which fit the goals of research policy. Not only does competition make it possible to direct research activities into certain areas of societal relevance - especially by programs of project funding which specify narrow areas of research - it also improves quality of research to some extent. However, both positive effects occur only up to a certain point. When competition becomes too intense, the effects start to become negative. University research might become too strongly harnessed to extra-scientific considerations of relevance, to the detriment of curiosity-oriented basic research, which in the long run is the indispensable breeding ground of many extra-scientific uses of scientific knowledge. Quality suffers, too, if research is conducted by largely unsupervised, relatively inexperienced assistants as a consequence of professors' being absorbed by acquisitive activities, or if funding agencies neglect unconventional, risky research approaches in favor of middle-of-the-road research. The problem with such
harmful tendencies is not so much that they have definitely grown to dangerous proportions, but rather, that nobody knows for sure whether they have or not. There are no alarm signals to warn us about these tendencies, and no emergency brakes to bring them to a halt. Such a drift of university research can continue for a long time without the damage becoming visible - and when it is finally manifest, it may very well be too late to do something about it.

For university research the decline of government support had particular worse effects. According to the unity of research and teaching general university funds make no distinction between items for research and teaching. Formally this means that teaching has been affected by the resource squeeze as much as research because both activities share a common pool of general government grants. One could even expect research to be in a more advantageous position due to its access to external project funding as an additional source of income while teaching has scarcely any other resources to draw on as the institutional funding. But, with institutional funds (general + capital grants) still making up about 70% of research expenditures, both activities have been forced into a strong zero-sum competition for resources because the resource demands of teaching have grown significantly along with the enrollment and the common pool of funds has not increased. However, in cases of conflicting resource demands teaching normally takes precedence over research. The needs of the latter are more urgent in the short term, can rely on influential pressure groups and the fulfillment of teaching tasks can be easily regulated and controlled by administrative means. Teaching is usually considered the primary university mission in the eyes of the general public, particularly students and their families and interest groups such as business associations and labor unions. These groups constitute important elements of the electorate whose demands has to be paid attention by a government seeking reelection. In contrast, the negative effects of inadequate research funding are far more difficult to measure and scientists are a rather powerless, if vocal, interest group compared for example to industry. Thus, the “organizational juxtaposition” of research and teaching is “asymmetrically structured. In the framework of this arrangement concerning the available resources from institutional funding a driving out of research by teaching is always possible, but only in special circumstances a driving out of teaching by research” (Schimank 1995a: 90/89-95). Examples are the issuing of administrative regulations raising the minimum number of hours for lectures and courses of a professor158 and the determination of teaching capacities in order to ensure that a maximum number of students is admitted (ibid.: 83-89).

On this background a creeping re-dedication of budgetary and staff resources from research to teaching has taken place with the simultaneous reduction of government support and growth of student numbers since the mid seventies creating a massive resource trouble for university research.159 Now the clinging to the Humboldtian principle of an unity of research and teaching by the university profes-

---

158 While until the seventies 5-6 teaching hours per week were the rule, this number was increased to 8 hours.

159 See for a detailed study on this problem Schimank (1995a).
soriate with which they resisted a functional and organizational differentiation of research and teaching and organizational reforms strengthening performance-related and competitive resource allocation (see chapter 2.2.2.4 and below) proofed as a severe handicap first for research, but also for teaching. The declining share of institutional funding for research might have gone largely unnoticed by professors had they been preoccupied by an increasing teaching load. But this has not been the case and would have been surprising in the face of the central role which research and scholarly achievements play for professional self-perception and reputation of professors and in academic award, salary and promotion systems. Instead, most professors have succeeded in neutralizing the time pressure of an increasing teaching load - by reducing the quality of teaching, standardizing teaching and examinations, and informally delegating teaching duties to assistants. As a consequence, they have almost all continued to need resources for research leading to the race for external grants described above. In 1996, the Science Council put the situation of university research through underfunding and teaching obligations in rather unusually open words:

“The inadequate funding and the pushing back of research through the increased demands on teaching which can be observed in mass disciplines and at mass universities endanger in the meantime the productivity of research in many universities ... Gaps in the resources for teaching are more and more covered by third-party-funds for research. The Science Council regards the maintenance of base funding and an improvement of research funding as essential in order to ensure the research ability of universities and to preserve its fundamental role in the research system. Otherwise universities will loose their competitiveness on the market for external grants and the competition for qualified younger scientists.” (Wissenschaftsrat 1996a: 31).

5.1.2 University reform: the never-ending story

On the background of the situation of university research and the emphasis still given to research as an integral mission of universities it is not surprising the eighties and nineties witnessed a continuous reform debate and a proliferation of concepts and proposals how to remedy the university malaise. In the political arena, however, the crisis symptoms created by overcrowded and underfinanced universities have led to radically different viewpoints (Schimank 1995b). The university side, represented mainly by the conference of university rectors and the association of university professors (Deutscher Hochschullehrerverband) clung more or less to the, idealized, model of the classical Humboldtian university that means the restoration of conditions which would allow them again to concentrate on research and research-based “scientific studies” (Lundgreen 1997). According the universities have demanded time and again compensation for the resource cuts referring to the obligation to admit

---

160 This position is documented in a programmatic report of the rector conference on the “future of universities” (WRK 1988) which critical commentators regard rather as an example for the conservati-
and train a permanently rising number of students. This would have meant huge increases primarily of institutional funds. In 1992, for instance, the rectors’ conference estimated that about 30 000 additional established posts for personnel were needed to restore approximately the situation of the mid-seventies (HRK 1992: 14). To governments, however, the causes for the structural problems of universities appeared in a rather different light. The state ministries of culture saw the reasons for the university malaise mainly in the inability of universities to adapt themselves to new realities, not in the scarcity of resources.

Government actors criticized especially two things. Firstly, the ongoing resistance of universities against reform concept leading to a functional and organizational differentiation of research and teaching on the one and practical “basic studies” for all students and selective and theoretical “graduate studies on the other hand within the universities. The Science Council propagates such a model since the sixties referring to the positive experiences in other countries like the US, but to not much avail (see chapter 2.2.2.4). A majority of professors fears to be degraded to mere advanced teachers loosening the prestige and privileges linked to research. Since only a few universities and professor can be rather sure to belong to the winners a powerful and stable coalition of potential losers has blocked the implementation of the council’s reform proposals (Lundgreen 1997). Secondly, partly as a justification of stagnating science budgets, partly as a response to a perceived lack of innovation and quality in PSR the new approach to research policy in the eighties presumed a considerable level of futile and mediocre research in universities. In consequence politicians emphasized a more effective and efficient use of existing resources (chapter 3.3).

For these reasons, governments have not been willing to listen to the pleas of universities for more resources. Moreover, their hands tied by fiscal constraints, government actors have not only been unwilling, but also unable to compensate the universities for the budget cuts. Instead, politicians have favored a redistribution of the reduced resources to those professors whose work is either of high scientific quality or of high societal relevance. In time, this may have amounted to a gradual elimination of the unity of research and teaching - a prospect government actors are well aware of, and one which they welcome.

“The idea that all universities are equal with regard to research, is already today a fiction. Such an idea can no longer be the basis for future research policy. Instead a differentiation of funding based on quality standards ... is necessary. This could lead to a dynamic process of differentiation among universities with higher research intensity, quality and better funding on the one and universities with lower research intensity and funding on the other hand.” (Wissenschaftstrat 1996a: 32).
Here we encounter two intertwined problems related to the problems of general university funding and a structural university reform. The first one are the internal procedures and criteria according to which budget proposals are drawn up and resources are allocated by the universities. Here, the Framework Act on Higher Education leaves the responsible university body wide flexibility. In reality, however, budgets are mainly allocated according to formal quantitative criteria - number of students, graduates or scientific staff -, different disciplinary costs of research and teaching and most important historically grown spending patterns. Which aspect dominates varies from state to state and university to university (Flitner 1990: 82-83; Karpen (Ed.) 1989). In general, however, one can say that the “law of mutual restraint” governs decision-making on resources within universities. This follows from two principles of the Humboldtian university: the professorial autonomy concerning research and collegial rule of professors at the departmental and university level: “The de facto used rule of allocation for the government block grants is to preserve the existing resource distribution … Each department and each professor receives the same as in the last year. … Increases the institutional funding all departments and professors participate proportionally. The share in the gains corresponds to the share in the status quo. The same applies for losses.” (Schimank 1995: 64).

This deficit of self-regulation is caused by the very high institutionalized autonomy each individual professor enjoys in Germany. Professors can choose their research topics and the type of research they wish to pursue entirely on their own. No hierarchical guidance from the state, or even from the university leadership is possible in this respect. As a consequence, professors have the opportunity to devote their attention totally to scientific curiosity and to disregard societal relevance completely. What’s more, nobody can force a professor to do research at all. There is no requirement to present any research results. A professor may declare as long as he wants that his present research is still "in progress". This autonomy is mutually respected within a department or among departments. Traditionally, relations among professors are deeply permeated by a strong mutual attitude of cooperativeness. One consequence of this is that professors, in collective decision-making about resource allocation, usually refrain from challenging the status quo of resource distribution as it has emerged from the past. This prevalent orientation towards each other is established as an informal norm, but can be attributed to quite rational deliberations (see chapter 2.2.2.4) bringing about a mutual non-aggression pact which disappoints government actors’ hopes for redistributing of institutional funds.

This “intra-university blockade of redistribution” is regarded as one of the central structural deficits and problems of German universities for two reasons. Firstly, it prevents a flexible allocation of resources to disciplines and research areas and departments and university teachers according to needs, promise and quality. In addition, “profile formation”, that means resource concentration on research areas where individual universities have competitive advantages, is made extremely difficult under
these conditions. By now this is mainly realized through the Collaborative Research Centers (SFB) of the DFG, that is from the outside and with additional financial incentives. Secondly, the inability for redistribution gives governments a pretext to deflect from the underfinancing of universities and subject them to external guidance and control. Thus, a very stable mutual blockade between universities and government actors has occurred. Each side refuses to do what the other wants it to do - with resulting frustration on both sides. For the research conditions at German universities this means that almost everybody has been worse off.

This highly unsatisfactory situation has inspired many discussions about the governance structure of universities in general, and university research in particular. Traditionally, the German university system is characterized up to the present day by a combination of undisputed alimentation and control by the state, on the one hand, and a simultaneous respect of the “freedom of teaching and research” which is even constitutionally granted. In legal terms, this amounts to a dual nature of universities as institutions of public law as well as autonomous corporations (Kimminich 1996). Accordingly, Clark (1983: 140) portrays the German university system with respect to its dominant mechanisms of problem processing as a combination of political guidance by the state and self-regulation of academic oligarchies. In this division of labor, state authorities quite often confine themselves to a provision of certain prerequisites of academic self-regulation, or simply ratify and formalize legally the outcomes of this other mechanism of problem processing.

In other respects, however, state authorities do intervene in university affairs quite extensively according to their genuine own aims and interests. German universities traditionally have been subject to tight administrative and financial state control (Brinkmann 1998: 58-77). With respect to their so-called “external matters” universities are regarded as parts of the public administration, the chancellor as chief administrator of a university being the personification of this side of the coin. More specifically, within German federalism a university belongs to the administration of the state where it is located and is financed by it. All financial and personnel issues are, in this understanding, “external matters”. The procurement and use of these two most important resources for teaching and research is highly regulated and controlled by state authorities. Universities each year apply for a certain amount of institutional funds; but the respective ministry decides what they get. Budgets list in detail how much money will be spend on a multiplicity of specific items. Normally a transfer of resources among these items or a carrying over of means from one year to another is not possible. This bureaucratic straitjacket extends to the number, kind, and organizational allocation of established posts. Final authority on the appointment of professors and thus faculty composition lays with the state ministries of culture. Faculties are involved in recruitment by proposing a ranking list of three candidates for a vacant chair to the ministry and normally the ministries keep to this list. But when negotiations with a

\[161\] This does not mean that they all choose to do so. Many professors, for various reasons, voluntarily take
candidate are unsuccessful or the ministry pursues own objectives it can and does disregard faculty proposals. Basic organizational decisions, such as the establishment or elimination of universities, departments, or professorships are also finally decided by the state. The same applies to decision-making rules and procedures within universities, especially to the competencies of rectors, deans, and the university senate, and to the rights of participation of the four status groups within universities (professors, scientific workers, non-scientific employees, and students).

In contrast, issues of teaching and research are regarded as “internal matters” of universities. Concerning these matters, the state refrains very much from political guidance – the more so the more decisions are substantially based on specialized scientific knowledge. With regard to teaching such decisions concern the selection and presentation of scientific knowledge to students and the assessment of students’ performance; concerning research the selection of research topics, methodological and theoretical approaches, and the critical discussion of research results are “internal matters”. Here, state authorities leave much room for academic self-regulation. Nevertheless, some kinds of political guidance is clearly visible. Requirements of studies and examinations must be approved by the state; teaching duties of professors and other scientists are also decided upon by the ministry. In contrast, research was and still is much less regulated politically. By now, the recent law on genetic research which prohibits certain research topics and methods is an exception. But this may change in future if more and more research fields leave the containment of the laboratory and create actual or possible risks to society (Krohn/Weyer 1990). In addition, research at universities is affected by stricter general legal regulations of safety at work or a more extensive legal protection of privacy. Finally, it is an important political intervention in “internal affairs” of the university, too, that – as already mentioned – the appointment of a professor needs the approval of the ministry.

Still, it can be concluded that “internal matters” of university research are subjected only to a rather loose political regulation. However, this does not necessarily mean that political decisions do not shape research conditions. By a tight legal regulation of “external matters”, that is financial, personnel, and organizational issues, state authorities may strongly, although perhaps unknowingly impede university research (Meusel 1977). Legal stipulations which apply to the whole public sector, and which may very well be quite fitting to many public administrations, may have highly dysfunctional side-effects in universities. Many observers maintain that such phenomena constitute the most serious negative consequences of political guidance for research at universities. All this must be seen against the background of strong pressures towards “homogeneity” of political regulation. All universities of a particular state are dealt with by their ministry according to the same legal rules. Moreover, this standardization of regulation extends beyond one state to all of them as a result of the framework law of the federal government and the coordination of states in the Standing Conference of the Ministers for societal relevance into consideration when designing their research.
Cultural Affairs. In contrast to the nineteenth century, when the plurality of independent German states brought about a vigorous and innovative competition especially in higher education policy (Ben-David/Zloczower 1962: 132), the present situation amounts basically to institutional immobility.

From this sketch of political regulation by state authorities two directions can be deduced where current debates in Germany search for institutional innovations. Burton Clark’s study on the organization of higher education systems has developed “a triangular model of state, market, and oligarchical forms of coordination” which through mutual influence or, in the light of German experience, blockade propel the higher education system on a specific development path (Clark 1983: chapter 5; Brinckmann 1998: ). Taking these three “ideal types” of university guidance - to which in our view a fourth type, hierarchical self-government by university management has to be added (see below) - as an analytical tool governments try to move German universities from the poles of “state authority” and “academic oligarchy” into the direction of “market” mechanisms and professional university management (Clark 1983: chapter 5). “Deregulation” and “differentiation” of the German university system are frequently used keywords in such debates. State authorities try to reduce what appears as an over-regulation of universities and attempt to abandon with too much regulatory standardization. A far-reaching proposal in this respect concerns the introduction of an “experimental clause” into the framework law. This clause would allow each state to suspend particular regulations of the federal law in favor of temporary institutional experiments. On the state level, too, political authorities want to enlarge their universities’ room to maneuver so that they are enabled to work out their own particular teaching and research profile in competition with each other. Such a competitive federalism lifting the “Procrustean bed” of national standards and regulations in higher education is seen as a necessary prerequisite for the starting and diffusing of innovative university reforms analogue to the spread of the Prussian university reforms in the 19th century where other states had to take over the Prussian model to stay competitive.

higher education policy.

Under the twin pressure of ever scarcer resources and impending external action by reform-oriented governments which exerted pressure on universities to move themselves, some cautious reform steps have been started in recent years and the former incompatibility of viewpoints between governments and professors has been defused somewhat, but not enough to allow for effective compromises necessary for bold reform steps. Meanwhile, both sides agree that the universities need “more money” as well as “substantial reforms”. But this is a rather superficial and fragile consensus. Both sides still assess the situation quite differently. While the universities want “much more money” vaguely promising “some reforms later on” in return, government actors insist on “fundamental reforms now” and offer “some money afterwards”. To make matters worse, neither side is willing to make the first move because they doubt each others` ability and willingness to deliver the agreed-upon return. The universities, on the one hand, have had no effective leverage to press for a fulfillment of such demands. Therefore, they can only try to persuade government using normative or utilitarian arguments. Gov-
ernment actors, on the other hand, have also been unable to achieve their goals. Their realization would have required a substantial capacity for self-regulation within the universities which are needed as implementation agents of the redistributive research policy. But it is this very capacity that universities so sorely lack. In consequence, the blockade and failure of reform initiatives is still omnipresent.

The deregulation policies on which the German reform debate presently concentrates have two main aspects. One consists in granting universities a higher financial autonomy than before. This took up the critic and reform proposals of the Science Council which blamed the administrative and financial regulation of universities as a main cause of their crisis by suffocating own initiative and flexible reaction towards changing scientific or social needs and challenges (Wissenschaftsrat 1993c: 41-45). In model projects at several universities, the traditional highly restrictive administrative budgeting system has been substituted by a “global” university budgets in the form of non-earmarked block grants (Wissenschaftsrat 1993c: 41-45; Brinckmann 1998: 146-152). Global budgets allow the substitution of budget items and the carrying forward of unspent funds to the next year. Additionally, structural and research planning and the corresponding resource allocation to disciplines, research areas, departments and chairs largely is delegated to the universities. This will give them considerably more flexibility in financial matters, so they can work more efficiently and more effectively. If this turns out to be successful, all universities will get a “global” budget in future.

The other kind of deregulation policy refers to university law in general, especially the framework law of the federal government. It is discussed under the term “process autonomy” giving universities autonomy in as many daily matters as possible, but even intensifying long-term political “goal direction” of universities. State authorities promise to reduce their involvement in the “external matters” of universities, that means personnel and organizational matters. Concerning “internal matters” the same is discussed with respect to regulations of studies and examinations. Especially the federal government hopes that “deregulation” will also lead to a stronger “differentiation” of the university system. Many political regulations at the federal level shall be reduced to make possible more competition between the higher education policies of the states. All this means that political guidance by state authorities shall be considerably substituted by market-oriented mechanisms – which we will deal with in the following. But the claim to political guidance is not given up. Rather, instead of losing themselves in procedural trivialities, political actors should become more active in negotiating with each university its general mission within a diversified university system. This is the well-known strategy of “management by objectives”. It works to the degree that operational goals are formulated and agreed upon by universities and governments, and the attainment of these goals is controlled by the latter. At present, German politicians and ministries confront universities with a wide variety of diffuse goals which conflict with each other and change often and unpredictable. This amounts to nothing more than

162 See for a detailed study of the discussed concepts Brinckmann (1998)
“symbolic politics” which allows government actors to blame universities for neglecting whatever is politically fashionable at the moment. Thus, politicians and ministries can continue their “university bashing” which diverts attention from their own mistakes in higher education policy.

But to make universities more innovative and productive not only a radical abolition of state authority is deemed necessary, but also a fundamental reform of the second governance structure predominant in German universities, namely academic oligarchy institutionalized in the autonomy and collegial rule of professors. At present, German universities are still chair-based organizations. With often hundreds of chair-holders at each university, the overall structure of the German university system looks like “small monopolies in thousands of parts” (Clark 1983: 140). A professorship is academically based because the appointment to it is a step in an academic career in which the respective person has gone through a long socialization in the respective scientific community, has gained scientific reputation for his research work, and has passed the habilitation as the final formal examination after diploma and doctorate. The oligarchic character of academic self-regulation within universities is the consequence of this career pattern: Professors are the dominant status group within German universities, the various kinds of scientific workers and non-scientific employees as well as the students being in clearly subordinate positions. Reform efforts to break this professorial dominance have been largely unsuccessful up to now (see chapter 2.2.2.4).163

With each professorship as a highly sovereign organizational unit, academic self regulation is very decentralized. With their constitutionally granted academic “freedom of teaching and research”, professors are similar to small businessmen with a number of subordinates. But as civil servants, professors enjoy also the respective rights, especially the right that they cannot be dismissed. Thus, to put it in a nutshell, professors are small businessmen who cannot go bankrupt – which is an important restriction of all kinds of competitive pressure to be discussed later. From the point of view of each professor, the university as a whole and the respective department to which he belongs is a local corporation of academic colleagues – the other professors – among whom a basic equality of rights and opportunities exists. This character of the university as a corporation manifests itself in the specific character of academic self-regulation which is respected by the state authorities. As a mode of collective decision-making, self-regulation – as already mentioned - installs for all professors a direct participation of those affected by decisions in the making of these decisions.164 No strong hierarchy exists. University leaders – rectors and deans – cannot disregard the majority of the professors.

---

163 In most of the old universities, chair-holders differentiate themselves markedly from other professors whereas in the new universities founded during the sixties and early seventies this distinction has lost much of its importance.

