Schmollers Jahrbuch 130 (2010), 381 – 391
Duncker & Humblot, Berlin

European Data Watch

This section offers descriptions as well as discussions of data sources that are of interest to social scientists engaged in empirical research or teaching courses that include empirical investigations performed by students. The purpose is to describe the information in the data source, to give examples of questions tackled with the data and to tell how to access the data for research and teaching. We focus on data from German speaking countries that allow international comparative research. While most of the data are at the micro level (individuals, households, or firms), more aggregate data and meta data (for regions, industries, or nations) are included as well. Suggestions for data sources to be described in future columns (or comments on past columns) should be send to: Joachim Wagner, Leuphana University of Lueneburg, Institute of Economics, Campus 4.210, 21332 Lueneburg, Germany, or e-mailed to ⟨wagner@leuphana.de⟩. Past "European Data Watch" articles can be downloaded free of charge from the homepage of the German Council for Social and Economic Data (RatSWD) at: http://www. ratswd.de.

The R&D Survey of the German Business Enterprise Sector

By Christoph Grenzmann, Andreas Kladroba,
and Britta Niehof*

1. Introduction

The fact that the German national economy is of such considerable significance internationally is primarily the result of the excellent infrastructure, the stable political and legal conditions, highly qualified personnel and, last but not least, one of the world's leading research & development systems. In this regard, it is often overlooked in public discussion that in Germany research & development is carried out not first and foremost by higher education and government research institutes, but by private business enterprises. No less than 70% of all R&D expenditure originates from the business enterprise sector.

* Many thanks also to Mrs. Ruth Hellmich, Wissenschaftsstatistik, for her great help.

It is because of this fundamental importance of industrial research that the Wissenschaftsstatistik GmbH in the Stifterverband für die deutsche Wissenschaft reports regularly on behalf of the Federal Government on the R&D effort of German business enterprises.

The present paper furnishes an introduction to the Stifterverband's R&D survey and gives an overview of the information which users can gain from it, taking the 2007 and 2008 surveys as an example.

2. International and German R&D Surveys

As the world is increasingly growing together and becoming interconnected, efforts are being made at various intergovernmental levels to standardise national economic statistics and thus to make them comparable. For the R&D survey the "Frascati manual" (OECD, 2002) has been used, under the direction of the OECD, to develop such an international code.

According to the Frascati manual, research & development is defined as "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (OECD, 2002, 30). The protagonists and institutions involved in research & development are divided into four sectors: the business enterprise sector, the higher education sector, the government sector and Private Non Profit (PNP). The business enterprise sector is made up mainly of enterprises, that is, "all firms, organisations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price" together with "the private non-profit institutions mainly serving them." (OECD, 2002, 54) The latter comprise mainly "cooperative research institutes".

Germany is unusual in comparison with almost all other OECD member states, in that here the responsibility for compiling data concerning R&D activities is also classified according to sector. The Federal Statistical Office,under the direction of the Federal Ministry of Education and Research (BMBF), reports on research & development in the higher education sector, the government sector and the PNP. Research & Development in the business enterprise sector, however, is covered by Stifterverband, a Private non Profit organisation. On the one hand a public task for the Research & Development Survey of the business enterprise sector is performed by the BMBF, whilst on the other hand the business enterprise sector itself, represented by the Stifterverband, is responsible for the survey and the resulting reporting system. This represents a peculiarity, not only in terms of comparison at international level, but also within the official German statistics system.

Before the Frascati-survey was established in 1972 Business-circles in Germany implemented a monitoring-system to report about the "efforts which have been made by Business Enterprises in science". Already in 1950 first "registrations" existed about the activities of the enterprises to get an *input for Science* a term which was in the former understanding an "umbrella" for donations to universities, research contracts with research institutes, intramural activities in enterprises for new products. This means that the later established system of Frascati was in the process of development but not yet established; in the fifties the whole statistical-system regarding definitions was still vague.

