Science and Technology in Germany (New Edn)

Wilhelm Krull & Frieder Meyer-Krahmer (Eds)

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Science and Technology in Germany is a part of a series edited by Paul R. Dufour and John de la Mothe about science and technology in a number of countries and regions world-wide. Six years after the first edition on Germany it was about time to see how these fields had developed especially taking account of the effect of reunification and the changes implied for the scientific area.

The book covers a total of 13 papers including an introductory paper by the editors and is split into the following four categories: (1) Science and Technology in Germany: trends and perspectives; (2) Changing roles of science and technology institutions; (3) Technological change and industrial R&D management; and (4) Statistical surveys of scientific output, research and development. Unfortunately, only a selection of the papers can be discussed here.

In their keynote paper about the development of science, technology and innovation in Germany in the past few years after reunification. Krull and Meyer-Krahmer provide a very detailed and extensive overview of the German research sector covering the different research organisations, bodies, institutions and foundations. In Germany, research financed and performed by the industry amounts to about 50% (other authors calculate this to be rather 67%) of a total research budget of almost 77 billion DM. Thereby, German research always has to be seen in the context of the EU. It is interesting to note that the focus in Germany is directed towards other areas of research than in the EU average. For example, the portion spent in R&D in information and communication technology is significantly lower than in EU (18% compared to 39%). However, in the environmental sector Germany spends 21% of its research budget and in comparison to the 9% on the EU average this might explain the strong German position in this technology.

The next chapter covers four papers on the trends and perspectives for science and technology in Germany. First, Mayntz refers to a very interesting development of the changes in the East German research system brought about by reunification. This is a point which has not been given much attention in the discussion when East Germany and West Germany were united in 1990 because there were so many other aspects (public policy, specific industries, unemployment, etc.) which were in the focus. However, it has to be noted that West and East Germany also were organised completely differently in terms of their research systems, in terms of what kind of research was conducted at universities, independent foundations or in industry. The changes for East Germany were significant and brought about not only a heavy decline in the personnel employed but of course also a loss in the scientific potential. Especially the demand for research by independent organisations was very limited in the first years. Furthermore, the universities which are financed by the German states had to face a reduction in the spending for research. Summing this up, it is obvious that the adoption of the Western system brought about some severe problems. This might be another example of many areas where unification was carried out so quickly that alternative approaches to the western system could not be evaluated and thus, the traditional way things were done in the Federal Republic simply were adopted in the East.

Grupp *et al.* look at strengths and weaknesses of high technology in Germany. While German products often are regarded as being of a high technical quality it is a reality that Germany is not a leading nation in the production of high technology. Taking

account of a country's R&D expenditure in comparison to the turnover of companies the past years have shown that Germany is not positioned in the area of high technology (where this ratio is above 8.5%) but rather has its strengths in the area of medium technology where R&D expenditures are a little bit above the average R&D expenditure of 3.5%. As the tendency towards a more service-oriented economy continues and since innovation and research are important parts of this it remains to adapt the national innovation system towards the increasing need of research excellency in high technology. Germany should be well positioned in those areas where human capital is of utmost importance due to the fact that the educational system is still evaluated very highly. The authors name environmental technology. biological technology and microelectronics as strategic sectors for the future.

The first chapter concludes with a paper by König and Licht on the factors that influence funding of research projects. At first they deal with the public good aspect of knowledge and thus, the private underinvestment in R&D due to the diffusion of knowledge and the externalities caused. Since firms tend not to profit from their research results themselves (compensation for their costs) public intervention is useful in order to finance R&D. This is also based on the argument that the capital markets do not tend to help small firms with good ideas by offering venture capital. This has long been true for Germany but at the beginning of 1997 the 'New Market' was introduced at the Frankfurt Stock Exchange for companies. At the moment there are two companies listed there (one from the area of environmental technology and the other is a service provider in the telecommunication area). Obviously, we are seeing the start of some change here. However, public support will remain an important factor. A statistical and econometric analysis shows that the areas of aerospace (44%), electrical engineering (22%) and machinery and equipment (10%) are promoted most highly in terms of shares of the total public R&D promotion. However, looking at this R&D promotion in relation to the total R&D expenditure by each respective industry the picture is different. Here, again the aerospace industry but also wood and paper and the textile branch score highly. Finally, in terms of R&D promotion in relation to total turnover all industries are located under the 1% line except for aerospace which reaches an extremely high value of 11%. An additional analysis shows that public R&D funding is not less effective than private R&D and that the strategy of picking winners has no justification based on the results reached by these companies.

The second chapter is on the 'Changing roles of science and technology institutions' and contains four papers of which two will be discussed here. Firstly Mittelstraß covers the current crisis of the university system and their future role in science and research. Going back to the historical development of universities in Germany he sees five major problems which are (1) the unexpected and unsolved problem of growth in the number of students, (2) the funding problem, (3) the general problems of reform incapability in Germany, (4) the crisis of education in schools and (5) the freedom (read: laziness) of professors in combination with slow students. However, in the rising popularity of polytechnic schools he finds some encouraging elements for a better preparation for profession and practice.