164 In the seventies, the other status groups gained some rights of participation, too. But the dominant position of the professors has been maintained.
Since academic self-regulation among professors shows a marked tendency to preserve the organizational status quo, especially state authorities have criticized this for a long time as the universities’ inability to reform themselves – for example, to reallocate resources according to performance criteria of demand, quality, or relevance (see above). Thus for governments and Science Council a precondition for granting universities such far-reaching autonomy is the professionalization and strengthening of university management and the establishment of evaluation systems for research and teaching in order to ensure the departure from status quo thinking dominating the collegial rule of professors and the acceptance of winners and losers (Wissenschaftsrat 1993c; 1996a; Schimank 1995b).

The two kinds of institutional mechanisms of problem processing of the German university system which we discussed up to this point show obvious deficiencies. In this general assessment everybody agrees. Different groups of actors disagree, however, about where the deficiencies are mainly located. For political actors, oligarchic academic self-regulation is the primary problem, although they admit that problems of political regulation exist, too. Professors, on the contrary, emphasize political regulation and the scarcity of resources as the major problems and often do not see any serious weaknesses of oligarchic academic self-regulation. Student, and many rectors and deans as well, perceive both kinds of institutional mechanisms of problem processing as highly deficient. These different perspectives obviously do not make it easier to reach and implement decisions about necessary reforms. Whereas professors, on the one hand, and political actors, on the other, again and again have run into embittered confrontations with each other, students have mostly turned against both sides. Similarly, those rectors and deans who are engaged in reform initiatives feel also to be lonely fighters without much support from either political actors or professors.

We have already mentioned several times that the search for ways to overcome these deficiencies of problem processing now often turns to the two other kinds of organizational mechanisms relevant for universities: “more market!”, meaning higher competitive pressure on universities, and “stronger leadership!”, meaning more professional and hierarchical self-governance. Both suggestions are often seen in tight connection. Only higher competitive pressure, culminating in threats to organizational or departmental survival, could strengthen university leadership against the non-aggression pacts of academic self-regulation; and only by rigorous leadership which builds up a strong “corporate identity” a university could realize competitiveness. Both arguments are partly influenced by a look at the American higher education system which is seen, firstly, as being very successful and, secondly, as being characterized by a dominance of exactly this combination of high competitive pressure and strong university leadership. In addition, both arguments are combined as inseparable key elements of a general debate on administrative modernization discussed under the catchword of “new public management” (Brinckmann 1998: 98-101; Naschold/Bogumil 1998). With this general perspective on the present German initiatives and debates, we can now take a closer look, firstly, at the competition for resources and customers as an institutional mechanism of problem processing.
Competition is generally rather weak in the German university system, compared especially to the American system. First of all, German universities do not compete for students as their principal customers. A student’s decision to study at a particular university is not much influenced by information about that university’s relative quality and special profile in the selected study. For decades, under the prevailing rule of “homogeneity” both in funding and with regard to the content and structure of study courses German universities and their departments could not much distinguish themselves in comparison to others by excellent teaching and innovative studies. It remains to be seen whether this will be changed by the current move towards “differentiation” – if it starts at all. At least, initiatives in this direction (Wissenschaftsrat 1996a: 31-32) are now supported by the Rectors Conference (HRK).

In other respects competition is limited by political regulation (see above). To be sure, universities do compete to a certain extent for the best professors. Universities try to attract professors by personally dedicated resources from their institutional funds. But the standardization of teaching duties does not allow universities to attract excellent researchers by a reduced teaching load. Moreover, in spite of the described intense political regulation and control of universities, government actors by now have not gone very far in the direction of a regular and comprehensive evaluation of teaching and research performance. It is not to be expected that evaluation exercises like the ones that took place in Great Britain will be installed in Germany in the near future. There is nothing more than a variety of fragmented activities and approaches going on in the different states and universities. This means that information on relative performance as a crucial precondition for a competitive allocation of resources to universities, departments, or individual professors is relatively vague and incomplete.

The degree to which competitive pressure exists at all, it is stronger in research than in teaching. The amount of resources a professor has for research depends significantly on his previous research performance. Firstly, his personally dedicated institutional funds vary significantly with his research achievements because these resources are allocated with his appointment, and research performance de facto is more important in appointment decisions than teaching abilities. Consequently, an excellent researcher can apply for other professorships from time to time to increase his personally dedicated funds. However, this competitive mechanism is limited because the personal dedication of funds is irreversible so that these resources cannot be reduced if a professor’s performance declines. Recently all state ministers decided to change this and award these personally dedicated funds only temporarily in the future. This will increase the competitive pressure in this respect.

A more ambivalent measure to deal with the lack of competition and flexibility in university research has been the setting up of strategic funds by the Länder. These funds pool financial means and staff positions freed if a chair holder retired or moved to another university165 and are used to provide par-

---

165 In Germany a newly appointed professor or a professor having received a “call” from another university conducts so-called “staying negotiations” (Bleibeverhandlungen) with the responsible state ministry of culture. This follows from the fact that universities are state institutions and it is the mi-
particular innovative and productive departments and researchers with additional infrastructure and resources on a temporary basis. In 1994, already about 10% of all professorial positions have been financed in this way (Künzel 1997: 170-171). However, in contrast to the declared policy objective to reduce state authority in favor of competition the ministries of culture have reserved management of these funds to themselves and not to universities and employ them often not only as an instrument for promoting research quality, but also a direction of teaching and research capacities according to political or economic priorities (Schimank 1995b: 72-75). For this reason, the universities can denounce the strategic funds as an undue increase of state interference, although the establishment and expansion of the strategic funds mainly was motivated by the inability of universities for priority setting and resource redistribution. The corresponding demand to transfer the fund management to universities is supported by the Science Council. But the council also has recommended to make such university-controlled funds the normal instrument for resource allocation in universities leaving professors only a guaranteed minimum level of budgetary and staff resources, but also infrastructure and to make the level of additional means dependent on regular evaluations (Wissenschaftsrat 1996a: 32).

Secondly, and more important, resources for research at universities are often separately budgeted funds for specific research projects. Since the demand for separately budgeted funds has increased faster than supply, provisions of these funds can guide university research quite effectively in several respects. Project funding may promote high quality research and discourage or eliminate mediocre or worse research. This criterion is dominant with the DFG. In contrast, by giving priority to the criterion of extra-scientific relevance, research activities may be promoted which deal with topics of interest to particular users of research results, be it industry, the health care system, or the military. This criterion dominates contract research, but also the research promotion of the ministries or the European Community.

Competitive pressure will probably increase within the German university system during the next years. However, it seems highly improbable that an increased competitive pressure on German universities, even if reinforced by deliberate policies of “differentiation”, will bring about evolutionary what is perhaps the most important feature of the American university system: a “differentiation” in more teaching-oriented and more research-oriented universities, departments, or professorships. Some observers think that a realization of this “differentiation” may be crucial for the German university system’s ability to meet present and future challenges. Only this “differentiation” could give research-

---

166 For example, between 1975 and 1990 universities could reallocate only about 5% of positions compared to 15% enforced by the state ministries (Schimank 1995b: 74).
oriented professors a chance to do good research work despite ever-growing numbers of students; and simultaneously, good teaching could be institutionally promoted and rewarded. Thus, in contradiction to Humbold’s celebrated principle of the “unity of teaching and research”, under conditions of a “mass university” both of its tasks could profit from their stronger separation from each other. Sticking too long to Humboldt’s principle it seems has led to a significant worsening of both teaching and research conditions and a fatal reform immobilism in the German university system.

While political guidance, academic self-regulation, and competitive pressure are three kinds of approaches to problem-solving which influence universities completely or mainly from outside. In contrast, the fourth kind of mechanisms which we shall deal with now, hierarchical self-government by a professional university management, is clearly an internal one. Especially American universities which serve as a reference point in this debate have given wide influence to institutional entrepreneurship of university leaders compared to their German counterparts.

As leaders who might enact hierarchical organizational self-guidance at German universities rectors and deans come into view. We already mentioned that their decision-making competencies are rather limited by the formal majority rules and informal non-aggression pacts of academic self-regulation. In addition, they are elected for specific terms by their professorial colleagues and the deanship often rotates among the full professors of a faculty. In this respect, Clark (1983: 140) notes very accurately that German universities show a self-contradictory organizational structure “... since chair power fragments the formal structure”. Leaders do not have effective power to put through decisions against the professors, especially the chair-holders as the dominant status group. This weakness of leadership was a deliberate feature for a long time. It secured the high autonomy of individual professors. Accordingly, rectors and deans stay in office only for a short period of time so that they have not much opportunity to become experienced leaders. The attractiveness of these positions is also low. Whoever is elected by his colleagues understands himself as a “primus inter pares” who has no legitimate right to rule over them, even if legal rights may exist. Thus, rectors and deans usually remain bounded by the logic of “cooperativeness”. All this means that university leadership cannot free itself from oligarchic academic self-regulation. It is more just another expression of it and consequently cannot overcome its deficiencies.

167 State authorities are outside actors, customers and providers of resources as well, and scientific communities, too. It is true that universities as organizations provide professorships as places to work. However, scientific discussions in which someone gains his reputation transcend the organizational boundaries of departments or universities. See in this respect Robert K. Merton’s (1949) distinction between “locals” and “cosmopolitans” and Niklas Luhmann’s (1990: 672-680) observation that careers in science are no intra-organizational careers. In Germany this is underlined by the stipulation that no one shall get his first appointment to a professorship in the same department where he passed his habilitation.

168 The more surprising it is that Clark’s initial typology of mechanisms of problem processing neglected this fourth kind of mechanism.
A closer look at American universities shows the conditions for hierarchical self-guidance to become an independent mechanism of problem processing. Three conditions are crucial for such a “professionalization” of university leadership. Firstly, rectors and deans must have an authority independent from the vote of the professors in their university or department. These leaders may need the formal approval of their professors but must be selected by other actors – for instance, a university board. Secondly, the rector or dean must have genuine competencies. He must be able to overrule the majority of the professors and to sanction effectively individual professors positively or negatively. Thirdly, the period of office of a rector or dean must be long enough to give him a chance to gather experience and implement “visions”. In addition, such leadership positions must be installed as new career paths within and between universities. Only if all these conditions are fulfilled, leaders within the German university system could “emancipate” themselves from oligarchic academic self-regulation. But only disconnected and very cautious initiatives for institutional innovations in this direction can be discerned, most of which seem to be doomed to fail. For example, in some states the periods of office of rectors and deans were prolonged, and new tasks were added to their responsibilities, but without giving them more power. Such half-hearted measures will only increase the unattractiveness of these positions. An actual example, that faculties and departments are not willing to give up their powers to centralized hierarchical guidance is the university of Heidelberg where the rector (sic!) has turned against a new university law transferring research planning and resource allocation to a considerable extent from faculties to university management.

Another institutional mechanism which might improve hierarchical control are so-called university boards (Hochschulräte) whose establishment is currently debated (Brinckmann 1998: 108-110). As members of these boards government actors have in mind eminent personalities from industry, politics, and other societal sectors. Possible competencies of the boards could include the overall monitoring and evaluation of a university’s performance and a number of rights of approval – most importantly with respect to the university statute, the establishment or closure of departments, the establishment or removal of particular professorships, and the recruitment of professors. All these are competencies which by now the respective state ministry possesses. This may suggest a sceptical view on university boards. If they simply shall do what the ministry did before, how can one expect them to do better? Still, some proponents of university boards hope that a delegation of these competencies to such a new actor might lead to a more intense confrontation of universities with the perspectives of the users of their services. But again, whether a university board can work as an effective counter-power against the prevailing “cooperativeness” among professors, especially in matters of resource allocation, is an open question. In this respect it would be crucial that the board has the right to approve the annual university budget on a detailed basis, including the right to change particular budgetary items proposed by the decision-making bodies of the university. But until now at least, such a far-reaching competency of university boards is rarely discussed.
It is clear that this fourth kind of institutional mechanisms of problem processing traditionally is the weakest one in the German university system, and there are no indications that this will change significantly. The danger which could arise might be that under these circumstances a successful increase of competitive pressure would not bring about desirable organizational reforms and the building up of a corporate identity of universities. Instead, oligarchic academic self-regulation might run out of control into numerous battles for survival of everybody against everybody. These battles will be even harder because no professor can be dismissed. This unlimited job security is certainly good from the point of view of each professor; but it limits sharply the possibilities of changing the German university system. Still, universities, departments, and individual professors could be played off one against others by state authorities with “divide et impera” strategies. In this way, with an ongoing weak university leadership the potential positive effects of more competition would turn to the negative.

To sum up these reflections on the governance structure of the German university system, it is probable that future development could lead into a situation of increased competitive pressure without a strengthened university leadership. This would overcome immobilism, but by erratic changes which might be no improvement at all. Thus, although the symptoms and causes of the university crisis have been noted by many observers time and again and the main elements for remedying this crisis are well known and have been successfully tested in other countries the snail’s pace of German university reforms reveals once more the considerable risk of mutual blockade built into German PSR arrangements which provide a multiplicity of autonomous actors with strong veto positions against reforms threatening to have negative effects (Mittelsträßer 1996; Ash (Ed.) 1997). This is reflected in the Science Council’s comments on the progress of university reform. In 1988, it had to observe that it recommended the same reform measures than ten years ago, because in most Länder these recommendations had not been implemented to any significant extent (Wissenschaftsrat 1988: 85). In the mid nineties the overall picture has not much changed, although one should not underestimate the diffusion and impact of local reform activities, especially if the objective to give individual states more autonomy in higher education policy will be implemented. Again the Science Council notices that for an evaluation of research quality at universities “no established procedures and criteria exist” and that the “strengthening of university management and deans” has not been realized (Wissenschaftsrat 1993c: 37-55; 1996a: 45-46). But as we have seen these are the two crucial prerequisites for granting universities more autonomy.

A not very encouraging sign for more radical reform steps in the nearby future has been the reconstruction of East German universities. Although the situation of teaching and research at West German universities was regarded as highly unsatisfactory by both the universities themselves as well as for government actors, the basic institutional structures were unhesitatingly transferred almost unaltered to the former GDR after reunification (Mayntz 1994b; Ash 1997). The opportunity to avoid some of the generally acknowledged structural defects of West German universities in the rebuilding of East Ger-
man universities was missed - mainly because quick decisions were necessary, but also because government anticipated the resistance of West German universities against any real reform models in the East. And since the goodwill and support of West German universities and professors was essential for the rebuilding of East German universities, this anticipation sufficed to induce government to give in to a very undesirable extension of the mutual blockade.\textsuperscript{169} This is not to say, that no innovations took place at Eastern universities which could serve as a starting point for similar reforms in the West. Examples are the higher number and greater student share of Fachhochschulen in the new compared to the old Länder, the founding of centers for interdisciplinary research and closer collaboration between universities and non-university institutes. In addition, student-faculty ratios are more favorable (Ash 1997). But these innovative elements often came about rather coincidentally or have been threatened by budget cuts and reform opponents. For example, the stronger role of Fachhochschulen owes much to the fact that in the GDR a large sector of specialized professional schools existed which could neither easily integrated into universities nor dissolved. Their transformation in Fachhochschulen suited both universities and governments. The former could preserve their privileged position as “scientific universities” manifested in the fact that they mobilized determined resistance against leaving the former specialized schools the right to award the doctorate which they had in the GDR. The latter could strengthen vocational short-term study courses a policy objective pursued in the West since the sixties.

The fate of six interdisciplinary “centers for the humanities” is also a striking example for the problems of university reforms. These institutional innovations, recommended by the Science Council, should serve as model for a new kind of research-focused university institutes in the social sciences, where disciplinary fragmentation and uncoordinated individual research is particularly prevalent, concentrating resources on research around a certain topic or research problem regardless of disciplinary boundaries. For financial reasons the centers were at first administrated and financed by the Max-Planck-Society. But their transfer into universities after the MPG-funding terminated in 1996 proofed difficult and was only partly successful. The more favorable student-teacher ratios seem also to be a rather temporary phenomenon due to the fall in new enrollments of East German students in the aftermath of the economic and social crisis following reunification and the reluctance of West German student to go East. In the meanwhile, however, both trends have been partly reserved. Moreover, although lack of teaching staff is seen as one of the major deficits of West German universities, their East German counterparts were regarded as highly overstaffed and staff positions were sharply reduced. Here, also the interests of West German professors and East German cultural ministries, often led by politicians and bureaucrats from the West, converged. A characteristic feature of Eastern faculties was the high number of non-professorial teaching staff (Mittelbau) which did not work on a doctoral or ha-

\textsuperscript{169} See the very critical account of the former president of the Science Council during the reunification process, Simon, Dieter: “Dompteur im Zoo der Forschungslobby” In: \textit{Frankfurter Allgemeine Zeitung} vom 30.12.1991.
bilitation thesis, but concentrated on teaching. This posed a clear threat to the dominance of the professors which in the old Federal Republic had been successful campaigned to reduce or even abolish these staff category arguing that it consisted largely of mediocre academics which was not qualified enough to reach a professorship. Although this was partly true to the massive expansion of teaching staff in the sixties and seventies, at least equally important for the opposition of professors was the fear that a numerous group of mere teaching staff at the lower faculty level could develop setting a precedence for a similar functional differentiation at the professorial level. For governments the arguments of the academic establishment provided a welcome justification for financially motivated shedding of university staff which affected the Mittelbau far more severe than professors irrespective of often positive personal evaluations (Ash 1997: 99-107).

5.2 The relationship between university and non-university research

The discussed problems of the university sector have had also consequences for its positioning relative to the other sub-sector of PSR. As was already mentioned non-university research organizations officially stand in a subsidiary relation to universities. But this formal precedence is no longer reflected in quantitative terms. In 1989, universities accounted for 57% of total expenditure on R&D and 60% of total R&D staff in the public sector. With unification a temporary improvement of the relative weight took place, but in the mid nineties the university shares in R&D resources are again declining (Table 9-10A). The phenomenon of a gradual moving out of research from universities to specialized research institutes outside can be observed since the end of the nineteenth century, but has accelerated in the post-war period (see chapter two). Although this shift of weight from university to non-university research was not as dramatic to speak of a general “emigration of research” out of universities, it has been a constant source of concern for university representatives and the Science Council. It is seen as an indicator for a loss of attractiveness and competitiveness of universities as places for research. One could take the position that the organizational separation of research and teaching would be in the long term benefit of both viewing the problems of the Humboldtian university in times of mass higher education (see 6.1). But this view is not even shared by German governments propagating a two-stage model of university studies in which the unity of research and teaching is restricted on advanced graduate studies similar to the graduate schools in the US. Close contacts between both functions are seen as necessary to hold university teachers up to date and the training of younger scientists which can only be ensure if professors is given ample room for research. The Science Council has identified three main factors responsible for the growth of non-university research at the expense of universities (Wissenschaftsrat 1988: 70-71):

---

170 One has to take into account that the official data systematically overestimate the share of R&D spending in the university budgets (see above).
• the worsening of research conditions at universities due to the crisis of university funding and student overcrowding leaving less and less time and resources for research (see 6.1.2). Non-university institutes often can offer a better research infrastructure. In addition, most of them still enjoy a rather high level of institutional funding making researchers less dependent on the competition for and acquisition of external grants. But the most important fact making extra-university facilities attractive for scientists is are completely or largely freed from teaching, but also more favorable research conditions since their scientists are less dependent on the acquisition of grants and less burdened with teaching duties (Wissenschaftsrat 1988: 76-77/88-89).

• the increasing scientification of industry and public policies leading to the founding of mission- and application-oriented research institutions. Due to their concentration on fundamental research, teaching obligations and right to academic self-government universities often are regarded by governments and industry as unsuited for taking over these tasks (Wissenschaftsrat 1975: 83-85).

• the structural problems of universities to concentrate infrastructure and resources on specific research areas. Often German universities are unable to provide the organizational prerequisites and the critical mass for carrying out complex large-scale research or to operate large-scale installations (Wissenschaftsrat 1988: 70).

• To these three factors one should add a fourth one already mentioned several times: the financial attractiveness of non-university solutions for the Länder following from the cost sharing arrangements with the central government in extra-university research.

On the background of these developments the Science Council warned to equate the stronger expansion of the non-university sector in the post-war period with a general “emigration of research” out of the universities. On the one and, universities have been able, if to an insufficient degree, “to strengthen dynamic research areas and to take up new areas largely from the stock of existing resources and without setting up new institutes” (Wissenschaftsrat 1988: 70). On the other hand, the council sees the mission of universities in basic research on a broad disciplinary basis and not for mission-oriented research. But the Science Council has also repeatedly expressed its concern about two developments which could lead in the long-term to a serious weakening of university with regard to extra-university research. Firstly, that especially innovative and expanding research areas with an applied character are primarily located outside universities and, secondly, that the linkage between research and teaching is loosened, “because institutes specialized on research work outside universities and within universities the resources are lacking for offering scientists competitive research conditions.” (Wissenschaftsrat 1988: 71). Accordingly, universities and Science Council demand since the mid seventies, when the crisis of university funding set in, that before an extra-university research institutes is founded, an assessment should take place, “if the planned research could not also be performed at universities.” (Wissenschaftsrat 1988: 71; 1975a: 87). Moreover, in regular intervals an evaluation of non-university
institutes shall take place to find out how the cooperation with universities could be improved and if their research tasks could not be reintegrated into universities (ibid.).