The Stifterverband – which is an institution of Business circles in Germany – was selected to organize this "registration". At a later time experts of this institution belonged to those "pioneers" who developed a common frame for the statistical system of Research and Development, recorded in the "Frascati-Handbook". Since then the German system of reporting on R&D is built up sector by sector. The Stifterverband is responsible for the R&D-statistics in the German Enterprise-Sector, while the German Federal Statistical Office however has taken responsibility for other economical sectors as there are "government sector", "higher-education" and "Private non Profit institutes".

3. Methodology

The R&D survey of the business enterprise sector is conducted in the form of a questionnaire addressed to enterprises and to the cooperative research institutes. There is a "total survey", which takes place during alternate years (in odd-numbered calendar years). In even-numbered years there is a "short survey" with a reduced questionnaire. The basic population for the total survey consists of all enterprises and cooperative research institutes which were active in Research & Development during the survey period. Since there is no complete register from which this information can be obtained, all enterprises which can be presumed to be active in Research & Development are contacted. The criteria for this are essentially the size of the enterprise, the industry sector, participation in funding programmes, patent applications or press announcements concerning research results. In this sense it can be considered to be a full survey of the R&D activities of the business enterprise sector.

Enterprises are classified according to their industry sectors and their size-class. The sector classification derives from the commercial emphasis of the enterprise as reported in the information it has provided. It is based on the Classification of Economic Activities, NACE, as used by the European Union.[1] Version 1.1 was used up to and including the survey for the 2007 reporting year; from 2008 onwards Version 2.0 will be applicable.

[1] Nomenclature statistique des activités économiques dans la Communauté européenne.

The reporting unit for enterprises is normally the smallest accounting unit. With enterprise groups, however, an attempt is made to divide them up into business units which can then be classified according to particular economic activities. This then allows the organisational diversity of enterprise groups to be reflected.

Although a more detailed classification by size-class is made, it is in fact the classification into small and medium enterprises (SMEs) with less than 250 employees[2] and large enterprises which is of political interest.

The information provided by enterprises in the questionnaires which are sent out to them is the most important source of R&D survey data. But other data sources such as annual reports or publicly accessible databases are also used.

In the questionnaires for the total survey (in odd-numbered years) enterprises are asked about the following groups of topics:

- general information about the enterprise (sector, employees, turnover)
- R&D expenditure distinguishing between intramural expenditure (work carried out in-house) and extramural expenditure (research contracts). Questions are asked about
  - source of funding (business enterprises, government, abroad)
  - allocation of funds, whether for labour costs, other current costs or capital expenditure
  - recipients of extramural expenditure
- R&D personnel classified by occupation (researchers, technicians, other supporting R&D staff) and gender.

Additional questions are asked about innovative activities and regional distribution of R&D sites.

For reasons of confidentiality publication of the results is in aggregated form only. This rules out any possibility of tracing the data back to individual enterprises. Where there is any likelihood of this occurring, the data will not be published.

The Stifterverband endeavours to make preliminary results available not later than 12 months after the end of the reporting year. The final version of the data is issued 18 months after the end of the reporting year in accordance with EU regulations[3]. The data is released in Stifterverband publications[4, 5]), in a BMBF publication[6, 7] and by the EU and the OECD.

[2] Up to and including the 2006 survey the dividing line between SMEs and large enterprises was 500 employees.

[3] EC 753 / 2004 dated 22. 04. 2004.

[4] Especially in “Facts” and the “FuE-Datenreport” [R&D Data Report].

[5] www.wissenschaftsstatistik.de.