In his paper, Schimanek focuses on the same point, arguing that there has been a decline in science since the mid-1970s due to a lack of funding. Whereas the growth of personnel in universities was stopped, firms could enlarge their R&D departments more easily and play a more important role. Also Schimanek sees the freedom of the professors who do not have to justify what topics and how they conduct research as the main obstacle to better results of the university system. Since there is no obligation on being available for questions or sometimes not even for giving lectures personally some students

only see their professor once, in the oral exam at the end of their time at university. In total contradiction to the US or other countries, universities are not organised as a service institution for students but as an administration with formal rules. However, those changes towards a more service oriented approach would be necessary in my view to improve results. This implies that students would have to pay for such a service-orientation.

The third chapter turns the focus to industrial R&D with two papers on that topic. Brockhoff outlines the R&D management in German companies and looks at the possible sources for inefficiencies—which he finds in organisational structures, lack of budget-discipline and overperfection—and at the challenges for R&D management which in his view are the foundation of R&D co-operations, the internationalisation of R&D and the human resource management. Danielmeyer, contributing with a paper on 'Industrial change and academia's challenge' gives some background information on public and private R&D spending and the changes (shorter product lifecycles, etc.) which lead to the necessity of new approaches in science and technology. He recommends that future R&D should focus on the service—not the industrial society and that analysis should be started on how the 'company of the future' could look like. As one of the most important fields of research he sees the 'challenge of Asia for Europe'.

The last section contains two papers on statistical surveys of scientific output. Weingart and Winterhager refer to strength and weaknesses of German science in the light of publications and citations. The result—comparing the G7 countries—is that Germany holds the third or fourth position in most areas, generally outperformed by the US and Japan, sometimes also by the UK and France. Strengths, that is, performance above average, are to be found in astrophysics, physics as well as molecular biology and genetics. Underperformance is to be found in ecology/environment, geosciences and computer science. However, in my view some doubts remain whether publications and citations can serve as a valid indicator for strengths and weaknesses in a specific scientific field due to different attitudes of scientists to publish their work and to the extent of citation.

Grenzmann discusses 'Private investment in R&D' which he argues has been rising due to the lack of university research after the two world wars leading to the foundation of private research and also institutions covering statistics on R&D. He then goes on by measuring input factors like manpower and budget for analysing R&D in the private sector in the time from 1979 to 1995. On average, the industry employed 250 000 people in R&D and funded R&D with 59 billion DM in 1995 which is about two thirds of the total R&D spending in Germany. However, R&D funding only results in 2.5% of GDP which is lower than in other countries. In East Germany he shows some impressive numbers on the steep decrease of R&D both in the public and in the private sector, leading to a 75% reduction in personnel during 4 years. The New Federal states are underrepresented in most areas. They only have 7.5% of the total R&D personnel and 4% of the total businesses R&D expenditures. The public part of R&D is a low 9.2%. These figures are not very hopeful for East Germany as a future place for science and technology.

In total, the book gives a very in-depth analysis of science and technology in Germany. The current problems in public R&D are clearly analysed and are highly relevant for the university sector. However more room should have been left to discuss and outline reform concepts and new ideas. Here, Danielmeyer is the only one giving some hints about the future direction which could imply some positive aspects. Also in terms of industrial R&D it is analysed very clearly in which areas Germany has competitive advantage and where it hasn't. However, a strategy based on this result is

missing. Should policy focus on picking the few winners and increase the funding or should it rather try to improve the positions of those industries which are not on a world-class level. Here again, the book in total is rather descriptive and lacks a 'strategy' or a 'vision' statement on how to proceed with science and technology, especially from a policy perspective in Germany.

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Spreading the News: The American Postal System from Franklin to Morse

Richard R. John

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In the seven decades after its establishment in 1775 the American postal system stimulated a communications revolution, comparable to the subsequent revolutions connected with the telegraph, telephone and computer. This book traces the central role of the postal system in that communications revolution and its contribution to American public life. The author shows how the postal system influenced the establishment of a national society out of a loose union of confederated states. Richard John throws the light onto a chapter in American history that is often neglected but sets up the origins of some of the most distinctive features of American life today. John characterises his book as an 'interpretative biography' of an important American institution. This biography is not written in a chronological order but rather arranged by different topics.

Chapter 1 characterises the role of the postal system as an agent of change that helped to spur the communications revolution. An important aspect is the organisation of the postal system as a branch of the central government. At that time, no other branch of the central government penetrated so deeply the whole territory of the US and played a comparable role in shaping the pattern of everyday life. The postal system bound the confederation of states together to 'one great neighbourhood' similar to today's information technologies creating a global village.

In *Chapter 2* John describes the development of the postal system from an appendix of the neocolonial bureaucracy to a central administration of an independent state. Starting point of that development was the Post Office Act of 1792 with the following major provisions:

- Including the transmission of newspapers through the mail for subsidised tariffs indicated a change from the fiscal rationale to the educational rationale for the postal system. This paved the way for the establishment of a national market for information.
- Congress got the power to designate new postal routes. Abandoning the fiscal rationale that each route should be self-supporting facilitated the rapid expansion of the postal system to a nationwide network.

The completion of the network is analysed in more detail in *Chapter 3*. Under the auspices of postmaster general McLean, the three elements of the postal system were further developed:

- Key structure of the communications circuit was since 1800 a hub and spokes system with distribution centres and branch depots. The communications circuit regulated the