Since the end of the eighties, the universities and the rectors’ conference have pressed government actors again and again to stop the further extension of the extra-university sector, and even to transfer some of its research capacities back to the universities (WRK 1987: 20-22). By now these recommendations have not been very effective. In contrast, the financial situation of universities have worsened further and the reunification process which the Science Council wanted to use as an opportunity to realize the strengthening of university research in the new Länder hoping that this would start a similar development in the West has produced a rather opposite outcome.¹⁷¹ By far less research groups and scientists from the former institutes of the Academy of Sciences could be integrated into universities than the Science Council proposed. For example, about 2000 positively evaluated researchers and technicians had to be funded via the so-called “scientists’ integration program” (Wissenschaftler-Integrations-Programm (WIP)) until universities were able to take them over in their research staff.

But when in 1993 the original program ran out this had been realized only for 30% of them. Even after a prolongation of the program until December 1996 only about 65 WIP-scientists had found a secure position at universities. Still 1300 of them, however, were without a new job. In consequence, the federal research ministry and the East German Länder declared to take special measures in the framework of their university programs to employ 900 of them in research, but it remained unclear how many WIP-scientists would be really transferred to universities in the end.¹⁷² “The failure to strengthen university-based R&D” is seen as a “fundamental problem to the new East German research system”: “Any capacity to train scientific staff at universities and employ university graduates within the system is most likely to remain extremely restricted for some time to come.” (Meske 1993: 309/307).

For universities and the rector conference the reasons why the strengthening of university research has failed are more or less clear. It is the financial attractiveness for the Länder and the amenability of non-university institutes for political or economic direction and not the alleged inability of universities to carry out the missions of extra-university institutes. It is true that not all, but a lot of extra-university research once had been done by the universities, and since the beginning of this century more and more research has “emigrated” from the universities to the extra-university sector. But even if one concedes to the universities legitimate rights of doing research which are neglected by now, or per-

¹⁷¹ In its 12 recommendations on the “perspectives for science and research on the way to German unity” (Wissenschaftsrat 1990: 11/25) the Science Council held “especially important for the creation of a diversified and efficient higher education system to have priority over other types of institutional research promotion. Since the institutes of higher education combine research with teaching and the training of scientific recruits, they provide the basis for all other fields of R&D … In a federal unified Germany the primary task of extra-university research has to be seen in a complementary promotion of basic research in such areas which are not or not yet suited to be taken up by universities, as well as in contract research for ministries and industry.”
receives dysfunctional effects for research as well as for teaching if they are separated too much by being divided between both sectors, one has to acknowledge that the described situation at German universities does not look inviting for research. Some commentators even have put the official prerogative of universities in research into question, which almost amounts to a sacrilege because it endangers the constitutional consensus of the German research system. As long as the universities are unable to improve research conditions by far-reaching reforms of their institutional structures, research policy would be unwise if it transferred back research capacities from the extra-university sector. This more cautious position towards the question if and to what extent research should be removed into universities is visible in the latest statement of the Science Council in this issue. It emphasizes the advantages of the “pluralistic structure” of the German research system in the light of the “multiple scientific approaches and working conditions” and sees the partial “overlapping of research profiles” between universities and non-university institutes as stimulus of a healthy competition improving research quality. Finally, it ends with a scarcely veiled warning to universities that it is their responsibility in the first place to become more attractive for research: “For the future development of the research system it is decisive if the universities improve their role as places of competitive research with productive structures including an effective research fund and overcome impeding institute and disciplinary boundaries. ... If this is successful the relationship between university and non-university research will have to be reconsidered.” (Wissenschaftsrat 1996a: 49).

Since a re-integration of research capacities into universities proved unrealistic the efforts of governments and Science Council turned to an improvement of contacts and collaboration between universities and extra-university institutes as an alternative (BMFT 1988: 38-39; Wissenschaftsrat 1988: 72-75). Two instruments mainly serve this purpose. Firstly, universities shall improve the access of doctoral and postdoctoral students from non-university institutes to teaching and training activities. In turn, the research institutes shall give university researchers better access to their infrastructure and equipment often not available at universities (Wissenschaftsrat 1988: 72). Secondly, senior scientists of non-university institutes shall whenever possible become faculty members of the local university and appointed by a joint commission of university and institute. In this way, the universities often gain leading experts in specific fields for teaching, while the heads of the non-university institute get early

---


173 The former president of the Science Council, for example, regards it as necessary to review the traditional principle “all research into universities” propagated by the rector conference: “For the research monopoly of universities is long gone without having harmed research to a provable extent.” In contrast, he sees the complaints of the rector conference that the sometimes lacking quality of university research is largely owed to the resources going to the non-university sector rather as a deflection from own weaknesses; Simon, Dieter: “Dompiteur im Zoo der Forschungsohobby” In: Frankfurter Allgemeine Zeitung vom 30.12.1991.

174 For example, in 1991 the Wissenschaftsrat published “Recommendations on the Collaboration of Universities and National Research Centers” and in its 1993 “Recommendations for the Reorganization of the Blue-List”(-Institutes) the improvement of the cooperation with universities played a central role.
and direct contact to qualified students and young scientists. Additionally, staff exchange and joint research projects are made easier. In the meanwhile common appointments take regularly place in three of the five sub-sectors of non-university research - Bund-Länder-Institutes, National Research Centers and Fraunhofer-Institutes - whereby directors of non-university institutes or departments are simultaneously, hold lectures and seminars at universities and supervise (doctoral) theses. In addition, qualified scientists of extra university institutes increasingly take over teaching tasks at universities. In its “Theses on University Research” the Wissenschaftsrat (1996a: 48) speaks therefore of a “clearly improved cooperation” between university and non-university research.

5.3 Extra-university state-financed research institutes

Since the end of the 19th century state-financed non-university research organizations and institutes for carrying out specialized research tasks have continuously gained in importance in German PSR. The previous chapters have shown that this development accelerated in the post-war period and that by now research capacities in the non-university sector reach almost the level of universities. Research (see Figure 1-2 in chapter 1 and Table 9-10A). In chapter two was described how by historical coincidence, the mid-seventies, when the problems of university research started, was also the period when an overall institutional equilibrium within the sector of state-financed extra-university research was finally reached after several decades of conflicts. Since the fifties, there had been domain conflicts between different groups of research institutes - especially between the Max-Planck-Society (MPG) as the established dominant corporate actor within this sector and the Fraunhofer-Society (FhG) and the National Research Centers (GFE) as the two groups of newcomers. In parallel, however, the federal ministry of research had challenged the initially very strong position of the states with regard to formal competence in research policy. Able to provide the largest share of government funding for research, the ministry was able to support the MPG and the DFG beyond the standard budgetary allocations, offer extensive project funding to universities and non-university research institutes and establish national research centers. At the end of this process stood the 1969 constitutional amendment turning research promotion into a “Joint Task” (Gemeinschaftsaufgabe) of Bund and Länder which henceforth had to cooperate in the institutional funding of most groups of extra-university research institutes. By the mid-seventies the administrative procedures were finally adapted to this new sharing of responsi-

175 In 1995, for example, 37 directors of Fraunhofer-Institutes (77%) held at the same time a professorship at universities.

176 For example, in 1994 80% of the entitled scientists in the Max-Planck-Society, which uses the instrument of joint appointments less frequently due to its policy to provide outstanding scientists with the possibility to concentrate completely on research, held lectures or seminars at universities. At some universities selected disciplines even are exclusively represented by Max-Planck-scientists (MPG 1996: 67).

177 See Hohn/Schimank (1990) and Stucke (1993) for extensive studies of this sector and the relevant government actors.
bilities institutionalized in the conclusion of the Framework Agreement on Research Promotion (RV-Fo) and the Bund-Länder-Commission for Research Promotion (BLK) (see chapter two).

It was also already analyzed how the formal involvement of the central government in the institutional funding of all major groups of non-university research institutes defused the resource conflicts among them and opened the way for a stable equilibrium concerning the domains and resource allocation. This equilibrium, which has remained basically unaltered to this day, is characterized by three important elements: (1) a functional specialization with regard to the types of research conducted by the different groups of research institutes; (2) a domain consensus in research policy, resulting in a clear delineation of the competencies of the federal government and the states has led to specific government and funding arrangements for each group of institutes; and (3) a balance between political guidance and scientific autonomy has also emerged in relation to each group of institutes. These three elements are tightly interrelated, as will become clear from a comparative characterization of the different groups of extra-university state-financed research institutes.

As Table 6.1 has shown research capacities in the non-university sector are concentrated in the natural and engineering sciences despite the institutional decentralization of the sector and the various tasks and types of research performed. This bias reflects the different function of non-university research which is mainly oriented towards socioeconomic relevant research areas and practical problem-solving for state and industry. The only clear exception from this originally was the Max-Planck-Society as an organization for institutes performing fundamental research in selected scientific fields. But even in the MPG the research areas of many institutes are chosen according to their long-term strategic relevance for state, industry or society (Trepte 1996). In parallel, also some of the national research centers focus completely or totally on basic research requiring an exceptional concentration of resources or large-scale installations and especially in East Germany several of the Bund-Länder-Institutes are primarily engaged in fundamental research (see above). At the same time, universities, Max-Planck-Society and Bund-Länder-Institutes have given more emphasis to technology-transfer and industry collaboration following political pressure for more relevance. In consequence, the functional delineation among the individual groups of institutes have become more open without being dissolved, a development welcomed by governments as an instrument to stimulate competition and cooperation.

Clearly dominating in quantitative terms are the 16 national research centers followed by the other four groups of institutes with roughly the same size. This has not been always the case (see chapter 2.2.2.4). At the beginning of the eighties the Max-Planck-Society (18%; 19%) and the Federal Research Establishments (16%; 19%) had clearly distanced the Bund-Länder-Institutes (9%; 10%) and the Fraunhofer-Society (6%; 6%) concerning R&D expenditure and staff (Table 9-10). Thus, even in the framework of Federal-state cooperation and the established domain consensus significant shift of weights have been possible, as the spectacular growth of the FhG since the mid seventies, the expansion of the Bund-Länder-Institutes in the nineties and the corresponding relative decline of MPG and
BFA show. Is this disproving the thesis of an overall status quo orientations and immobility built into the German public research system? Not exactly, as a closer look reveals. Exceptional circumstances have been necessary to generate such changes to the status quo and powerful countervailing forces have been set into motion against them. In the case of the Fraunhofer-Society (see chapter 2.2.2.4) it is its funding arrangements which allow an above average growth mainly financed by income from contract research with industry. Since the Fraunhofer-Institutes receives only about 30-40% of their budget as institutional funding from Bund and Länder and this share tends to decline by increasing contract receipts, their expansion poses only partially a threat to the resources of the other non-university institutions. In addition, with its internationally recognized prestige as highly innovative and successful research organization for applied R&D and technology transfer the Fraunhofer-Society is the “favorite child” of present research policy protecting it against demands from its rivals for government support.

A different case constitutes the unexpected and, for universities and the other research organizations, unwelcome expansion of the Bund-Länder-Institutes in the wake of reunification. Chapter 5.2 has described how the transformation into a Bund-Länder-Institute became the dominant solution for former research institutes of the East German Academy of Sciences which had been positively evaluated by the Science Council. Virtually over night the number of Bund-Länder-Institutes rose by 34 making them the largest group of research institutes in absolute numbers and with regard to R&D staff (Table 2.2). Due to their joint Federal-State financing the so-called Blue-List-Institutes are direct rivals for institutional funding of Max-Planck-Society, Fraunhofer-Society and universities. Moreover, while in the West the BLI were a heterogeneous collection of institutes whose research tasks and quality was not regarded as a major challenge to the R&D activities of the other public research sectors, the East German Bund-Länder-Institutes now contained a large number of institutes which according to their research profile and scientific quality competed with basic research, the domain of MPG and universities, and application-oriented research, the domain of the FhG. Accordingly, these have demanded to regard the post-reunification situation as a temporary exception and to reduce the Blue List again to its former proportion (Meske 1993: 306; Schimank 1994b: 268-269).

By now, however, such demands have remained unsuccessful, largely for political reasons. On the one hand, the only solution for the East German institutes would have been the original strategy of the Science Council to integrate them into universities. But the financial situation of the East German Länder and universities, which had prevented the implementation of this strategy, has rather worsened than improved. Thus, the transformation of BLI into university institutes is not a realistic option for the foreseeable future. Universities which have to reduce their own scientific staff and state governments which receive half of the BLI-budgets from the central government, but no major federal support for universities are neither willing nor able to agree to this. In consequence, only a strong reduction of the Blue List in the West could bring about its reduction. The opportunity for this provided the commis-
sioning of the Science Council by Bund and Länder to repeat its systematic evaluation of the East German Bund-Länder-Institutes in the old Länder (Wissenschaftsrat 1993d). This was seen to be dictated by fairness considerations with regard to East German science, but was also at least partly a response to the demands of the other research organizations to restrict the size of the BLI. But from the beginning it was obvious that the number of Blue-List-Institutes in the West German Länder could not be reduced to an extent which would bring their relative weight in unified Germany to pre-unification level. Such a step would have required the exclusion of between one third and one half of all institutes from the joint Bund-Länder funding. Neither were the “host states” willing to accept this drastic measure nor produced the evaluation exercise of the Science Council results which would have justified such an outcome. Several institutes have been recommended for total or partial exclusion and in some cases these proposals have been already implemented, but the more institutes have been closed the more the resistance against further closures will grow.\footnote{That several Blue-List-Institutes in fact have been excluded from the joint funding, something which failed in the seventies and eighties mostly due to the resistance of the “host state”, is owed to the publicly announced decision of the federal research ministry to continue its support only for institutes which receive a positive evaluation by the Science Council (Rüttgers 1996a). Although such an unilateral withdrawal is at least an “unfriendly act” in Federal-state cooperation, normally leading to retaliation in other issues, this time the BMBF can put the blame on the federal ministry of finance which insists on this strategy to reduce federal obligations in research promotion.}

Instead another mechanism of the interlocked research policy making system can be observed, namely the stabilization and perpetuation of structural changes once they have taken place. In German cooperative federalism it is not only difficult to achieve such changes, but also to reverse them. Here, the Bund-Länder-Institutes also can serve as an illustration. Recognizing the fact that a significantly enlarged Blue List will remain in the foreseeable future Bund, Länder and Science Council concentrated their activities on plans how to develop a more homogeneous research profile of the Bund-Länder-Institutes and how to improve the quality of their research. The instrument to realize this objective is seen in a self-organization of the BLI analogue to that of the Max-Planck- and Fraunhofer-Society (Wissenschaftsrat 1993d). For this purpose, institutes working in neighboring scientific fields or performing similar missions, like the six institutes for economic research, shall be combined in sections with joint planning and policy-making structures. These sections in turn shall be integrated into a common organization. Gradually the joint decision-making bodies shall take over long-term strategic planning including preparing decisions on the in- and exclusion and profile and restructuring of member institutes and quality control which by now largely are the domain of Bund and Länder. Thus, the common organizational structures attempt to improve and safeguard the scientific autonomy of the Bund-Länder-Institutes and their position towards governments. In addition, by freeing the BLI from the corset of Federal-state cooperation their flexibility concerning resource distribution and thematic re-orientation shall be enhanced (Wissenschaftsrat 1993d: 471-477).
In summary, one can make several general statements about the non-university sector in the Federal Republic in the mid nineties. Firstly, it has reached an institutional stability and size which make its constituent parts a recognized and valued element in the “differentiated, plural and decentralized science structure, which belongs to the most competitive worldwide” as the federal research minister confirmed in his recent “guidelines on the strategic orientation of the German research landscape” (Rüttgers 1996a). Even though the priority of universities in research is regularly repeated, in reality no measures have been taken or are planned to reallocate groups or parts of non-university institutes into universities. Instead of putting the existence of criticized institutions into question, Bund and Länder have started activities to orient non-university research more closely to new scientific and social challenges and demands and to improve quality control. A major step in this direction was their decision in November 1997 to subject all non-university organizations including the prestigious German Research Society and the Max-Planck-Society to systematic evaluation and to strengthen competitive resource allocation (see chapter 4). These efforts, however, will increase rather than weaken the legitimization and competitiveness of non-university research towards universities. Moreover, to the extent that extra-university institutes are successful in implementing the political demands for resource concentration on strategic and innovative scientific fields and technologies, the more the structural deficiencies of universities to respond to new developments in the production of knowledge like internationalization, transdisciplinarity and problem-orientation (Gibbons et al. 1994; Trepte 1996) will become visible and the more unlikely will be that government actors are willing to strengthen university at the expense of extra-university research beyond an improvement of collaboration between both sectors. But even here, it is the objective to provide non-university institutes with access to promising and qualified students and latest advances in fundamental research and expand their role in the training of (post)doctoral students which is at least as important for this policy than the wish to provide universities access to the non-university research infrastructure and to use the potential of the scientific staff of extra-university institutes for teaching (see 6.2).

Secondly, in the eighties and particularly the nineties the rather comfortable position of German non-university research relying on a high share of stable institutional funding and enjoying a rather high autonomy towards governments concerning research planning, resource allocation and quality control has come increasingly under pressure. Under conditions of tight science budgets Bund and Länder now emphasize the systematic concentration of resources on innovative and productive institutes, departments and scientists through regular evaluation and a competitive and performance-related distribution of equipment, staff and funding (Rüttgers 1996a; BMBF 1998: 88). The research organizations are required to maintain their productivity in existing and flexibility in taking up new research areas within more or less stagnating government support by a quicker and more far-reaching cutting back of capacities in fields which are no longer up to date or less productive. In addition, research policy demands a more effective strategic research planning and priority setting on the basis of foresight exer-
cises to target research more strongly on areas deemed of central importance for future scientific, economic or social development (ibid.). This affects especially research institutes located in the old Länder where a relative generous funding had allowed to continue rather outdated or mediocre research. After unification such a conflict-avoiding strategy is no longer possible. Especially the federal research ministry financing 50% or more of the budgets of extra-university institutions needs to redistribute funding from the old to the new Länder in order to be able to finance the renewal of the East German research system. Accordingly, the budgets of some research organizations in West Germany are frozen or they are required to reduce the number of staff positions (see below). If cuts across-the-board are not a preferred option, conflicting with the political demand for “a more efficient resource management which avoids misallocation and stimulates performance through competition” (Rüttgers 1996a), decisions about priorities and quality are necessary including the closure of whole institutes and departments. In the long term this streamlining and thematic re-orientation due to financial constraints can lead to the restructuring and renewal of German non-university research which was often attempted, but never really implemented in more favorable circumstances showing again that a high problem pressure is needed to push through major structural changes and reforms in German PSR.

Thirdly, a clear status ranking within the non-university sector can be distinguished. At the top are the German Research Society, the Max-Planck-Society and the Fraunhofer-Society whose legitimization and quality is largely undisputed. The DFG is regarded as one of the most efficient and prestigious funding agencies for fundamental research internationally and its scientific autonomy and peer-review system are seen as exemplary for an efficient and quality-oriented general science promotion. That does not mean that the DFG is beyond critique. Preference for established and traditional research lines and approaches through the peer-review committees controlled by the academic elite of an discipline are sometimes a cause of complaint for young scientists. Governments in turn want the DFG to strengthen the “top-down” compared to the now prevalent “bottom-up” dimension in the funding policy through the introduction of instruments for research foresight and strategic priority setting in funding programs. For this purpose the German Research Society has been asked to carry out an internal self-evaluation through domestic and international experts for improving its grant procedures. A similar privileged position takes the MPG whose claim to operate international “centers of excellence” at the forefront of scientific advancement is recognized by governments (Rüttgers 1996a). But also the Max-Planck-Society has been requested to improve its mechanisms for quality control and research planning (BMBF 1998: 88). The high esteem of DFG and MPG is reflected in the decision of Bund and Länder to increase their budgets annually by 5% since 1989. Beyond dispute, at least for research policy, is the Fraunhofer-Society regarded as a key element in the German innovation system bridging academic and industrial research (Meyer-Krahmer 1996): “The Fraunhofer-Society has demonstrated in recent years that it transforms with commitment and success state-financed research into innovations. ... With this the Fraunhofer-Society has developed a profile which gives it a strong importance
as motor of innovation. Just following from the fact that we still have innovation deficits in Germany ...
the efforts of the Fraunhofer-Society gain further importance. Even more necessary is it ...
open it
new opportunities for enabling it to use its potential fully.” (Rüttgers 1996a). In this context, the FhG
shall concentrate its R&D activities even more strongly on future key technologies and advance its
internationalization through the establishment of institutes and information centers abroad (ibid.;

A middle position took the more than 50 Federal Research Establishments. They are a rather unnoticed
sector of non-university research and are only very rarely object of research policy debates, although
they rival in size with MPG, FhG and BLI. For example, the Science Council has never developed any
initiatives towards this research sectors. Two reasons are responsible for this. Firstly, the BFA are an
undisputed domain of the Bund. Bundesforschungsanstalten are operated and funded to 100% by the
various federal ministries to support them in their policy-making functions. Thus, they are not part of
Federal-state cooperation and funding in research promotion and no direct competitor for the other
research organizations. Moreover, there is no doubt that the federal departments would resist any ex-
ternal interference in “their” research establishments. Secondly, the BFA do not have to legitimize
their resources and activities exclusively in terms of R&D contributions as the other research organi-
izations. Instead they perform several other functions and task like government advice in law making
and administrative regulation, monitoring or standard setting to which research stands rather in an
auxiliary relation. Due to this support to public policy making and implementation the Federal Re-
search Establishments are largely withdrawn from considerations of research policy.