Under restricted conditions micro data of the R&D survey can be provided to scientists for research projects (e.g. Peters / Kladroba, 2009). Reasons of confidentiality allow access to these data without exception only in the Stifterverband office and under the supervision of an employee only. The access will be accepted only to a subset of the micro data, depending on the aim of the specific research project. Analytical results can be published in the case that there is no possibility to draw a conclusion on individual companies.[8]

4. Example: The 2007 and 2008 R&D Surveys

The nature of the information that can be obtained from the R&D survey of the business enterprise sector is clarified below, making reference to the total survey for the 2007 reporting year and the short survey for the 2008 reporting year, both of which were current at the time this paper was published. Examination of both these surveys makes it possible, on the one hand, to analyse the current figures for R&D expenditure and R&D personnel from the 2008 short survey and, on the other hand, to gain an overview of the structure of Research & Development in the German business enterprise sector. But since it is only in the total surveys that the relevant figures are requested, we need to refer to the 2007 total survey in order to obtain these figures.

For the R&D survey regarding the 2007 reporting year, approximately 30,000 enterprises of all branches were contacted in the 2nd and 3rd quarter of 2008 and asked about their R&D involvement during 2007 and their planning for 2008 and 2009. A good 10,000 of those enterprises reported R&D activities. 1,400 enterprises were questioned for the 2008 short survey. These included approximately 300 enterprises with 500 or more employees, so that about 85% of R&D expenditure in the business enterprise sector was covered.

As mentioned above, the main indicators of the growth of Research & Development in the business enterprise sector are R&D expenditure and R&D personnel.

Examination of expenditure data not only provides an absolute figure, but also allows a comparison to be made with overall business development. The relationship between (intramural) R&D expenditure and gross domestic product, called “research intensity”, is usually viewed as the core size for assessing R&D effort within a national economy. Research intensity acquires additional political significance as a result of the “Lisbon target” with which the

6 Bundesbericht Forschung und Innovation [Federal Report on Research and Innovation].

7 www.bmbf.de.

8 For further information please contact Dr. Andreas Kladroba.

member states of the European Union affirmed their intention of achieving a research intensity of 3% by the year 2010.

Examination of the R&D personnel data as the second important indicator takes account of the fact that, in the public consciousness, employment is regarded as one of the most important economic factors. This variable has an additional advantage over R&D expenditure, in that it is free of inflationary influences. But it is the consideration of R&D expenditure and R&D personnel data taken together which provides a complete picture of Research & Development within a national economy.

The R&D survey results, both for expenditure and for R&D personnel, permit the adoption of either of two approaches:

First of all a longitudinal section will highlight not just the current figures but also the percentage comparison with previous years. Thus the German business enterprise sector spent € 53.4 bn on Research & Development in 2007. This was 2.8% more than in the previous year. In 2008 the figure was € 57.3 bn, an increase of 7.2% in comparison with 2007. A long term comparison shows that R&D expenditure has almost doubled between 1991 (the year of reunification) and 2008 (+96.4%). For the sake of precision it must, however, be noted that this is not a true longitudinal section. Because of enterprise start-ups and closures, and especially because one should not underestimate the number of enterprises which perform only temporary, project-related R&D, the basic population changes with each survey year. But aggregation means that this can be disregarded, enabling a temporal comparison to be made.

When considering the data for R&D expenditure and R&D personnel the important differences are highlighted when a long term view is taken. As mentioned above, R&D expenditure between 1991 and 2008 increased by over 95%. In accordance with international agreements, it is the nominal R&D expenditure which is taken into consideration, so this growth rate includes an inflationary element which cannot be more precisely identified. In comparison with expenditure, R&D personnel seems hardly to have altered over this long period. In 1991 there were 321,756 people (full-time equivalent) engaged in R&D, while 17 years later the number was 332,909. The time series view, however, clearly shows that there are cycles underlying R&D personnel data. For example, between 1991 and 1995 the number fell to 283,316. There was another low point at 298,072 in 2003. In the interim, the personnel figure had increased to over 307,000 in 2001. However, this should not give the impression that business enterprises' R&D involvement does not change during the course of time. While inflationary effects influence the expenditure side producing an overestimation of the growth rate, increased productivity can lead, conversely, to an underestimation of the actual growth in R&D activity.