The most precarious position with regard to their legitimization, research domains and resources oc-
occupy the national research centers and the Bund-Länder-Institutes. Their role and especially size in the
public research system has been questioned time and again. In the case of the BLI this was not of ma-
jor concern before reunification because their resource demands were rather low and the Länder re-
garding the Bund-Länder-Institutes largely as their domain protected the institutes located in their
territory against negative consequences following from evaluations by the Science Council or demands
by the federal ministry of finance to reduce the number and costs of the Blue List. It was already
shown that this relatively undisputed niche existence has ended with reunification (see above) and the
debate on the future of this public research sector is in full force.

The Großforschungseinrichtungen have been exposed to even more severe critic than the BLI today.
This started already in the seventies when most centers showed unable to reorient their research to-
wards innovative key technologies and technology transfer as the new political priorities of the BMFT
for the GFE (chapter 2.2.2.4). For universities, research organizations, but also industry as the sup-
posed clientele, the research centers absorb a far too high share of federal research promotion com-
pared to their alleged mediocrity of research and their inability to concentrate on strategic research
areas and to collaborate with industry. This critic affects not all GFE, but mostly the centers which
Sub-sectors

concentrate on application-oriented technology research denounced as “mammoths” and “dinosaurs” showing a lack of thematic flexibility and orientation towards interdisciplinary research and user demands. Mostly founded in the fifties and sixties they have lost their original mission like the six nuclear centers and have not found a new identity and research profile replaced by a maze of fragmented research programs and individual projects. Even though not all of these R&D activities are regarded to be non-innovative and of poor quality critics argue that for this research one does not need big science structures and that the competitive institutes and research teams are better transferred to universities or other non-university institutes (Hohn/Schimank 1990: chapter 7; Stucke 1994).\textsuperscript{179}

By now the consequences for the GFE have been rather modest. No center has been closed or is in the process of being closed. Instead the GFE-budgets in the West German Länder were frozen in the early nineties and the federal research ministry committed them to reduce their staff by 12-15\% due to its tight financial situation caused by unification (Stucke 1994: 241).\textsuperscript{180} In parallel, three new centers based on modernized organizational structures were established in the former GDR. With their flexible and problem-oriented research teams, “flat hierarchies” and less administrative and financial regulation they shall serve as a model for the restructuring of their Western counterparts. At the same time the BMBF has defended the \textit{Großforschungseinrichtungen} against demands for more far-reaching changes, that means a strong reduction or dissolution of some centers.\textsuperscript{181} The reasons seem to be the same as in the seventies and eighties (see chapter 2.2.2.4). Paradoxically it is their size which is a major protection against such measures: the closure of a GFE would imply high political and social costs. In addition, the GFE are still the most important research infrastructure of the federal research ministry. Their transformation into other types of research institutes would imply a loss of influence and control even if these resources often could not be used for a political direction of the GFE.

In summary, it is interesting to compare the present situation of extra-university state-financed research institutes with universities. Both sub-sectors of state-financed research exhibit a firm institutional stability. But this is assessed quite differently for both sub-sectors by relevant actors. Government actors are deeply dissatisfied with the university sector, as are many professors as well. But most of the latter still prefer the status quo to other alternatives, especially the transfer of research from universities to the extra-university sector. Thus, professors have accepted their fate and try to make the best out of their situation. Since government actors are unable to redesign the universities without the professors’


support, or at least their compliance, university research will remain in a rather uncomfortable situation. Tensions will escalate, but nobody is able or willing to ease the situation by institutional changes. In striking contrast, the institutional equilibrium of the extrauniversity research sector is not without problems, to be sure. But these problems seem to be much more manageable than in the university sector, in part because there is a prevalent determination to constructive problem-solving. Actors are not trapped in a destructive antagonism. Instead, tensions are viewed here as inevitable but tolerable side-effects of a generally satisfactory institutional equilibrium.

In the following a short portrait of the five sectors of non-university research will be given concentrating on organizational features, government arrangements and present challenges.

5.3.1 MPG

The “Max-Planck-Society for the Advancement of the Sciences” (Max-Planck-Gesellschaft zur Förderung der Wissenschaften (MPG)) is the oldest and most prestigious German research organization. Officially founded in February 1948 the history of the MPG being the renamed successor of the “Kaiser-Wilhelm-Society” goes back to 1911. It is a “carrier organization” (Trägereinrichtung) that operated in 1995 66 research institutes or laboratories and 29 working groups or research units, whereby 9 institutes and 27 temporary research units were located in the East German Länder and two institutes abroad. In 1995, the Max-Planck-Society had a budget of 1,5 billion DM and a total R&D staff of 9300 (1993). In the postwar period the MPG has changed its profile from an organization carrying out mainly basic research, but also application-oriented and even applied research to a specialized institution for fundamental research in selected areas of natural sciences, medicine and social sciences, whereby the natural disciplines are clearly predominating with a share of about three quarters, followed by medicine (ca. 20%) and social sciences (ca. 10%).

Its institutes are organized in three scientific “sections” (Sektionen): the “Chemistry, Physics and Technology Section”, the “Biology and Medicine Section” and the “Arts and Humanities Section” and the main research fields according to budgetary appropriations in 1995 were:

- physics (29%)
- biological research (29%)
- astronomy and astrophysics (9%)
- chemistry (8%)
- medical research (8%)

182 This paragraph is based on Meusel (1996b) and Trepte (1996).
The role of the Max-Planck-Institutes in the PSR system is that of international competitive “centers of excellence” performing pure research at the forefront of scientific development which is in the public interest, whereby scientific originality and quality are the decisive selection and evaluation criteria for scientific staff and research projects (Trepte 1996). Max-Planck-Institutes have a supplementary function to university research by carrying out research with “an adequate concentration of staff and funds” in fields that are not or not adequately covered by universities. In the system of institutional research promotion, the Max Planck Society are assigned several functions by offering in its institutes the best possible infrastructure and working conditions to outstanding researchers in

- scientifically important or promising areas (research sponsor function);
- taking up new research areas in both emergent fields not yet taught at university level (innovation and catalyst function) and areas requiring close interdisciplinary collaboration difficult to organize at universities (interdisciplinary Function);
- research requiring large-scale or sophisticated infrastructure and equipment not available at universities (complementary and supportive Functions).

In recent years the MPG has intensified its efforts to sharpen its research profile. The main instrument in times of stagnating or slowly growing resources is the thematic reorientation of a department or whole institute (Trepte 1996: 128). Accordingly, every time the head of an institute or department retires or leaves their research programs are subjected to an *ex post* evaluation of the previous research, the long-term prospects of the field and the need for a continued promotion within the MPG (ibid.: 129). Only if these items are positively answered the search for an adequate replacement of the director is started. Otherwise the department/institute is dissolved to free resources for more up-to-date and productive research areas. But even if a basic decision for continuance is taken, the thematic orientation of the institute in question can change fundamentally, because a selected candidate determines in the negotiations with the MPG the future research area and as director is totally free in the selection of research topics. In this way, 20 departments were closed between 1992 and 1996 accounting for about 10% of all MPG-departments and the research tasks of more then 20 institutes were refocused in the appointment process of new directors (Trepte 1996: 131).

In the nineties the Max-Planck-Society has also strengthened its internal evaluation procedures. Each institute is now visited by an evaluation committee of external experts every two years discussing the current research program and giving recommendations for the future development to the director and the MPG. In addition, every institute has a board of trustees meeting normally once a year and having

---

183 See for detailed data concerning the shares of scientific fields in the different non-university sub-sectors Table 11-12A.
the task to cultivate relations with the general public. Moreover, the work of directors is reviewed every seven years by the MPG and since 1994 this includes also a review of the resources originally assigned to the director. This opens the opportunity for a more performance-related resource allocation (Trepte 1996: 139).

Organization

The Max-Planck-Society is an incorporated association under private law. Although every natural or juristic person wanting to support science can become member of the MPG the decisive group of actors are the “Scientific Members”, that means the present and former directors and senior scientists of the individual Max-Planck-Institutes as well as leading scientists from abroad. The central decision-making and supervisory body is the “Senate” electing the President and the other members of the Executive Committee which advises the president and prepares strategic decisions. In addition, it has the final say on the founding or dissolving of institutes and departments, the appointment of directors and scientific members of the institutes, and the allocation of the annual budget, the most important instruments of structural planning and research policy making in the Max-Planck-Society. The senate is composed of up to 32 elected members whereby directors and scientists from the MPG enjoy always a broad majority, while the central government can send two and the Länder three representatives. In addition, several senators are members ex officio. The Presidents of the major German science organizations are also permanently invited to Senate sessions. Substantial decisions like the founding or restructuring of institutes and the appointment of directors are prepared by the Scientific Sections comprising the directors and scientific members of the section’s institutes and scientific members elected by the scientific staff of the institutes.

Challenges

Since the end of the sixties, the MPG has been jointly financed by the federal government and the collectivity of the states, each side providing half of the budget. This establishes a mutual blockade with regard to federal or state attempts to influence the MPG politically. The federal government begrudges the states political interventions into research topics or types of research, and vice versa. Thus, the MPG is now in the situation of a third party benefiting from the division between federal government and states. It gets its institutional funds from government without any stipulations.

Moreover, as a group of institutes the MPG has a strong self-organization which enables it to make decisions which are collectively binding for all the institutes. This allows for the scientific autonomy of the directors of an institute, on the one hand, and the scientific self-governance of the group as a whole on the other with regard to the establishment of new institutes and the closing down of old ones. The directors can design their institute’s research program on their own, and have to be successful only according to scientific performance criteria. The MPG as a corporate actor, represented by its president, its senate, and its scientific sections, chooses its ”portfolio” of research areas also only by esti-
mating how scientifically excellent and promising they are, on the basis of evaluations of the performance of existing institutes and concepts for new institutes. All in all, this conditions have allowed the MPG to specialize in curiosity-driven basic research (Trepte 1996).

The MPG sometimes has to make concessions to government, adapting its scope of research areas partially to political interests. Demonstrating on certain occasions that basic research can also be related to particular societal needs for scientific knowledge - for instance, by founding an institute for polymer research or for information science - is advisable to ensure the willingness of federal government and the states to maintain and expand the amount of resources given to the MPG. This latent pressure on the MPG has grown over the years. In addition, the more the MPG institutes need separately budgeted funds from the federal research ministry or the EU, the more likely their research topics are to conform to research programs with a political basis. The amount of separately budgeted funds acquired by the MPG is still not very high, but it has increased recently. If it grows even more, and if these funds are concentrated strongly in certain institutes, at least this segment of the MPG will become more and more exposed to criteria of societal relevance.

In the wake of reunification, the Max-Planck-Society was required by Bund and Länder to reduce the number of staff positions by 737 from 1994 to 2000 amounting to a annual loss of 1-2% as part of the “federal consolidation program” for financing the “built up East”. On this background the MPG-president announced in 1996 a “closing program” proposing the dissolving of 4 West German institutes because these reductions could not be implemented by across-the-board cuts without harming the quality of research (MPG 1996: 44-49). As the following internal conflicts and cumbersome negotiations about which institutes and departments should be closed showed, this streamlining of research capacities in the West poses a major challenge for the MPG in the next years.

5.3.2 FhG\textsuperscript{184}

The “Fraunhofer-Society for the Advancement of Applied Research” (Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung) (FhG) founded in 1949 is today one of the largest and most successful organizations carrying out contract research and technology transfer in the service of industrial and public clients internationally.\textsuperscript{185} Similar in its organizational structures to the MPG, the FhG operated in 1995 40 research institutes, 5 working groups or research institutions and 3 service institutions. 7 of the institutes and the three research institutions limited to 5 years are located in East Germany. In addition, the society has three “resource” and “research” centers in the USA and offices in the United States, Singapore, Malaysia and China. The FhG had in 1993 a R&D staff of almost 6000 and a turn-over of 1.3 billion DM.

\textsuperscript{184} See for the FhG Meyer-Krahmer (1996) and FhG’90.
The function of the Fraunhofer-Gesellschaft is to provide industry and state with a qualified and flexible research institution with the tasks (1) to promote applied research, (2) to support industry in technical problem-solving and the development and introduction of new technologies and product and process innovations and (3) to support the state in the solution of public tasks of overall economic importance. For this purpose, the Fraunhofer-Institutes perform application-oriented “own research” that takes up new scientific and technological knowledge and converts it into technologies and innovations ready for production or deployment for problem-solving. This “own research”, however, serves only as the basis for contract research on behalf of industrial and public clients with the aim to transfer new scientific and technological knowledge into innovative products, production processes and problem solution. In this way, the Fraunhofer-Institutes act as a “bridge” or “transmission belt” between academic basic research and problem- and market-oriented industrial research. The concentration of the FhG on production-oriented applied R&D is reflected in the unique share of engineering sciences accounting for almost 70% of its R&D personnel and 80% of R&D spending and the distribution of the budgetary appropriation. At present, the Fh-Institutes carry out research in the following 8 research fields:

- production technology (57%);
- microelectronics and micro-systems (13%);
- materials and components (11%);
- information and communication (6%);
- energy, environment, health (7%);
- process engineering (5%);
- sensor systems, testing technologies (4%);
- technical and economic studies (3%).

Within these fields the FhG concentrates on three functions:

“acute technological development”: This means the individual application of marketable technological problem-solutions in companies or public agencies. R&D activities in this sector have a rather short time horizon of up to 5 years and here is the share of industry-financed research highest. In the early nineties more than half of R&D expenditures was used for this short-term applied R&D.

“key technologies”: Here the Fraunhofer-Society wants to identify and develop future innovative technologies which are not yet ready for industrial use, but possess a high innovative potential. Accordingly the time horizon is much longer (10-15 years) and the share of private funding is much lower.

\[185\] Information concerning the tasks and research areas of the FhG are taken from its “Annual Reports”; see
due to the scientific and economic risks and long-term character of research. This kind of research is mostly financed by public project funding to develop the research area until it becomes marketable and interesting for firms. About one quarter of R&D resources are used for the development of key technologies.

“precaution research”: This is research on behalf of governments for innovative solutions in public policies, especially environmental problems and technical standardization. It is the smallest research area and research activities are financed largely by public funds whereby the share of institutional funding is with about one third very high.

In 1990, the FhG set up the “Fraunhofer Management Society” (FhM) as an independent, nonprofit subsidiary company in order to make the know-how of the Fraunhofer-Society in the running and managing of research projects and institutes available to external users. Its main tasks are

- technology and innovation management by supporting and advising start-up companies, restructuring R&D establishments and running qualification courses for engineers and scientists;
- technology assessment for public and private clients;
- management of R&D institutes outside the FhG;
- administrative and legal planning and preparing of R&D projects and facilities.

Fraunhofer-Institutes are normally located nearby an university to which they maintain close formal and informal contacts. In addition, most FhI-directors are professors at the local university. This provides the institutes with direct access to qualified students and researchers and information on the latest scientific and technological developments. Another instrument and asset of the Fraunhofer-Society for adjusting to new developments and market needs is the high turn over of staff. Annually, more than 10% of the scientists leave the FhG to take up jobs in industry or at other research institutions. This high mobility allows a permanent renewal and restructuring of research programs and the permanent in-flow of new ideas and approaches. To improve the cooperation with academic research providing the “raw material” for the R&D activities of the FhG the Fraunhofer-Gesellschaft has established “Application Centers” that are branches of certain Fraunhofer-Institutes located at universities but run by a professor.

Organization

Analogue to its sister organization the FhG shows simultaneously a powerful self-organization allowing a strategic direction of the overall research profile and a corresponding resource allocation on the one and a decentralized structure at the level of research performance. Formulating of research programs within the institute’s mission, acquisition of research contracts and staff recruitment are the

also the homepage of the FhG (http://www.fhg.de).
autonomous responsibility of the director. According to their dependence on contract income Fraunhofer-Institutes are managed like independent “profit-centers” orienting their research towards market needs and potentials. Decisive criterion for the success and continuation of an institute is the level of its contract income. Although an internal redistribution mechanism ensures that institutes which are developing a research field to “marketability” get a larger share of institutional funding this is regarded as a temporary support. If after a certain time the share of contract receipts does not reach a satisfactory level, a discontinuation or restructuring of the department or institute takes place.

Central decision-making body is the FhG-Senate composed of up to 18 elected personalities from science, industry, and public, 4 federal and 3 state representatives, and 3 elected members of the Scientific-Technical Council representing the institute’s directors and delegates of the scientific staff. In contrast to the MPG, scientists do not have a majority in the senate showing the stronger orientation of the FhG to users (FhG-Jahresbericht 1995: 106).

Unique is the funding arrangement for the FhG (see chapter 2.2.2.4). The share of institutional funding provided jointly by Bund and Länder is not stable, but variable and depends on the volume of contract income. Originally, the volume of government block grants matched the contract receipts. However, with the growth of the FhG the level of institutional support was steadily reduced to about 30%. Income from contract research is derived from public and private sources. In general one can say, that industry contributes about 30% to the FhG-budget.

Challenges

In recent years the federal research ministry has put pressure on the society to increase the share of industry-financed research giving rise to fears that the FhG will be more and more dependent on short-term R&D for firms with a low innovative quality and lose its ability to take up and develop new technological fields (see the contributions in FhG’90). This would mean a fatal blow to the Fraunhofer success formula which precisely consists in the mixture of long-term institutional support, targeted public project funding and contract income from industry.

With the FhG, we find the group with the greatest dependence on the market. The FhG has to earn more than half of its financial resources by research contracts. By imposing this mode of financing on the FhG in the early seventies, government actors deliberately gave up a hierarchical guidance of this group of institutes and delegated their competencies to the plurality of users of the FhG’s research capacity. In this way, government actors not only avoid a mutual blockade like they have in relation to the MPG, but also bring in the knowledge of the users about what they need from the FhG - which is much more accurate and precise than government actors’ estimation of these needs.

In contrast to the federal research institutes which must serve the clients of their ministry’s policy area, the institutes of the FhG are not obliged to accept any research demand. Rather, an institute can choose which specific demands it wants to accept from the total demand for its research capacity. Of course, if
all research contracts asked for are needed by the institute to survive, there is no choice. But to the
degree that the demand exceeds the institute’s research capacity it is not only forced, but able to choose
- and may do this by selecting those research contracts which are scientifically most interesting. Most
institutes are in such a situation most of the time. Thus, the market governance allows for more or less
autonomy of the FhG, depending on the scarcity or plenitude of research demand. However, the re-
search demand directed at the FhG is almost always less scientifically interesting than the research
topics the Max Planck institutes are working on. Thus, in the FhG, as in the federal research institutes,
scientific curiosity is clearly subordinated to societal relevance. In terms of functional specialization,
the FhG organizes the transfer of results from applied research to societal users.

Research demand varies considerably from one FhG institute to the next, and within any given institu-
tute over time. This fact has been one of the reasons why the FhG as a group has developed a strong
self-organization. As a corporate actor the FhG is able to redistribute resources among its institutes. To
a certain extent, temporarily "rich" institutes support "poor" institutes, as long as the latter can be ex-
pected to prosper again in the future. Thus, the FhG functions as a mutual insurance among its insti-
tutes. This implies that the central management of the FhG anticipates market trends for contract re-
search and adapts the group’s overall research profile to these trends. In this way, the built-in respons-
siveness to societal demands works not only on the level of each institute, but also on the group level.

Although all this amounts to a high priority of criteria of societal relevance, for functional reasons the
institutes of the FhG, just like the federal research institutes, have to preserve curiosity-oriented re-
search to a certain extent. This is necessary for the FhG to counterbalance its tendency to identify to-
tally with the problem perspectives of the users of its research results. Only if the FhG’s solutions to
 technological problems are different from the users’ own views is there a long-term raison d’être for
this group of research institutes. The FhG’s institutional funds are meant to support such research ac-
tivities which continually revitalize the institutes' research base. In addition, the institutes maintain
widespread informal and formal networks with university research, especially at technical universities.
These networks give the FhG a "parasitical" grip upon university research. Here is another function of
the central management of the FhG. It keeps an attentive eye on the institutes and tries to prevent them
from "successful failure", i.e. the maximization of short-term returns from contract research which
would turn out to be a dead-end street sooner or later.

Thus, the plans of the BMBF to reduce the share of institutional funding in the FhG-budget further is a
major threat to the FhG because it would restrict its scientific autonomy and flexibility. Another chal-
lenge facing the society is the globalization of markets and production. In order to maintain contacts
and collaboration with its industrial clientele, it must follow them in the internationalization of their
activities. However, this expansion abroad is only feasible if Bund and Länder are willing to provide
the necessary funds needed for building up facilities abroad (Meyer-Krahmer 1996: 158-161).
5.3.3 Federal Research Establishments

A relatively large, but rather unknown sector of public research are the 56 (1995) Federal Research Establishments (Bundesforschungsanstalten (BFA)) with a total R&D staff of about 9600 and a total expenditure on R&D of about 1,1 billion DM. The history of some of the federal research establishments goes back to the second half of the 19th century when the central government started to establish government laboratories and research institutes with the task to support ministries and governmental agencies in the performance of public tasks like public health, standard and norm setting or promotion of agriculture and industry (Wissenschaftsrat 1965: 15). The most famous of these is the still existing “Physikalisch-Technische-Reichsanstalt” (PTR) founded in 1887 as the first national government laboratory for physics, precision mechanics and meteorology. Most Federal Research Establishments (44) are legally dependent state institutions carrying out research on behalf of the federal ministry to which they are assigned. Thus, in contrast to universities and the other non-university sectors the research activities of the BFE are directly subjected to political objectives and needs and concentrated on producing scientific knowledge and the solution of practical problems that the responsible ministry requires for carrying out its tasks (Ressortforschung). A main area of activities in this context is “service” or “routine” research (Hohn/Schimank 1990: 307-316):

- provision of scientific information, expertise and advice for political decision-making and legislation;
- systematic and comprehensive data collecting and processing necessary for public planning and monitoring tasks;
- product certification, norm-setting and provision of scientific information and services for industrial and societal clients of the ministry;
- carrying out of short-term research tasks for the ministry in the framework of its ongoing activities.

R&D is therefore only one task of the Federal Research Establishments. In 1995, only about 50% of overall expenditure and staff were classified as R&D resources and in some BFA this share is only 10% (BMBF 1996a: 488). The BFA vary also considerably in their size reaching from institutes with less than 20 staff members and budgets of about 2 million DM to large-scale institutions with up to 3000 employees and a budget of about 400 million DM. The historical rooting and service function of the BFE is reflected in their distribution on the 14 federal ministries operating at least one establishment. 28 of 56 BFE are operated by four ministries performing classical public tasks, the federal ministry of agriculture (10), defense (5), health (5), transport (5) and social matters, whereas BFE in the responsibilities of the environmental ministry (3) and post and telecommunication (3) or a BFE for

---

186 See for the only existing study on this PSR sector Hohn/Schimank (1990): chapter 8.
187 See for the development of “government research” (staatliche Forschung) Lundgreen et al. (1986).
sport sciences show the rise of the modern welfare and service state. The expansion and scientification of government tasks is also revealed by the share of scientific fields covered by the BFE. Although natural sciences predominate accounting for 43% of R&D expenditure, engineering sciences (18%) and medicine (21%) are also important. According to their smaller socioeconomic and practical relevance only social sciences (4%) are of marginal importance. A particular feature of the BFE is the relatively large share of agricultural sciences (14%) that makes the 10 research establishments in the responsibility of the federal ministry for agriculture the centers of agricultural research in the Federal Republic.

Already at the end of the 19th century a special group of federal research establishments emerged whose research activities are not related to public policy needs. This group of BFA consists of institutes in the arts and humanities located abroad that are operated and funded by the central government due to its responsibility for foreign cultural policy. They comprise such internationally prestigious institutions like the “German Archeological Institute” with branches in several countries and the “Institute for Art History” in Florence, already established in the 19th century by private initiatives and later taken over by the federal government. In addition, there are 5 “German Historical Institutes” in Paris, Rome, London, Washington and Warsaw, a “German Institute for Japan Studies” in Tokyo and an “Orient-Institute” in Beirut for investigating and cultivating bilateral relations. In contrast to the “real” federal research establishments, the ministry to which these institutes are assigned exercise only a formal supervision, whereas they enjoy scientific autonomy in planning and carrying out their research programs and projects.

Challenges

Compared to the MPG, the federal research institutes are in a very different situation. Because they are each subordinated to a particular federal ministry, their autonomy is rather low. In this hierarchical relationship the ministry can order an institute to work on certain research topics. Only if these orders do not exhaust the institute's research capacity may there be a niche for criteria of scientific curiosity. However, many institutes suffer from a chronic overload of such research orders. In addition, the institutes can also be ordered to respond to research demands articulated by the respective policy area. To the degree that this happens the ministry abdicates its hierarchical guidance of research in favor of a market governance by a plurality of users of the institute's research capacity. But, in contrast to the typical kind of market relationship, a federal research institute is usually not allowed to decide whether to accept a research demand or not; instead, the contracts cannot be refused, only postponed if there are too many of them at the moment. Thus, market governance also leaves almost no room for scientific curiosity. Finally, because the federal research institutes have no self-organization as a group, they cannot even partially resist these forces of political and market governance by collective pressure for more scientific autonomy. Each of them is individually controlled by its ministry.
However, the respective ministries are aware of being dependent upon their institutes with regard to certain research activities. This awareness, which can be subtly reinforced by the institutes, can cause the ministries to refrain from pressing them too much politically. Otherwise, the institutes’ cooperativeness and scientific standing might be reduced. Especially when it comes to legitimizing political decisions by presenting an expert opinion, a task for which ministries often turn to their institutes, a high scientific standing is required. This self-interested reserve of the ministries gives the federal research institutes at least a little leeway to conduct curiosity-based research. Thus, the autonomy of the MPG is weakened a bit by political considerations whereas political considerations increase the autonomy of the federal research institutes a little bit. Nevertheless, the difference between both groups of research institutes in terms of autonomy undoubtedly remains very large.

5.3.4 National Research Centers

The largest sub-sector of non-university research are the 16 “National Research Centers” (Großforschungseinrichtungen (GFE)) that had a combined R&D budget of 4,2 billion DM and a total of 22300 R&D employees in 1995.188 A first group of 5 GFE in nuclear physics was founded in 1956-57 whose number grew to 8 in 1964 and 1969. In 1969 a thematic expansion took place when GFE for data processing and aeronautics and space research were established, followed by centers for cancer research and biotechnology in 1976 and polar and maritime research in 1980. Since then, however, only 3 new research centers for geological research, environmental research and molecular medicine were added in the East German Länder following reunification.

As described in chapter two the national research centers were founded in the framework of federal priority programs for big science and the development of large technical systems complemented over time by long-term programs in areas of “precaution research”, especially environmental, health, and climate research. Accordingly, three quarters of financial and staff resources go to the natural sciences, followed by about 20% in engineering and 5% in medicine. In the framework of the federal priority programs the GFE have the task to carry out complex, economic risky, technical demanding and long-term basic and application-oriented research that depends on (1) a concentration of financial and staff resources, (2) specialized and sophisticated scientific-technical infrastructure or (3) large-scale interdisciplinary research teams. A second task of some GFE is to operate large research installations like reactors and particle accelerators that are available to external research teams, especially from universities, and whose efficient use requires long-term planning and coordination of experiments. According to the program budget of the “Confederation of National Research Centers” (see below) activities of the GFE are concentrated on 10 priority tasks:

---

188 In the reform that is currently undertaken in order to provide the GFE with a more centralized organization and to concentrate and coordinate their resources and research activities the centers were renamed into “Helmholtz-Centers” within the “Helmholtz-Society” in November 1995.
- research into fundamentals of matters (17%);
- energy research and technology (15%);
- research in the service of health (13%);
- environmental research (12%);
- space exploration and engineering (8%);
- information and communication technology (6%);
- new materials and advanced technologies (6%);
- integral research into system earth (5%);
- traffic and transportation systems (5%);
- biotechnology (3%).

If one takes into account that a large share of energy research go to atomic energy and “research into fundamentals of matters” is mainly oriented towards nuclear physics the central role still played by nuclear-related research becomes clear. 6 of the 16 research centers are still to various degrees active in this area. Size, organization, research areas and tasks of individual GFE vary considerably. Whereas the smallest GFE have about 500 employees, the largest have about 4000. In 1995 the “Research Center Karlsruhe (FZK)” had an estimated budget of almost 1 billion DM compared to about 60 million DM of the “Society for Biotechnological Research (GBF)”. The “Foundation German Electron-Synchrotron (DESY)” is primarily a service institution operating particle accelerators for German and international research groups. In contrast, the “GMD-Research Center Information-Technology (GMD)” does not have a large research installation and its decentralized institutes and research teams cooperating with universities in basic research and teaching as well as industrial partners in applied R&D and technology-transfer. While some of the GFE concentrate exclusively on one scientific field or problem like the German Cancer Research Center (DKFZ), the “Research Center Jülich (FZJ), for example, is active in 5 priority tasks reaching from nuclear technology over environmental research to new materials and advanced technologies and health research.

In addition to the thematic fragmentation of R&D both between and within the individual centers the Großforschungseinrichtungen also lack a strong self-organization able to formulate long-term strategies and to represent them towards governments. Until recently, the GFE were only loosely coupled in the “Confederation of National Research Centers (Arbeitsgemeinschaft der Großforschungseinrichtungen (AGF)), established in 1970 to exchange financial, administrative, scientific and technical problems, to coordinate research activities, to discuss common problems and especially to develop and represent common interests and positions towards external actors. Hierarchical decision-making and implementing powers of the AFG are, however, weak and its work rests de facto on the voluntary co-
operation of the independent GFE having scientific autonomy and own research programs developed in cooperation with federal government and industry. Only in November 1995, the AFG was transformed into the “Hermann von Hemholtz Association of National Research Centers” (Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF)) to provide the GFE with a more centralized and cohesive organization and to concentrate resources and research activities on key technologies and research fields. For this purpose, the new senate of the HGF comprises representatives of state and industry and has the power to give recommendations on a common “program budget” and priorities and research areas for all centers. In addition, Bund and Länder decided in 1997 to earmark 5% of the institutional funding for the GFE for a”strategic fund” administered by the senate for which the centers can apply on a competitive basis.

With this government supported strengthening of self-organization the national research centers shall be enabled to develop long-term strategies above the level of individual centers and to reallocate resources accordingly. Another step in this direction was the introduction of an ex post evaluation and foresight system if the head of an institute or department retires. Like in the MPG this opportunity shall now be used to determine if the quality and promise of the research performed by the institute warrants its continuation or if it shall be dissolved to free resources for more innovative fields.

Challenges

The autonomy of the big science centers is not as high as that of the MPG and not as low as that of the federal research institutes and the FhG. The centers are the scientific allies of the federal research ministry, improving its political standing in relation to the states as well as to other federal ministries. Being in charge of the big science centers, the ministry is not as dependent upon other research actors for whose political direction it has to come to terms with the states. In addition, the centers are important instruments supporting the ministry’s claim to be the dominant actor of federal research policy. All this adds up to a considerable dependency of the federal research ministry upon the big science centers.

These constellations find their institutional expression in the formal bilateral bargaining relation between each center and the ministry. Both sides have to agree upon the center’s research program. On the one hand, this gives the ministry a strong position for its political guidance of the centers’ research activities. The formal veto power is even underlined by the resource dependency of the centers upon the ministry. By being more or less generous in financial terms, the ministry can reinforce its demands. But on the other hand, as just mentioned, the ministry is also strongly dependent upon the big science centers. Therefore, compared to the federal research institutes, this group of institutes enjoys considerable autonomy. Nevertheless, compared to the MPG, it has to find a consensus with the federal research ministry about research programs; and this enables the ministry to subject the centers to criteria of societal relevance.
Initially, almost every big science center was deliberately established as an organization which would bridge the gap between curiosity-driven basic research and transfer-oriented applied research in a particular technological field of high societal relevance such as nuclear energy, space technology, or data processing. But in addition to big science centers like the Kernforschungszentrum Karlsruhe, there are others like the Deutsche Elektronensynchroton which provide large research facilities for purely curiosity-driven basic research. Moreover, most of the big science centers which were designed to be bridging mechanisms between basic and applied research did not succeed and have split up into many disconnected research groups. Some groups do curiosity-driven basic research similar to a Max Planck institute, others within the same center work like a research institute of the federal government, and still others like a Fraunhofer institute. Thus, the big science centers have had a somewhat diffuse profile from the beginning which is quite fragmented today.

This failure to realize a new type of research has been one of the reasons why the federal ministry has tried to reorganize the centers since the mid-seventies, and even to close down some of them. However, there is also a tacit coalition between a particular big science center and the state in which it is located. The states are not usually interested in participating in the political direction of the centers’ research programs. But the states do want to ensure their respective centers continued existence and, if possible, their growth. Because only 90% of the institutional funds given to a big science center come from the federal research ministry while 10% are contributed by the respective state, the latter has formal rights which allow the pursuit of this interest. As a consequence, the federal research ministry is virtually unable to close down a big science center. This inability implies that the ministry lacks the clout to threaten with a "last resort" sanction, which weakens its influence upon the big science centers. To overstate the case, they know that, whatever they may do, the worst cannot happen to them.

On their own initiative, the big science centers founded the Arbeitsgemeinschaft der Großforschungseinrichtungen (AGF), an association which was supposed to strengthen the group's self-organization. But compared to the MPG and the FhG, the big science centers have not become a group of research institutes with a strong collective willpower. Each center is too involved with maintaining its own autonomy. Granting the AGF far-reaching rights of collectively binding decisions might result in decisions which are detrimental to a particular center's interests. Therefore, the AGF can only take positions which are agreed upon by all centers. This, in turn, weakens the position of the AGF vis-à-vis the federal research ministry. In fact, in all substantial matters the ministry interacts directly with each big science center. Thus, the existence of the AGF does not contribute significantly to the autonomy of this group of research institutes.

In the nineties the GFE experienced again a legitimation crisis putting their existence as distinct type of PSR institution into question (see above). The financial situation now has become so tight that the centers no longer could hope to remain unaffected by the demands to scale them down or even to close them as on previous occasions. Thus, the main challenge for the national research centers is if they are
finally able to implement the demands for a concentration on strategic research areas, to terminate mediocre or outrun fields, to create more flexible structures and to intensify collaboration with industry. If this is not the case, this time maybe even the BMBF will no longer hold its protecting hand over the most heavily criticized centers. It also remains to be seen if the self-organization in the Helmholtz-Association will establish strategic planning and resource allocation capacities overcoming the egoism of individual centers (Rüttgers 1996a).

5.3.5 Bund-Länder-Institutes\textsuperscript{189}

A special sub-sector of non-university research is the heterogeneous group of the so-called “Blue-List-Institutes” (Blaue-Liste-Institute) or “Bund-Länder-Institutes” (BLI). Before reunification the smallest non-university sector accounting, the number of institutes has increased from 47 in 1989 to 82 in 1995 due to the establishment of 35 Blue-List-Institutes in the East German Länder. In consequence, the BLI has become almost as important as the Max-Planck-Society in quantitative. The West German BLI were mostly regional research institutes founded by single Länder or central government, some of them already at the turn of the century with very different size, research areas, tasks and legal statutes. Research areas and tasks extend from museums and research institutes in the humanities over economic research institutes and institutes in natural and life sciences to service institutions gathering and providing information in special scientific fields and scientific institutions operating research installations for universities and industrial users. Their character as a “residual category” collecting rather research facilities with very different research areas, missions and quality is reflected in the distribution of resources by scientific fields. Most striking is the strong position of the humanities and social sciences on the one and medicine on the other hand differentiating the BLI from other non-university sectors (Table 12-13A). But the dominance of the natural sciences is evident and has increased significantly since unification. The position of the BLI as the “fourth pillar” of non-university research is only based on the administrative criterion of the joint Federal-state financing of “independent research facilities of national importance and of interest for science policy of the whole Federation” if their costs exceed a certain volume (Art. 2 § 1 of the RV-Fo).

Due to this historical development and mere administrative identity the BLI are not organized in an central carrier institution like MPG and FhG. Until November 1991, when most of them became members of the “Confederation of Research Institutions Blue List” (Arbeitsgemeinschaft Forschungseinrichtungen Blaue Liste (AG-BL)) they lacked even a forum for mutual information, voluntary coordination and a common interest representation as the National Research Centers have established despite their independent and decentralized establishment. In March 1995, the AG-BL was renamed in “Sci-

\textsuperscript{189} The Bund-Länder-Institutes already has been extensively dealt with in other contexts. Here, only a short summary of the main features and developments is provided.
The "Blue List" has always been a heterogeneous assortment of institutes each of which could be assigned to one of the four other groups depending on its particular type of research. Each institute, receiving usually half of its funds from a particular federal ministry and half from the state in which it is located, enjoys a considerable autonomy as a result of the mutual blockade between both political actors. In this respect, the situation of these institutes is similar to that of the MPG. But since they lack the MPG’s strong self-organization, each institute of the "Blue List" is more vulnerable to political interventions. As with the big science centers, the states are primarily interested in ensuring an institute's continued existence, and thus tolerate the respective federal ministry's political interventions into the institute's research program. But an institute of this group is not as important to a state as a big science center is, nor is it as important to the respective federal ministry as a big science center is to the federal research ministry. Thus, it is certainly difficult, but not impossible to eliminate an institute from the "Blue List". In fact, such exclusions have happened in a number of cases. This threat gives the federal ministries more influence on these institutes than the federal research ministry has on the big science centers.
In addition, many of the institutes of the "Blue List" need to augment their budget with considerable separately budgeted funds. These institutes are much more dependent upon such additional funds than big science centers or the Max Planck institutes. Moreover, separately budgeted funds allotted to an institute of the "Blue List" often come from the respective federal ministry, giving it still more influence over the institute. For instance, the federal ministry of economic affairs is institutionally in charge of the six institutes of economic research belonging to the "Blue List" and it gives considerable project funds to these institutes as well. Consequently, the autonomy of the "Blue List" is lower than that of the big science centers. The institutes of the "Blue List" have to attend much more to criteria of societal relevance. In some cases, though, the federal ministry is as uninterested in the institute’s research activities as the state. This indifference can give an institute the opportunity to orientate its research to criteria of scientific curiosity as much as a Max Planck institute does.

One unintended result of unification was the strong expansion of the "Blue List" compared to other groups of research institutes, which has been viewed with a certain skepticism especially by the MPG (see above). This may result in a future domain conflict between these two groups. Another tension which has to be observed carefully in future is the one between the "poor" East and the comparatively well-to-do West German states. This difference may undermine the solidarity of the states in bargaining situations with the federal government, giving the latter the opportunity to play off one group of the states against the other. It remains to be seen whether such tensions, if they intensify, can destabilize the institutional equilibrium of the sector. No indications of such a development are visible yet, however.
6 Literature


Bundesministerium für Bildung und Wissenschaft (BMBW), 1972: *Bundesbericht Forschung IV*. Bonn: BMBW.


Bundesministerium für Forschung und Technologie (BMFT), 1975: *Bundesbericht Forschung V*. Bonn: BMFT.

Bundesministerium für Forschung und Technologie (BMFT), 1979: *Bundesbericht Forschung VI*. Bonn: BMFT.


Bundesministerium für Forschung und Technologie (BMFT), 1993a: *Bundesbericht Forschung*. Bonn: BMFT.


Bundesministerium für wissenschaftliche Forschung (BMwF), 1965: *Bundesbericht Forschung I*. Bonn: BMwF.

Bundesministerium für wissenschaftliche Forschung (BMwF), 1967: *Bundesbericht Forschung II*. BMwF.

Bundesministerium für wissenschaftliche Forschung (BMwF), 1969: *Bundesbericht Forschung III*. Bonn: BMwF.


Hochschulrektorenkonferenz (HRK), 1992: *Konzept zur Entwicklung der Hochschulen in Deutschland*. Bonn: HRK.


Max-Planck-Gesellschaft (MPG), 1995: *MPG in Zahlen*. München: MPG.

Max-Planck-Gesellschaft (MPG), 1996: *Jahresbericht*. München: MPG.


Literature 231


Literature


Westdeutsche Rektorenkonferenz (WRK), 1987: *Arbeitsbericht*. Bonn: WRK.

Westdeutsche Rektorenkonferenz (WRK), 1988: *Die Zukunft der Hochschulen. Überlegungen für eine zukunftsoriene Hochschulpolitik*. Bonn: WRK.


## Appendix

### Table 1: Expenditure on R&D in the FRG according to financing sector 1962-1995 (million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total R&amp;D-exp.</td>
<td>4490</td>
<td>7900</td>
<td>17750</td>
<td>24137</td>
<td>39230</td>
<td>51696</td>
<td>64635</td>
<td>76580</td>
<td>78964</td>
<td>80809</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>11</td>
<td>20</td>
<td>45</td>
<td>61</td>
<td>100</td>
<td>132</td>
<td>165</td>
<td>195</td>
<td>201</td>
<td>206</td>
</tr>
<tr>
<td>Industry</td>
<td>2150</td>
<td>4060</td>
<td>8735</td>
<td>11792</td>
<td>21816</td>
<td>31090</td>
<td>41197</td>
<td>46949</td>
<td>48323</td>
<td>49542</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>10</td>
<td>18</td>
<td>40</td>
<td>53</td>
<td>100</td>
<td>143</td>
<td>189</td>
<td>215</td>
<td>222</td>
<td>227</td>
</tr>
<tr>
<td>In %</td>
<td>47,9</td>
<td>51,4</td>
<td>49,2</td>
<td>48,9</td>
<td>55,6</td>
<td>60,1</td>
<td>63,7</td>
<td>61,3</td>
<td>61,2</td>
<td>61,3</td>
</tr>
<tr>
<td>State</td>
<td>2278</td>
<td>3746</td>
<td>8700</td>
<td>12035</td>
<td>17261</td>
<td>20473</td>
<td>23113</td>
<td>29249</td>
<td>30402</td>
<td>31064</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>13</td>
<td>22</td>
<td>50</td>
<td>70</td>
<td>100</td>
<td>119</td>
<td>134</td>
<td>169</td>
<td>176</td>
<td>180</td>
</tr>
<tr>
<td>In %</td>
<td>50,7</td>
<td>47,4</td>
<td>49,0</td>
<td>49,9</td>
<td>44,0</td>
<td>39,6</td>
<td>35,8</td>
<td>38,2</td>
<td>38,5</td>
<td>38,4</td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bund</td>
<td>1096</td>
<td>1777</td>
<td>4636</td>
<td>7538</td>
<td>10363</td>
<td>12767</td>
<td>13956</td>
<td>16926</td>
<td>16856</td>
<td>16500</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>11</td>
<td>17</td>
<td>45</td>
<td>73</td>
<td>100</td>
<td>123</td>
<td>135</td>
<td>163</td>
<td>163</td>
<td>159</td>
</tr>
<tr>
<td>In % of state</td>
<td>48,1</td>
<td>47,4</td>
<td>53,3</td>
<td>62,6</td>
<td>60,0</td>
<td>62,4</td>
<td>60,4</td>
<td>57,9</td>
<td>55,4</td>
<td>52,8</td>
</tr>
<tr>
<td>Länder</td>
<td>1182</td>
<td>1969</td>
<td>4064</td>
<td>4497</td>
<td>6898</td>
<td>7706</td>
<td>9157</td>
<td>12287</td>
<td>13546</td>
<td>14564</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>17</td>
<td>29</td>
<td>59</td>
<td>65</td>
<td>100</td>
<td>112</td>
<td>133</td>
<td>178</td>
<td>196</td>
<td>211</td>
</tr>
<tr>
<td>In % of state</td>
<td>51,9</td>
<td>52,6</td>
<td>46,7</td>
<td>37,4</td>
<td>40,0</td>
<td>37,6</td>
<td>39,6</td>
<td>42,1</td>
<td>44,6</td>
<td>47,2</td>
</tr>
</tbody>
</table>

Table 2: Expenditure on R&D in the FRG according to financing sector 1962-1995 in constant prices (1981=100) (in million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total R&amp;D-exp.</td>
<td>14254</td>
<td>21526</td>
<td>32689</td>
<td>31717</td>
<td>39230</td>
<td>46784</td>
<td>53417</td>
<td>58280</td>
<td>54989</td>
<td>54601</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>36</td>
<td>55</td>
<td>83</td>
<td>81</td>
<td>100</td>
<td>119</td>
<td>136</td>
<td>149</td>
<td>140</td>
<td>139</td>
</tr>
<tr>
<td>Industry</td>
<td>6825</td>
<td>11063</td>
<td>16087</td>
<td>15495</td>
<td>22082</td>
<td>28136</td>
<td>34047</td>
<td>35730</td>
<td>33651</td>
<td>33474</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>31</td>
<td>51</td>
<td>74</td>
<td>71</td>
<td>100</td>
<td>129</td>
<td>156</td>
<td>164</td>
<td>154</td>
<td>153</td>
</tr>
<tr>
<td>State</td>
<td>7223</td>
<td>10207</td>
<td>16022</td>
<td>15815</td>
<td>17261</td>
<td>18528</td>
<td>19102</td>
<td>22260</td>
<td>21171</td>
<td>20989</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>42</td>
<td>59</td>
<td>93</td>
<td>92</td>
<td>100</td>
<td>107</td>
<td>111</td>
<td>129</td>
<td>123</td>
<td>122</td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bund</td>
<td>3479</td>
<td>4842</td>
<td>8538</td>
<td>9905</td>
<td>10363</td>
<td>11554</td>
<td>11534</td>
<td>12881</td>
<td>11738</td>
<td>11149</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>34</td>
<td>47</td>
<td>82</td>
<td>96</td>
<td>100</td>
<td>111</td>
<td>111</td>
<td>124</td>
<td>113</td>
<td>108</td>
</tr>
<tr>
<td>Länder</td>
<td>3752</td>
<td>5365</td>
<td>7484</td>
<td>5909</td>
<td>6898</td>
<td>6974</td>
<td>7568</td>
<td>9351</td>
<td>9433</td>
<td>9841</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>54</td>
<td>78</td>
<td>109</td>
<td>86</td>
<td>100</td>
<td>101</td>
<td>110</td>
<td>136</td>
<td>137</td>
<td>143</td>
</tr>
</tbody>
</table>

Source: see Table 1; own calculations on the basis of the price index of government expenditure published by the Federal Statistical Office.
### Table 3: Gross domestic expenditure on R&D (GERD) in the FRG by performing sector 1962-1995 (million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GERD</td>
<td>4300</td>
<td>7450</td>
<td>17210</td>
<td>23710</td>
<td>37821</td>
<td>50113</td>
<td>63872</td>
<td>74517</td>
<td>76563</td>
<td>79520</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>11</td>
<td>20</td>
<td>46</td>
<td>91</td>
<td>100</td>
<td>133</td>
<td>169</td>
<td>197</td>
<td>202</td>
<td>210</td>
</tr>
<tr>
<td>% of GDP</td>
<td>1.19</td>
<td>1.62</td>
<td>2.30</td>
<td>2.24</td>
<td>2.43</td>
<td>2.72</td>
<td>2.87</td>
<td>2.61</td>
<td>2.43</td>
<td>2.30</td>
</tr>
<tr>
<td>Public sector</td>
<td>1850</td>
<td>2880</td>
<td>6510</td>
<td>8780</td>
<td>11616</td>
<td>13901</td>
<td>17786</td>
<td>22842</td>
<td>25328</td>
<td>26685</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>16</td>
<td>25</td>
<td>56</td>
<td>76</td>
<td>100</td>
<td>120</td>
<td>153</td>
<td>197</td>
<td>219</td>
<td>230</td>
</tr>
<tr>
<td>In %</td>
<td>43.0</td>
<td>38.7</td>
<td>37.8</td>
<td>37.0</td>
<td>30.7</td>
<td>27.7</td>
<td>27.8</td>
<td>30.7</td>
<td>33.1</td>
<td>33.6</td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Universities</td>
<td>910</td>
<td>1450</td>
<td>3500</td>
<td>4590</td>
<td>6312</td>
<td>7289</td>
<td>9227</td>
<td>12169</td>
<td>13838</td>
<td>14430</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>14</td>
<td>23</td>
<td>55</td>
<td>73</td>
<td>100</td>
<td>115</td>
<td>146</td>
<td>193</td>
<td>219</td>
<td>229</td>
</tr>
<tr>
<td>In % of total</td>
<td>21.2</td>
<td>19.5</td>
<td>20.3</td>
<td>19.4</td>
<td>16.7</td>
<td>14.5</td>
<td>14.6</td>
<td>16.3</td>
<td>18.1</td>
<td>18.1</td>
</tr>
<tr>
<td>State / PNP</td>
<td>940</td>
<td>1430</td>
<td>3010</td>
<td>4190</td>
<td>5304</td>
<td>6612</td>
<td>8559</td>
<td>10673</td>
<td>11490</td>
<td>12255</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>18</td>
<td>27</td>
<td>57</td>
<td>79</td>
<td>100</td>
<td>125</td>
<td>161</td>
<td>201</td>
<td>217</td>
<td>231</td>
</tr>
<tr>
<td>In % of total</td>
<td>21.9</td>
<td>19.2</td>
<td>17.5</td>
<td>17.7</td>
<td>14.0</td>
<td>13.2</td>
<td>13.4</td>
<td>14.3</td>
<td>15.0</td>
<td>15.4</td>
</tr>
<tr>
<td>Industry</td>
<td>2450</td>
<td>4570</td>
<td>10700</td>
<td>14930</td>
<td>26196</td>
<td>36212</td>
<td>46086</td>
<td>51675</td>
<td>51236</td>
<td>52835</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>9</td>
<td>17</td>
<td>41</td>
<td>57</td>
<td>100</td>
<td>138</td>
<td>176</td>
<td>197</td>
<td>196</td>
<td>202</td>
</tr>
<tr>
<td>In %</td>
<td>57.0</td>
<td>61.3</td>
<td>62.2</td>
<td>63.0</td>
<td>69.3</td>
<td>72.3</td>
<td>72.2</td>
<td>69.3</td>
<td>66.9</td>
<td>66.4</td>
</tr>
</tbody>
</table>

### Table 4: Gross domestic expenditure on R&D in the FRG by performing sector 1962-1995 in constant prices (1981=100) (in million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total R&amp;D exp.</td>
<td>13651</td>
<td>20300</td>
<td>31694</td>
<td>31156</td>
<td>45351</td>
<td>52787</td>
<td>56710</td>
<td>53317</td>
<td>53370</td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>36</td>
<td>54</td>
<td>84</td>
<td>82</td>
<td>100</td>
<td>120</td>
<td>140</td>
<td>150</td>
<td>141</td>
<td>142</td>
</tr>
<tr>
<td>Public sector</td>
<td>5873</td>
<td>7847</td>
<td>11989</td>
<td>11537</td>
<td>12580</td>
<td>14699</td>
<td>17384</td>
<td>17638</td>
<td>18030</td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>51</td>
<td>68</td>
<td>103</td>
<td>99</td>
<td>100</td>
<td>108</td>
<td>127</td>
<td>150</td>
<td>152</td>
<td>155</td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Universities</td>
<td>2889</td>
<td>3951</td>
<td>6446</td>
<td>6032</td>
<td>6596</td>
<td>7626</td>
<td>9261</td>
<td>9636</td>
<td>9750</td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>46</td>
<td>63</td>
<td>102</td>
<td>96</td>
<td>100</td>
<td>104</td>
<td>121</td>
<td>147</td>
<td>153</td>
<td>154</td>
</tr>
<tr>
<td>State / PNP</td>
<td>2984</td>
<td>3896</td>
<td>5543</td>
<td>5506</td>
<td>5304</td>
<td>5984</td>
<td>7074</td>
<td>8123</td>
<td>8001</td>
<td>8280</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>56</td>
<td>73</td>
<td>105</td>
<td>104</td>
<td>113</td>
<td>133</td>
<td>153</td>
<td>151</td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>7778</td>
<td>12452</td>
<td>19705</td>
<td>19619</td>
<td>26196</td>
<td>32771</td>
<td>38088</td>
<td>39326</td>
<td>35680</td>
<td>35699</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>30</td>
<td>48</td>
<td>75</td>
<td>75</td>
<td>100</td>
<td>125</td>
<td>145</td>
<td>150</td>
<td>136</td>
<td>136</td>
</tr>
</tbody>
</table>

Source: see Table 2-3.
Table 5: Gross domestic expenditure on R&D in West and East Germany according to performing sector 1989-1995 (in million DM)

<table>
<thead>
<tr>
<th></th>
<th>1989</th>
<th>1991</th>
<th>1993</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total industry</td>
<td>48635</td>
<td>51675</td>
<td>51236</td>
<td>52835</td>
</tr>
<tr>
<td>West German Länder</td>
<td>46086</td>
<td>49394</td>
<td>48644</td>
<td>49732</td>
</tr>
<tr>
<td>In % of industry</td>
<td>86,1</td>
<td>95,6</td>
<td>94,9</td>
<td>94,1</td>
</tr>
<tr>
<td>In % of West German R&amp;D-exp.</td>
<td>72,2</td>
<td>71,8</td>
<td>69,8</td>
<td>69,4</td>
</tr>
<tr>
<td>East German Länder</td>
<td>7438</td>
<td>1938</td>
<td>2077</td>
<td>2716</td>
</tr>
<tr>
<td>In % of industry</td>
<td>13,9</td>
<td>3,8</td>
<td>4,1</td>
<td>5,1</td>
</tr>
<tr>
<td>In % of East German R&amp;D-exp.</td>
<td>76,9</td>
<td>40,6</td>
<td>33,8</td>
<td>37,5</td>
</tr>
<tr>
<td>Total universities</td>
<td>9797</td>
<td>12169</td>
<td>13838</td>
<td>14430</td>
</tr>
<tr>
<td>West German Länder</td>
<td>9227</td>
<td>10388</td>
<td>11480</td>
<td>11945</td>
</tr>
<tr>
<td>In % of universities</td>
<td>94,2</td>
<td>85,4</td>
<td>83,0</td>
<td>82,8</td>
</tr>
<tr>
<td>In % of West German R&amp;D-exp.</td>
<td>14,3</td>
<td>15,1</td>
<td>16,5</td>
<td>17,2</td>
</tr>
<tr>
<td>East German Länder</td>
<td>570</td>
<td>1463</td>
<td>2035</td>
<td>2275</td>
</tr>
<tr>
<td>In % of universities</td>
<td>5,8</td>
<td>12,0</td>
<td>14,7</td>
<td>15,8</td>
</tr>
<tr>
<td>In % of East German R&amp;D-exp.</td>
<td>5,9</td>
<td>30,7</td>
<td>33,2</td>
<td>31,4</td>
</tr>
<tr>
<td>Total state /PNP</td>
<td>9927</td>
<td>10378</td>
<td>11647</td>
<td>12255</td>
</tr>
<tr>
<td>West German Länder</td>
<td>8263</td>
<td>8970</td>
<td>9555</td>
<td>9939</td>
</tr>
<tr>
<td>In % of state/PNP</td>
<td>83,2</td>
<td>86,4</td>
<td>82,0</td>
<td>81,1</td>
</tr>
<tr>
<td>In % of West German R&amp;D-exp.</td>
<td>11,1</td>
<td>13,0</td>
<td>13,7</td>
<td>14,3</td>
</tr>
<tr>
<td>East German Länder</td>
<td>1664</td>
<td>1372</td>
<td>2024</td>
<td>2251</td>
</tr>
<tr>
<td>In % of state/PNP</td>
<td>16,8</td>
<td>13,2</td>
<td>17,4</td>
<td>18,4</td>
</tr>
<tr>
<td>In % of East German R&amp;D-exp.</td>
<td>17,2</td>
<td>28,7</td>
<td>33,0</td>
<td>31,1</td>
</tr>
</tbody>
</table>

Table 5-1: R&D-personnel in the new Länder according to employing sector 1989-1993 (FTE)

<table>
<thead>
<tr>
<th></th>
<th>1989</th>
<th>1991</th>
<th>1993</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>140567</td>
<td>82831</td>
<td>50820</td>
<td>57051</td>
</tr>
<tr>
<td>In % of total R&amp;D-personnel</td>
<td>16,0</td>
<td>10,8</td>
<td>12,4</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>85767</td>
<td>34922</td>
<td>22032</td>
<td>23741</td>
</tr>
<tr>
<td>In % of Germany</td>
<td>10,9</td>
<td>7,5</td>
<td>8,4</td>
<td></td>
</tr>
<tr>
<td>In % of new Länder</td>
<td>61,0</td>
<td>42,2</td>
<td>43,4</td>
<td>41,6</td>
</tr>
<tr>
<td>Universities</td>
<td>14088</td>
<td>19509</td>
<td>16680</td>
<td>18948</td>
</tr>
<tr>
<td>In % of Germany</td>
<td>18,8</td>
<td>15,2</td>
<td>18,8</td>
<td></td>
</tr>
<tr>
<td>In % of new Länder</td>
<td>10,0</td>
<td>23,6</td>
<td>32,8</td>
<td>33,2</td>
</tr>
<tr>
<td>State /PNP</td>
<td>32486</td>
<td>28400</td>
<td>12429</td>
<td>14362</td>
</tr>
<tr>
<td>In % of Germany</td>
<td>31,3</td>
<td>17,5</td>
<td>19,1</td>
<td></td>
</tr>
<tr>
<td>In % of new Länder</td>
<td>23,1</td>
<td>34,3</td>
<td>24,5</td>
<td>25,2</td>
</tr>
</tbody>
</table>

Table 6: Public Expenditure on R&D in West and East Germany 1991-1995 (in million DM)

<table>
<thead>
<tr>
<th></th>
<th>1991</th>
<th>1993</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West German Länder</td>
<td>26247</td>
<td>25386</td>
<td>25668</td>
</tr>
<tr>
<td>Index (1991=100)</td>
<td>97</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>East German Länder</td>
<td>2967</td>
<td>4974</td>
<td>5396</td>
</tr>
<tr>
<td>Index (1991=100)</td>
<td>168</td>
<td>182</td>
<td></td>
</tr>
<tr>
<td><strong>Bund</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West German Länder</td>
<td>15487</td>
<td>14393</td>
<td>13892</td>
</tr>
<tr>
<td>Index (1991=100)</td>
<td>93</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>East German Länder</td>
<td>1440</td>
<td>2467</td>
<td>2608</td>
</tr>
<tr>
<td></td>
<td>171</td>
<td>181</td>
<td></td>
</tr>
<tr>
<td><strong>Länder</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West German Länder</td>
<td>10761</td>
<td>10993</td>
<td>11776</td>
</tr>
<tr>
<td>Index (1991=100)</td>
<td>102</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>East German Länder</td>
<td>1527</td>
<td>2511</td>
<td>2788</td>
</tr>
<tr>
<td>Index (1991=100)</td>
<td>164</td>
<td>183</td>
<td></td>
</tr>
</tbody>
</table>

### Table 7: R&D personnel and researchers in the FRG by employing sector 1971-1993 (full time equivalent)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R&amp;D personnel</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>84</td>
<td>86</td>
<td>100</td>
<td>111</td>
<td>121</td>
<td>147</td>
<td>130</td>
</tr>
<tr>
<td>Public sector</td>
<td>94821</td>
<td>115632</td>
<td>109535</td>
<td>115858</td>
<td>129937</td>
<td>194575</td>
<td>175822</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>87</td>
<td>106</td>
<td>100</td>
<td>106</td>
<td>119</td>
<td>178</td>
<td>161</td>
</tr>
<tr>
<td>In %</td>
<td>32,1</td>
<td>38,1</td>
<td>31,1</td>
<td>29,6</td>
<td>30,5</td>
<td>37,7</td>
<td>38,3</td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>55811</td>
<td>65028</td>
<td>58614</td>
<td>62188</td>
<td>69667</td>
<td>103864</td>
<td>100674</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>95</td>
<td>111</td>
<td>100</td>
<td>106</td>
<td>119</td>
<td>177</td>
<td>172</td>
</tr>
<tr>
<td>In % of total</td>
<td>18,9</td>
<td>21,5</td>
<td>16,6</td>
<td>15,9</td>
<td>16,3</td>
<td>20,1</td>
<td>23,2</td>
</tr>
<tr>
<td>State / PNP</td>
<td>39010</td>
<td>50604</td>
<td>50921</td>
<td>53670</td>
<td>60270</td>
<td>90711</td>
<td>75148</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>77</td>
<td>99</td>
<td>100</td>
<td>105</td>
<td>118</td>
<td>178</td>
<td>148</td>
</tr>
<tr>
<td>In % of total</td>
<td>13,2</td>
<td>16,7</td>
<td>14,5</td>
<td>13,7</td>
<td>14,1</td>
<td>17,6</td>
<td>16,4</td>
</tr>
<tr>
<td>Industry</td>
<td>199249</td>
<td>186252</td>
<td>242544</td>
<td>275080</td>
<td>296510</td>
<td>321756</td>
<td>283316</td>
</tr>
<tr>
<td>In % of total</td>
<td>67,5</td>
<td>61,4</td>
<td>68,9</td>
<td>70,4</td>
<td>69,5</td>
<td>62,3</td>
<td>61,8</td>
</tr>
<tr>
<td><strong>Researchers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public sector</td>
<td>38069</td>
<td>41525</td>
<td>51183</td>
<td>53873</td>
<td>63156</td>
<td>100883</td>
<td>101758</td>
</tr>
<tr>
<td>In %</td>
<td>42,2</td>
<td>40,0</td>
<td>39,9</td>
<td>36,5</td>
<td>35,8</td>
<td>41,7</td>
<td>43,9</td>
</tr>
</tbody>
</table>
### Table 7 continued

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>25617</td>
<td>25617</td>
<td>32264</td>
<td>33448</td>
<td>38836</td>
<td>62171</td>
</tr>
<tr>
<td>In % of total</td>
<td>28.4</td>
<td>24.7</td>
<td>25.2</td>
<td>22.7</td>
<td>22.0</td>
<td>25.7</td>
</tr>
<tr>
<td>In % of PSR</td>
<td>67.3</td>
<td>61.7</td>
<td>63.0</td>
<td>62.1</td>
<td>61.5</td>
<td>61.7</td>
</tr>
<tr>
<td>State / PNP</td>
<td>12452</td>
<td>15908</td>
<td>18919</td>
<td>20425</td>
<td>24320</td>
<td>38614</td>
</tr>
<tr>
<td>In % of total</td>
<td>13.8</td>
<td>15.3</td>
<td>14.8</td>
<td>13.9</td>
<td>13.8</td>
<td>16.0</td>
</tr>
<tr>
<td>In % of PSR</td>
<td>32.7</td>
<td>38.3</td>
<td>37.0</td>
<td>37.9</td>
<td>38.5</td>
<td>38.3</td>
</tr>
<tr>
<td>Industry</td>
<td>56589</td>
<td>61591</td>
<td>77017</td>
<td>93545</td>
<td>113247</td>
<td>141084</td>
</tr>
<tr>
<td>In % of total</td>
<td>62.7</td>
<td>59.4</td>
<td>60.1</td>
<td>63.5</td>
<td>64.2</td>
<td>58.3</td>
</tr>
</tbody>
</table>


### Table 8: Expenditure on R&D in the public (private) sector financed by industry (state) 1975-1995 (in million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In % of PSR</td>
<td>1.6</td>
<td>3.7</td>
<td>4.4</td>
<td>4.3</td>
<td>6.0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Of which</th>
</tr>
</thead>
<tbody>
<tr>
<td>State / PNP</td>
</tr>
<tr>
<td>In % of state/PNP</td>
</tr>
</tbody>
</table>

| University | 85  | 115  | 394  | 646  | 846  | 1184 |
| In % of university | 1.9 | 1.8  | 5.4  | 7.0  | 7.0  | 8.2  |

| Industry   | 2862 | 4421 | 5543 | 5073 | 5164 | 4647 |
| In % of industry | 19.2 | 16.9 | 15.3 | 11.0 | 10.0 | 8.8  |

Table 9: PSR expenditure on R&D in the FRG 1975-1995 by performing sector (million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>7530</td>
<td>10654</td>
<td>12748</td>
<td>16121</td>
<td>19610</td>
<td>22937</td>
<td>24208</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>71</td>
<td>100</td>
<td>120</td>
<td>151</td>
<td>184</td>
<td>215</td>
<td>227</td>
</tr>
<tr>
<td>Universities</td>
<td>4590</td>
<td>6312</td>
<td>7289</td>
<td>9227</td>
<td>12169</td>
<td>13838</td>
<td>14430</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>73</td>
<td>100</td>
<td>115</td>
<td>146</td>
<td>193</td>
<td>219</td>
<td>229</td>
</tr>
<tr>
<td>In %</td>
<td>61,0</td>
<td>59,2</td>
<td>57,2</td>
<td>57,2</td>
<td>62,1</td>
<td>60,3</td>
<td>59,5</td>
</tr>
<tr>
<td>State/PNP</td>
<td>2939</td>
<td>4342</td>
<td>5459</td>
<td>6894</td>
<td>7441</td>
<td>9099</td>
<td>9778</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>68</td>
<td>100</td>
<td>126</td>
<td>159</td>
<td>171</td>
<td>210</td>
<td>225</td>
</tr>
<tr>
<td>In %</td>
<td>39,0</td>
<td>40,8</td>
<td>42,8</td>
<td>42,8</td>
<td>37,9</td>
<td>39,7</td>
<td>40,4</td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GFE</td>
<td>1593</td>
<td>2236</td>
<td>2836</td>
<td>3576</td>
<td>3758</td>
<td>4192</td>
<td>4222</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>71</td>
<td>100</td>
<td>127</td>
<td>160</td>
<td>168</td>
<td>187</td>
<td>189</td>
</tr>
<tr>
<td>In %</td>
<td>21,2</td>
<td>21,0</td>
<td>22,2</td>
<td>22,2</td>
<td>19,2</td>
<td>18,3</td>
<td>17,4</td>
</tr>
<tr>
<td>In % of state / PNP</td>
<td>54,0</td>
<td>51,5</td>
<td>52,0</td>
<td>51,9</td>
<td>50,5</td>
<td>46,1</td>
<td>43,2</td>
</tr>
<tr>
<td>MPG</td>
<td>602</td>
<td>778</td>
<td>923</td>
<td>1122</td>
<td>1217</td>
<td>1429</td>
<td>1585</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>77</td>
<td>100</td>
<td>119</td>
<td>144</td>
<td>156</td>
<td>185</td>
<td>198</td>
</tr>
<tr>
<td>In %</td>
<td>8,0</td>
<td>7,3</td>
<td>7,2</td>
<td>7,0</td>
<td>6,2</td>
<td>6,2</td>
<td>6,5</td>
</tr>
<tr>
<td>In % of state / PNP</td>
<td>20,5</td>
<td>17,9</td>
<td>16,9</td>
<td>15,7</td>
<td>14,0</td>
<td>15,4</td>
<td>16,2</td>
</tr>
<tr>
<td>FhG</td>
<td>112</td>
<td>253</td>
<td>439</td>
<td>696</td>
<td>807</td>
<td>1000</td>
<td>1261</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>44</td>
<td>100</td>
<td>174</td>
<td>275</td>
<td>319</td>
<td>395</td>
<td>499</td>
</tr>
<tr>
<td>In %</td>
<td>1,5</td>
<td>2,4</td>
<td>3,4</td>
<td>4,3</td>
<td>4,1</td>
<td>4,4</td>
<td>5,2</td>
</tr>
<tr>
<td>In % of state / PNP</td>
<td>3,8</td>
<td>5,8</td>
<td>8,0</td>
<td>9,7</td>
<td>9,3</td>
<td>10,7</td>
<td>12,9</td>
</tr>
</tbody>
</table>
### Table 9 continued

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BLI</td>
<td>212</td>
<td>386</td>
<td>456</td>
<td>549</td>
<td>642</td>
<td>1350</td>
<td>1321</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>55</td>
<td>100</td>
<td>118</td>
<td>142</td>
<td>166</td>
<td>350</td>
<td>342</td>
</tr>
<tr>
<td>In %</td>
<td>2,8</td>
<td>3,6</td>
<td>3,6</td>
<td>3,4</td>
<td>3,3</td>
<td>5,9</td>
<td>6,0</td>
</tr>
<tr>
<td>In % of state / PNP</td>
<td>7,2</td>
<td>8,9</td>
<td>8,4</td>
<td>7,7</td>
<td>7,4</td>
<td>14,5</td>
<td>14,9</td>
</tr>
<tr>
<td>BFA</td>
<td>420</td>
<td>689</td>
<td>805</td>
<td>951</td>
<td>1017</td>
<td>1286</td>
<td>1148</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>61</td>
<td>100</td>
<td>117</td>
<td>138</td>
<td>148</td>
<td>164</td>
<td>181</td>
</tr>
<tr>
<td>In %</td>
<td>5,6</td>
<td>6,5</td>
<td>6,3</td>
<td>5,9</td>
<td>5,2</td>
<td>4,9</td>
<td>5,2</td>
</tr>
<tr>
<td>In % of state / PNP</td>
<td>14,3</td>
<td>15,9</td>
<td>14,7</td>
<td>13,3</td>
<td>11,7</td>
<td>12,1</td>
<td>12,8</td>
</tr>
</tbody>
</table>


### Table 10: R&D personnel by employing public sector 1975-1995 (FTE)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>98207</td>
<td>104126</td>
<td>115828</td>
<td>132623</td>
<td>165206</td>
<td>160009</td>
<td></td>
</tr>
<tr>
<td>Universities</td>
<td>58614</td>
<td>62188</td>
<td>69667</td>
<td>84354</td>
<td>110020</td>
<td>100674</td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>100</td>
<td>106</td>
<td>119</td>
<td>144</td>
<td>188</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>59,7</td>
<td>59,7</td>
<td>60,1</td>
<td>63,6</td>
<td>66,6</td>
<td>62,9</td>
<td></td>
</tr>
<tr>
<td>State / PNP</td>
<td>34691</td>
<td>39539</td>
<td>41938</td>
<td>46161</td>
<td>48269</td>
<td>55186</td>
<td>59335</td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>88</td>
<td>100</td>
<td>106</td>
<td>117</td>
<td>122</td>
<td>139</td>
<td>150</td>
</tr>
<tr>
<td>In %</td>
<td>40,3</td>
<td>40,3</td>
<td>39,9</td>
<td>36,4</td>
<td>33,4</td>
<td>37,1</td>
<td></td>
</tr>
</tbody>
</table>
Table 10 continued

<table>
<thead>
<tr>
<th></th>
<th>GFE</th>
<th>16823</th>
<th>18486</th>
<th>19417</th>
<th>21205</th>
<th>21355</th>
<th>22335</th>
<th>22326</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index (1981=100)</td>
<td>91</td>
<td>100</td>
<td>105</td>
<td>115</td>
<td>116</td>
<td>121</td>
<td>121</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>18,8</td>
<td>18,6</td>
<td>18,3</td>
<td>16,1</td>
<td>13,5</td>
<td>14,0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In % of state /PNP</td>
<td>48,5</td>
<td>46,7</td>
<td>46,3</td>
<td>45,9</td>
<td>44,2</td>
<td>40,5</td>
<td>37,6</td>
<td></td>
</tr>
<tr>
<td>MPG</td>
<td>6621</td>
<td>7521</td>
<td>7988</td>
<td>8776</td>
<td>8960</td>
<td>9334</td>
<td>9900</td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>88</td>
<td>100</td>
<td>106</td>
<td>117</td>
<td>119</td>
<td>124</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>7,7</td>
<td>7,7</td>
<td>7,6</td>
<td>6,8</td>
<td>5,6</td>
<td>6,2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In % of state /PNP</td>
<td>19,1</td>
<td>19,0</td>
<td>19,0</td>
<td>19,0</td>
<td>18,6</td>
<td>16,9</td>
<td>16,7</td>
<td></td>
</tr>
<tr>
<td>FlhG</td>
<td>1456</td>
<td>2216</td>
<td>2823</td>
<td>3860</td>
<td>4890</td>
<td>5965</td>
<td>6229</td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>66</td>
<td>100</td>
<td>127</td>
<td>174</td>
<td>221</td>
<td>269</td>
<td>281</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>2,3</td>
<td>2,7</td>
<td>3,3</td>
<td>3,7</td>
<td>3,6</td>
<td>3,9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In % of state /PNP</td>
<td>4,2</td>
<td>5,6</td>
<td>6,7</td>
<td>8,4</td>
<td>10,1</td>
<td>10,8</td>
<td>10,5</td>
<td></td>
</tr>
<tr>
<td>BLI</td>
<td>3500</td>
<td>3953</td>
<td>4132</td>
<td>4611</td>
<td>4675</td>
<td>8820</td>
<td>11273</td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>89</td>
<td>100</td>
<td>105</td>
<td>117</td>
<td>118</td>
<td>223</td>
<td>285</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>4,0</td>
<td>4,0</td>
<td>4,0</td>
<td>3,5</td>
<td>5,3</td>
<td>7,0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In % of state /PNP</td>
<td>10,1</td>
<td>10,0</td>
<td>9,9</td>
<td>10,0</td>
<td>9,7</td>
<td>16,0</td>
<td>19,0</td>
<td></td>
</tr>
<tr>
<td>BFA</td>
<td>6291</td>
<td>7417</td>
<td>7578</td>
<td>7709</td>
<td>8389</td>
<td>8732</td>
<td>9607</td>
<td></td>
</tr>
<tr>
<td>Index (1981=100)</td>
<td>85</td>
<td>100</td>
<td>102</td>
<td>104</td>
<td>113</td>
<td>118</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>7,6</td>
<td>7,3</td>
<td>6,7</td>
<td>6,3</td>
<td>5,3</td>
<td>6,0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In % of state /PNP</td>
<td>18,1</td>
<td>18,7</td>
<td>18,1</td>
<td>16,7</td>
<td>17,4</td>
<td>15,8</td>
<td>16,2</td>
<td></td>
</tr>
</tbody>
</table>

Table 12: R&D expenditure in the public sector by scientific fields in 1995 (million DM)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Natural sciences</th>
<th>Engineering</th>
<th>Medicine</th>
<th>Social sciences</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universities</td>
<td>12169</td>
<td>3493</td>
<td>2570</td>
<td>2998</td>
<td>2316</td>
<td>574</td>
</tr>
<tr>
<td>In %</td>
<td>28,7</td>
<td>21,1</td>
<td>24,6</td>
<td>19,0</td>
<td>4,7</td>
<td></td>
</tr>
<tr>
<td>State / PNP</td>
<td>9778</td>
<td>5242</td>
<td>2540</td>
<td>630</td>
<td>483</td>
<td>392</td>
</tr>
<tr>
<td>In %</td>
<td>53,6</td>
<td>26,0</td>
<td>6,4</td>
<td>4,9</td>
<td>4,0</td>
<td></td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GFE</td>
<td>4222</td>
<td>2604</td>
<td>1224</td>
<td>340</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>61,7</td>
<td>29,0</td>
<td>8,1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPG</td>
<td>1585</td>
<td>1256</td>
<td>153</td>
<td>176</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>79,2</td>
<td>9,7</td>
<td>11,1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FhG</td>
<td>1262</td>
<td>202</td>
<td>1031</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>16,0</td>
<td>81,7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLI</td>
<td>1460</td>
<td>824</td>
<td>137</td>
<td>307</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>56,4</td>
<td>9,4</td>
<td>21,0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BFA</td>
<td>1249</td>
<td>356</td>
<td>285</td>
<td></td>
<td></td>
<td>392</td>
</tr>
<tr>
<td>In %</td>
<td>28,5</td>
<td>22,8</td>
<td></td>
<td></td>
<td></td>
<td>31,4</td>
</tr>
</tbody>
</table>

Table 13: R&D personnel in the public sector by scientific field in 1995 (FTE)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Natural sciences</th>
<th>Engineering</th>
<th>Medicine</th>
<th>Social sciences</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universities</td>
<td>100674</td>
<td>29085</td>
<td>19782</td>
<td>24594</td>
<td>22204</td>
<td>5009</td>
</tr>
<tr>
<td>In %</td>
<td>28,9</td>
<td>19,6</td>
<td>24,4</td>
<td>22,1</td>
<td>5,0</td>
<td></td>
</tr>
<tr>
<td>State / PNP</td>
<td>57813</td>
<td>29975</td>
<td>13081</td>
<td>3939</td>
<td>3320</td>
<td>3654</td>
</tr>
<tr>
<td>In %</td>
<td>51,8</td>
<td>22,6</td>
<td>6,8</td>
<td>5,7</td>
<td>6,3</td>
<td></td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GFE</td>
<td>22326</td>
<td>13742</td>
<td>6520</td>
<td>1876</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>61,6</td>
<td>29,2</td>
<td>8,4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPG</td>
<td>9900</td>
<td>7945</td>
<td>860</td>
<td>1095</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>80,3</td>
<td>8,7</td>
<td>11,1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FhG</td>
<td>6229</td>
<td>1073</td>
<td>4617</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>17,2</td>
<td>74,1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLI</td>
<td>9751</td>
<td>4910</td>
<td>1203</td>
<td>2225</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>50,4</td>
<td>12,3</td>
<td>22,8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BFA</td>
<td>9607</td>
<td>2305</td>
<td>1944</td>
<td></td>
<td>3654</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>24,0</td>
<td>20,2</td>
<td></td>
<td></td>
<td>38,0</td>
<td></td>
</tr>
</tbody>
</table>

### Table 14: R&D expenditure of the Bund by spending ministry 1963-1995 (million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1711</td>
<td>2231</td>
<td>6439</td>
<td>7538</td>
<td>10448</td>
<td>12835</td>
<td>14036</td>
<td>16962</td>
<td>16856</td>
<td>16500</td>
</tr>
<tr>
<td>BMFT</td>
<td>640</td>
<td>919</td>
<td>3981</td>
<td>3919</td>
<td>5903</td>
<td>6966</td>
<td>7325</td>
<td>8256</td>
<td>10879</td>
<td>10759</td>
</tr>
<tr>
<td>In %</td>
<td>37,4</td>
<td>41,2</td>
<td>61,8</td>
<td>52,0</td>
<td>56,5</td>
<td>54,3</td>
<td>52,2</td>
<td>48,8</td>
<td>64,5</td>
<td>65,2</td>
</tr>
<tr>
<td>BMBW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>11,5</td>
<td>8,4</td>
<td>7,7</td>
<td>8,0</td>
<td>9,2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMVg</td>
<td>548</td>
<td>739</td>
<td>1232</td>
<td>1495</td>
<td>1560</td>
<td>2534</td>
<td>3156</td>
<td>3193</td>
<td>2662</td>
<td>2874</td>
</tr>
<tr>
<td>In %</td>
<td>32,0</td>
<td>33,1</td>
<td>19,1</td>
<td>19,8</td>
<td>14,9</td>
<td>19,7</td>
<td>22,5</td>
<td>18,9</td>
<td>15,8</td>
<td>17,4</td>
</tr>
<tr>
<td>BMWi</td>
<td>64</td>
<td>94</td>
<td>440</td>
<td>496</td>
<td>1082</td>
<td>1193</td>
<td>965</td>
<td>1247</td>
<td>1221</td>
<td>1054</td>
</tr>
<tr>
<td>In %</td>
<td>3,7</td>
<td>4,2</td>
<td>6,8</td>
<td>6,6</td>
<td>10,4</td>
<td>9,3</td>
<td>6,9</td>
<td>7,4</td>
<td>7,2</td>
<td>6,4</td>
</tr>
</tbody>
</table>

### Table 15: R&D expenditure of the Bund by general objectives 1981-1995 (million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>10448</td>
<td>12835</td>
<td>14106</td>
<td>16927</td>
<td>16860</td>
<td>16966</td>
</tr>
<tr>
<td>General research promotion</td>
<td>1707</td>
<td>2146</td>
<td>2469</td>
<td>3320</td>
<td>3459</td>
<td>3621</td>
</tr>
<tr>
<td>In %</td>
<td>16.3</td>
<td>16.7</td>
<td>17.5</td>
<td>19.6</td>
<td>20.5</td>
<td>21.3</td>
</tr>
<tr>
<td>Precaution research</td>
<td>1767</td>
<td>1960</td>
<td>2669</td>
<td>3656</td>
<td>3559</td>
<td>3555</td>
</tr>
<tr>
<td>In %</td>
<td>16.9</td>
<td>15.3</td>
<td>18.9</td>
<td>21.6</td>
<td>21.1</td>
<td>21.0</td>
</tr>
<tr>
<td>Technology/innovation</td>
<td>5445</td>
<td>6199</td>
<td>5840</td>
<td>6780</td>
<td>7206</td>
<td>6925</td>
</tr>
<tr>
<td>In %</td>
<td>52.1</td>
<td>48.3</td>
<td>41.4</td>
<td>40.1</td>
<td>42.7</td>
<td>40.8</td>
</tr>
<tr>
<td>Defense research</td>
<td>1528</td>
<td>2531</td>
<td>3128</td>
<td>3170</td>
<td>2635</td>
<td>2866</td>
</tr>
<tr>
<td>In %</td>
<td>14.6</td>
<td>19.7</td>
<td>22.2</td>
<td>18.7</td>
<td>15.6</td>
<td>16.9</td>
</tr>
</tbody>
</table>

Source: BMBF (1997); own calculations; 1995 planning data.
Table 16: R&D expenditure of the Bund by thematic priorities 1981-1995 (million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total R&amp;D expenditure</td>
<td>10448</td>
<td>12835</td>
<td>14106</td>
<td>16927</td>
<td>16856</td>
<td>16500</td>
</tr>
<tr>
<td>general research promotion</td>
<td>1788</td>
<td>2408</td>
<td>2613</td>
<td>3052</td>
<td>3823</td>
<td>4043</td>
</tr>
<tr>
<td>In %</td>
<td>17,1</td>
<td>18,8</td>
<td>18,5</td>
<td>18,0</td>
<td>22,7</td>
<td>24,5</td>
</tr>
<tr>
<td>Carrier organizations (MPG; DFG; FhG)</td>
<td>908</td>
<td>1209</td>
<td>1221</td>
<td>1378</td>
<td>1786</td>
<td>2042</td>
</tr>
<tr>
<td>In %</td>
<td>8,7</td>
<td>9,4</td>
<td>8,7</td>
<td>8,1</td>
<td>10,6</td>
<td>12,4</td>
</tr>
<tr>
<td>University programs</td>
<td>279</td>
<td>348</td>
<td>413</td>
<td>725</td>
<td>1020</td>
<td>964</td>
</tr>
<tr>
<td>In %</td>
<td>2,7</td>
<td>2,7</td>
<td>2,9</td>
<td>4,3</td>
<td>6,0</td>
<td>5,8</td>
</tr>
<tr>
<td>Large-scale installations im basic research</td>
<td>601</td>
<td>851</td>
<td>979</td>
<td>949</td>
<td>1017</td>
<td>1037</td>
</tr>
<tr>
<td>In %</td>
<td>5,8</td>
<td>6,6</td>
<td>6,9</td>
<td>5,6</td>
<td>6,0</td>
<td>6,3</td>
</tr>
<tr>
<td>Key technologies/innovation</td>
<td>1514</td>
<td>2008</td>
<td>2121</td>
<td>2516</td>
<td>2990</td>
<td>3195</td>
</tr>
<tr>
<td>In %</td>
<td>14,5</td>
<td>15,6</td>
<td>15,0</td>
<td>14,9</td>
<td>17,7</td>
<td>19,4</td>
</tr>
<tr>
<td>- information technology</td>
<td>375</td>
<td>624</td>
<td>702</td>
<td>873</td>
<td>970</td>
<td>967</td>
</tr>
<tr>
<td>In %</td>
<td>3,6</td>
<td>4,9</td>
<td>5,0</td>
<td>5,2</td>
<td>5,8</td>
<td>5,9</td>
</tr>
<tr>
<td>- biotechnology</td>
<td>99</td>
<td>152</td>
<td>254</td>
<td>275</td>
<td>388</td>
<td>397</td>
</tr>
<tr>
<td>In %</td>
<td>0,9</td>
<td>1,2</td>
<td>1,8</td>
<td>1,6</td>
<td>2,3</td>
<td>2,4</td>
</tr>
<tr>
<td>- materials</td>
<td>321</td>
<td>379</td>
<td>525</td>
<td>610</td>
<td>614</td>
<td>663</td>
</tr>
<tr>
<td>In %</td>
<td>3,1</td>
<td>3,0</td>
<td>3,7</td>
<td>3,6</td>
<td>3,6</td>
<td>4,0</td>
</tr>
<tr>
<td>- environmental technologies</td>
<td>224</td>
<td>267</td>
<td>288</td>
<td>331</td>
<td>353</td>
<td>339</td>
</tr>
<tr>
<td>In %</td>
<td>2,1</td>
<td>2,1</td>
<td>2,0</td>
<td>2,0</td>
<td>2,1</td>
<td>2,1</td>
</tr>
<tr>
<td>- innovation</td>
<td>496</td>
<td>586</td>
<td>352</td>
<td>427</td>
<td>665</td>
<td>830</td>
</tr>
<tr>
<td>In %</td>
<td>4,7</td>
<td>4,6</td>
<td>2,5</td>
<td>2,5</td>
<td>3,9</td>
<td>5,0</td>
</tr>
</tbody>
</table>
### Table 16 continued (1)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Precaution/public research</td>
<td>1719</td>
<td>1673</td>
<td>1986</td>
<td>2513</td>
<td>2809</td>
<td>2674</td>
</tr>
<tr>
<td>In %</td>
<td>16,5</td>
<td>13,0</td>
<td>14,1</td>
<td>14,8</td>
<td>16,7</td>
<td>16,2</td>
</tr>
</tbody>
</table>

- health

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>3,3</td>
<td>2,9</td>
<td>3,8</td>
<td>4,0</td>
<td>4,5</td>
<td>4,7</td>
</tr>
</tbody>
</table>

- working conditions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>1,1</td>
<td>0,9</td>
<td>0,8</td>
<td>0,7</td>
<td>0,6</td>
<td>0,6</td>
</tr>
</tbody>
</table>

- environment/climate

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>1,8</td>
<td>2,2</td>
<td>2,7</td>
<td>3,2</td>
<td>3,9</td>
<td>3,9</td>
</tr>
</tbody>
</table>

- renewable energies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>2,8</td>
<td>1,7</td>
<td>1,7</td>
<td>2,0</td>
<td>2,1</td>
<td>1,8</td>
</tr>
</tbody>
</table>

- geological/oceanographic research

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>2,0</td>
<td>1,7</td>
<td>2,0</td>
<td>1,9</td>
<td>2,5</td>
<td>2,4</td>
</tr>
</tbody>
</table>

- nutrition

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>0,7</td>
<td>0,6</td>
<td>0,6</td>
<td>0,6</td>
<td>0,6</td>
<td>0,6</td>
</tr>
</tbody>
</table>

- transport

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>3,2</td>
<td>1,8</td>
<td>1,5</td>
<td>1,4</td>
<td>1,3</td>
<td>1,1</td>
</tr>
</tbody>
</table>

- urban research

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>1,6</td>
<td>1,1</td>
<td>1,0</td>
<td>1,1</td>
<td>1,1</td>
<td>1,1</td>
</tr>
</tbody>
</table>
Table 16 continued (2)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Big science/technology</td>
<td>4043</td>
<td>5623</td>
<td>5884</td>
<td>6367</td>
<td>5654</td>
<td>5264</td>
</tr>
<tr>
<td>In %</td>
<td>38.7</td>
<td>43.8</td>
<td>41.7</td>
<td>37.6</td>
<td>33.5</td>
<td>31.9</td>
</tr>
<tr>
<td>- defense research</td>
<td>1528</td>
<td>2531</td>
<td>3128</td>
<td>3170</td>
<td>2635</td>
<td>2840</td>
</tr>
<tr>
<td>In %</td>
<td>14.6</td>
<td>19.7</td>
<td>22.2</td>
<td>18.7</td>
<td>15.6</td>
<td>17.2</td>
</tr>
<tr>
<td>- space research</td>
<td>662</td>
<td>831</td>
<td>1217</td>
<td>1540</td>
<td>1804</td>
<td>1582</td>
</tr>
<tr>
<td>In %</td>
<td>6.3</td>
<td>6.5</td>
<td>8.6</td>
<td>9.1</td>
<td>10.7</td>
<td>9.6</td>
</tr>
<tr>
<td>- atomic research</td>
<td>1375</td>
<td>1732</td>
<td>829</td>
<td>758</td>
<td>596</td>
<td>491</td>
</tr>
<tr>
<td>In %</td>
<td>13.2</td>
<td>13.5</td>
<td>5.9</td>
<td>4.5</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>- aviation</td>
<td>478</td>
<td>530</td>
<td>710</td>
<td>899</td>
<td>620</td>
<td>351</td>
</tr>
<tr>
<td>In %</td>
<td>4.6</td>
<td>4.1</td>
<td>5.0</td>
<td>5.3</td>
<td>3.7</td>
<td>2.1</td>
</tr>
</tbody>
</table>

### Table 17: Expenditure on R&D by the Bund according to type and sector of spending (in million DM) 1975-1995

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total R&amp;D expenditure</td>
<td>7538</td>
<td>10484</td>
<td>12835</td>
<td>14036</td>
<td>16962</td>
<td>16856</td>
<td>16500</td>
</tr>
<tr>
<td>Project funding</td>
<td>3881</td>
<td>5940</td>
<td>7409</td>
<td>7468</td>
<td>8640</td>
<td>7572</td>
<td>7344</td>
</tr>
<tr>
<td>In %</td>
<td>51,5</td>
<td>56,7</td>
<td>57,7</td>
<td>53,2</td>
<td>50,9</td>
<td>44,9</td>
<td>44,5</td>
</tr>
<tr>
<td>Institutional funding</td>
<td>3041,0</td>
<td>3562,8</td>
<td>4300</td>
<td>5413,4</td>
<td>6169,2</td>
<td>6634,1</td>
<td>6688,3</td>
</tr>
<tr>
<td>In %</td>
<td>40,3</td>
<td>34,0</td>
<td>33,5</td>
<td>38,6</td>
<td>36,4</td>
<td>39,4</td>
<td>40,5</td>
</tr>
<tr>
<td>Research organizations</td>
<td>850,0</td>
<td>1136,5</td>
<td>1388,4</td>
<td>1681,7</td>
<td>2111,1</td>
<td>2681,7</td>
<td>2893,7</td>
</tr>
<tr>
<td>In %</td>
<td>11,3</td>
<td>10,8</td>
<td>10,8</td>
<td>12,0</td>
<td>12,4</td>
<td>15,9</td>
<td>17,5</td>
</tr>
<tr>
<td>Institutional funding</td>
<td>664,8</td>
<td>948,0</td>
<td>1110,1</td>
<td>1281,4</td>
<td>1454,5</td>
<td>1856,3</td>
<td>2107,7</td>
</tr>
<tr>
<td>Project funding</td>
<td>185,2</td>
<td>188,5</td>
<td>278,3</td>
<td>400,3</td>
<td>656,6</td>
<td>825,4</td>
<td>786,0</td>
</tr>
<tr>
<td>In % of project funding</td>
<td>4,8</td>
<td>3,2</td>
<td>3,8</td>
<td>5,4</td>
<td>7,6</td>
<td>10,9</td>
<td>10,7</td>
</tr>
<tr>
<td>National research centers</td>
<td>1231,4</td>
<td>1768,7</td>
<td>2210,8</td>
<td>2528,3</td>
<td>2709,4</td>
<td>3060,7</td>
<td>2898,1</td>
</tr>
<tr>
<td>In %</td>
<td>16,3</td>
<td>16,9</td>
<td>17,2</td>
<td>18,0</td>
<td>16,0</td>
<td>18,2</td>
<td>17,6</td>
</tr>
<tr>
<td>Institutional funding</td>
<td>1181,5</td>
<td>1614,5</td>
<td>1989,3</td>
<td>2315,2</td>
<td>2405,9</td>
<td>2685,3</td>
<td>2544,6</td>
</tr>
<tr>
<td>Project funding</td>
<td>49,9</td>
<td>154,2</td>
<td>221,5</td>
<td>213,1</td>
<td>303,5</td>
<td>375,4</td>
<td>353,5</td>
</tr>
<tr>
<td>In % of project funding</td>
<td>1,3</td>
<td>2,6</td>
<td>3,0</td>
<td>2,9</td>
<td>3,5</td>
<td>5,0</td>
<td>4,8</td>
</tr>
<tr>
<td>Federal research institutions</td>
<td>695,4</td>
<td>782,6</td>
<td>1012</td>
<td>1109,5</td>
<td>1243,9</td>
<td>1397,9</td>
<td>1273,7</td>
</tr>
<tr>
<td>In %</td>
<td>9,2</td>
<td>7,5</td>
<td>7,9</td>
<td>7,9</td>
<td>7,3</td>
<td>8,3</td>
<td>7,7</td>
</tr>
<tr>
<td>Institutional funding</td>
<td>639,0</td>
<td>682,6</td>
<td>845,2</td>
<td>979,9</td>
<td>1114,5</td>
<td>1275,6</td>
<td>1173,4</td>
</tr>
<tr>
<td>Project funding</td>
<td>56,4</td>
<td>100,0</td>
<td>166,8</td>
<td>129,6</td>
<td>129,4</td>
<td>122,3</td>
<td>100,3</td>
</tr>
<tr>
<td>In % of project funding</td>
<td>1,5</td>
<td>1,7</td>
<td>2,3</td>
<td>1,7</td>
<td>1,5</td>
<td>1,6</td>
<td>1,4</td>
</tr>
</tbody>
</table>
Table 17 continued

<table>
<thead>
<tr>
<th>Universities</th>
<th>770.0</th>
<th>579.0</th>
<th>763.7</th>
<th>1145.7</th>
<th>1601.6</th>
<th>1501.3</th>
<th>1482.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>In %</td>
<td>10.2</td>
<td>5.5</td>
<td>6.0</td>
<td>8.2</td>
<td>9.4</td>
<td>8.9</td>
<td>9.0</td>
</tr>
<tr>
<td>Institutional funding</td>
<td>397.4</td>
<td>273.3</td>
<td>339.7</td>
<td>390.0</td>
<td>670.0</td>
<td>962.9</td>
<td>850.7</td>
</tr>
<tr>
<td>Project funding</td>
<td>372.6</td>
<td>352.4</td>
<td>452.9</td>
<td>742.6</td>
<td>895.0</td>
<td>538.4</td>
<td>631.9</td>
</tr>
<tr>
<td>In % of project funding</td>
<td>19.8</td>
<td>9.7</td>
<td>10.3</td>
<td>15.3</td>
<td>18.5</td>
<td>19.8</td>
<td>20.2</td>
</tr>
<tr>
<td>Industry</td>
<td>3162</td>
<td>4628.3</td>
<td>5767.5</td>
<td>5030.9</td>
<td>5461.1</td>
<td>4632.5</td>
<td>4572.4</td>
</tr>
<tr>
<td>In %</td>
<td>41.9</td>
<td>44.1</td>
<td>44.9</td>
<td>35.8</td>
<td>32.2</td>
<td>27.5</td>
<td>27.7</td>
</tr>
<tr>
<td>In % of project funding</td>
<td>81.5</td>
<td>77.9</td>
<td>77.8</td>
<td>67.4</td>
<td>63.2</td>
<td>61.2</td>
<td>62.3</td>
</tr>
<tr>
<td>International organizations</td>
<td>598.9</td>
<td>708.2</td>
<td>786.4</td>
<td>1155.2</td>
<td>1482.3</td>
<td>1686.8</td>
<td>1619</td>
</tr>
<tr>
<td>In %</td>
<td>7.9</td>
<td>6.8</td>
<td>6.1</td>
<td>9.5</td>
<td>8.7</td>
<td>10.0</td>
<td>9.8</td>
</tr>
</tbody>
</table>


Table 18: Share of civil and defense R&D in public research funding in the Federal Republic 1971-1993 (million DM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total public R&amp;D exp.</td>
<td>12738.3</td>
<td>17741.7</td>
<td>21030.8</td>
<td>23636</td>
<td>29450</td>
<td>31382</td>
<td>31639</td>
</tr>
<tr>
<td>Defense research</td>
<td>1405</td>
<td>1572.3</td>
<td>2508.9</td>
<td>3023</td>
<td>3234</td>
<td>2674</td>
<td>2866</td>
</tr>
<tr>
<td>In %</td>
<td>11.0</td>
<td>8.9</td>
<td>11.9</td>
<td>12.8</td>
<td>11.0</td>
<td>8.5</td>
<td>9.6</td>
</tr>
<tr>
<td>Civil research</td>
<td>11333.3</td>
<td>16169.4</td>
<td>18521.9</td>
<td>20613</td>
<td>26216</td>
<td>28708</td>
<td>28773</td>
</tr>
<tr>
<td>In %</td>
<td>89.0</td>
<td>91.1</td>
<td>88.1</td>
<td>87.2</td>
<td>89.0</td>
<td>91.5</td>
<td>90.9</td>
</tr>
</tbody>
</table>

Table 19-1: Real university funds 1980-1994 (in constant prices 1980=100)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total expenditure</td>
<td>15081</td>
<td>14860</td>
<td>16929</td>
<td>21458</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>99</td>
<td>112</td>
<td>142</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>116</td>
<td>132</td>
<td>152</td>
</tr>
<tr>
<td>R&amp;D expenditure</td>
<td>6050</td>
<td>6289</td>
<td>7473</td>
<td>9487</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>104</td>
<td>124</td>
<td>157</td>
</tr>
<tr>
<td>General university grants</td>
<td>9711</td>
<td>9837</td>
<td>10120</td>
<td>12688</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>101</td>
<td>104</td>
<td>131</td>
</tr>
<tr>
<td>Investments</td>
<td>2957</td>
<td>1893</td>
<td>2108</td>
<td>3562</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>64</td>
<td>71</td>
<td>120</td>
</tr>
<tr>
<td>Third-party-funds</td>
<td>1567</td>
<td>1770</td>
<td>2249</td>
<td>2940</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>113</td>
<td>144</td>
<td>188</td>
</tr>
<tr>
<td>In % of R&amp;D expenditure</td>
<td>25,9</td>
<td>28,1</td>
<td>30,1</td>
<td>31,0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFG</td>
<td>723</td>
<td>766</td>
<td>825</td>
<td>1034</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>106</td>
<td>114</td>
<td>143</td>
</tr>
<tr>
<td>In % of third-party-funds</td>
<td>46,2</td>
<td>43,3</td>
<td>36,7</td>
<td>35,2</td>
</tr>
<tr>
<td>In % of R&amp;D expenditure</td>
<td>12,0</td>
<td>12,2</td>
<td>11,0</td>
<td>10,9</td>
</tr>
</tbody>
</table>

Table 19: Expenditure on research and teaching at German universities 1975-1994 by type of funding (million DM) in nominal and constant prices (1981=100)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total expenditure</td>
<td>15081,1</td>
<td>17222,3</td>
<td>22313</td>
<td>32658,8</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>114</td>
<td>148</td>
<td>217</td>
</tr>
<tr>
<td>R&amp;D expenditure</td>
<td>6050</td>
<td>7289</td>
<td>9849</td>
<td>14439</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>120</td>
<td>163</td>
<td>239</td>
</tr>
<tr>
<td>General university grants</td>
<td>9711</td>
<td>11401</td>
<td>13338</td>
<td>19311</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>117</td>
<td>137</td>
<td>199</td>
</tr>
<tr>
<td>Investments</td>
<td>2957</td>
<td>2194</td>
<td>2779</td>
<td>5421</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>74</td>
<td>94</td>
<td>183</td>
</tr>
<tr>
<td>Third-party-funds</td>
<td>1566,9</td>
<td>2050,9</td>
<td>2964</td>
<td>4475</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>131</td>
<td>189</td>
<td>286</td>
</tr>
<tr>
<td>In % of R&amp;D expenditure</td>
<td>25,9</td>
<td>28,1</td>
<td>30,1</td>
<td>31,0</td>
</tr>
<tr>
<td>Of which</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFG</td>
<td>723,3</td>
<td>888</td>
<td>1087</td>
<td>1574</td>
</tr>
<tr>
<td>Index (1980=100)</td>
<td>100</td>
<td>123</td>
<td>150</td>
<td>218</td>
</tr>
<tr>
<td>In % of third-party-funds</td>
<td>46,2</td>
<td>43,3</td>
<td>36,7</td>
<td>35,2</td>
</tr>
<tr>
<td>In % of R&amp;D expenditure</td>
<td>12,0</td>
<td>12,2</td>
<td>11,0</td>
<td>10,9</td>
</tr>
<tr>
<td>Bund</td>
<td>354,2</td>
<td>452,9</td>
<td>847,4</td>
<td></td>
</tr>
<tr>
<td>In % of third-party-funds</td>
<td>22,6</td>
<td>22,1</td>
<td>28,6</td>
<td></td>
</tr>
<tr>
<td>Länder</td>
<td>64,7</td>
<td>82,2</td>
<td>127,7</td>
<td></td>
</tr>
<tr>
<td>In % of third-party-funds</td>
<td>4,1</td>
<td>4,0</td>
<td>4,3</td>
<td></td>
</tr>
</tbody>
</table>
Table 19 continued

<table>
<thead>
<tr>
<th>Industry</th>
<th>183,8</th>
<th>312,5</th>
<th>433,4</th>
</tr>
</thead>
<tbody>
<tr>
<td>In % of third-party-funds</td>
<td>11,7</td>
<td>15,2</td>
<td>14,6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foundations</th>
<th>145,5</th>
<th>195,5</th>
<th>282,7</th>
</tr>
</thead>
<tbody>
<tr>
<td>In % of third-party-funds</td>
<td>9,3</td>
<td>9,5</td>
<td>9,5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abroad</th>
<th>10,3</th>
<th>15,4</th>
<th>27,6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0,7</td>
<td>0,8</td>
<td>0,9</td>
</tr>
</tbody>
</table>


Table 20: Number of scientific staff positions, students and student places at German universities (without medical institutions) 1975-1995

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific staff positions</td>
<td>54215</td>
<td>53886</td>
<td>52961</td>
<td>53940</td>
<td>68869</td>
</tr>
<tr>
<td>Growth index (1975=100)</td>
<td>100</td>
<td>99</td>
<td>98</td>
<td>99</td>
<td>127</td>
</tr>
<tr>
<td>Number of students</td>
<td>638582</td>
<td>756040</td>
<td>936459</td>
<td>1107442</td>
<td>1411855</td>
</tr>
<tr>
<td>Growth index (1975=100)</td>
<td>100</td>
<td>118</td>
<td>147</td>
<td>173</td>
<td>205</td>
</tr>
<tr>
<td>Number of student places</td>
<td>497886</td>
<td>521246</td>
<td>582000</td>
<td>596000</td>
<td>731200</td>
</tr>
<tr>
<td>Growth index (1975=100)</td>
<td>100</td>
<td>105</td>
<td>117</td>
<td>120</td>
<td>147</td>
</tr>
<tr>
<td>Students per teaching person</td>
<td>11,8</td>
<td>14,0</td>
<td>17,7</td>
<td>20,5</td>
<td>20,3</td>
</tr>
<tr>
<td>Growth index (1975=100)</td>
<td>100</td>
<td>119</td>
<td>150</td>
<td>174</td>
<td>172</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific staff positions</td>
<td>9033</td>
<td>9031</td>
<td>9143</td>
<td>9428</td>
<td>13650</td>
</tr>
<tr>
<td>Growth index (1975=100)</td>
<td>100</td>
<td>100</td>
<td>101</td>
<td>104</td>
<td>151</td>
</tr>
<tr>
<td>Number of students</td>
<td>142525</td>
<td>174302</td>
<td>268802</td>
<td>331082</td>
<td>397942</td>
</tr>
<tr>
<td>Growth index (1975=100)</td>
<td>100</td>
<td>122</td>
<td>188</td>
<td>232</td>
<td>279</td>
</tr>
<tr>
<td>Number of student places</td>
<td>105458</td>
<td>114486</td>
<td>129400</td>
<td>138000</td>
<td>183300</td>
</tr>
<tr>
<td>Growth index (1975=100)</td>
<td>100</td>
<td>109</td>
<td>123</td>
<td>131</td>
<td>174</td>
</tr>
<tr>
<td>Students per teaching person</td>
<td>15,8</td>
<td>19,3</td>
<td>29,3</td>
<td>35,1</td>
<td>29,2</td>
</tr>
</tbody>
</table>

Source: see Table 18.