Alongside this longitudinal section view, analysis of the structures of R&D activity within business enterprises plays an important role. Regarding the two variables, expenditure and personnel, the main points are

1. in relation to expenditure
   a) the distribution between intramural and extramural R&D expenditure (and the recipients of the extramural expenditure)
   b) the source of funds
   c) the allocation of funds according to cost element type (labour costs, other current costs, R&D capital expenditure) but also according to type of R&D (basic research, applied research, experimental development)
   d) distribution of expenditure by industry sector and size of business
   e) regional distribution
2. in relation to personnel
   a) gender distribution
   b) classification by occupation (researchers, technicians, other supporting R&D staff)
   c) likewise, distribution by industry sector, size of business and region.

Detailed analyses of the structures can be extracted from the respective current Stifterverband R&D Data Reports. Here is an outline of the main points (using 2007 for reference).

1. The € 53.4 bn total expenditure on R&D referred to above is subdivided into € 43.0 bn intramural expenditure and € 10.4 bn extramural expenditure. This means that just under 20% of R&D is not carried out by the enterprises themselves, but is awarded in the form of research contracts. Of course, this proportion fluctuates substantially over time. To some extent intramural and extramural expenditure also experience different directions of development, such as happened in 2007. While intramural expenditure increased by over 4.5%, extramural expenditure, on the other hand, dropped by almost 4%. Most extramural R&D expenditure is allocated for R&D contracts within the same enterprise group, however. Over 45% went to affiliated companies at home and abroad. A further almost 30% remained in the domestic business enterprise sector. Only just over 20% of funds went to higher education and government research institutes.
2. The question as to how Research & Development is funded is one which is often asked. It must be recognised that business enterprises pay for their research themselves, almost without exception. Far more than 90% of expenditure is funded by the business enterprise sector at home and abroad. The government share of funding is under 4%, and this includes both research contracts and support by governmental R&D incentive programmes. EU funding programmes make up a mere 0.5% of intramural R&D expenditure.

3. Research & Development in the German business enterprise sector is characterized by manufacturing industry and here especially in the sectors manufacture of transport equipment, manufacture of electrical and optical equipment, manufacture of machinery and manufacture of chemicals. These four sectors together represent more than 80% of R&D expenditure in the business enterprise sector, while manufacture of transport equipment alone accounts for almost 40% of total R&D expenditure by German business enterprises. In terms of employment, these four sectors represent just under 80%. It is true, though, that the service sector is growing in significance. But its share of R&D expenditure is still less than 10%.
4. In Germany Research & Development is mainly performed by large enterprises. The proportion of R&D expenditure incurred by small and medium enterprises with less than 500 employees was just under 14% in 2007. In terms of employment it was just over 20%. Taking a longer term view, however, it becomes evident that SMEs are growing in significance.
5. With regard to regional distribution within Germany, there is a pronounced divide, both between north and south and between east and west. Well over 60% of intramural R&D expenditure is incurred by the business enterprise sector in the three southern federal states of Baden-Württemberg, Bavaria and Hessen. In the remaining western federal states it is just under 30%, and in the east (including Berlin) less than 10%. The southern federal states are ahead in terms of employment, too. Over 50% of all R&D employees work in the south.
6. Questions are also often asked by academics and politicians about the aspect of gender distribution amongst R&D personnel. It has to be said that Research & Development is a sphere which is still male-dominated. Just 18.1% of R&D employees are women. The differences become even more clearly apparent when one looks at individual personnel groups (scientists & engineers, technicians and other supporting R&D staff). Women represent just 12% of the scientists and engineers, a group which includes the managers of R&D units.

Other issues covered by the Stifterverband R&D Survey, such as innovation, will not be dealt with here. These are covered by the relevant literature (e.g. R&D Data Reports).

5. The Lisbon Target and International Comparisons

From the point of view of intramural R&D expenditure and R&D employees, Germany is the 4th strongest research location in the world, after the USA, Japan, and China. So, within Europe, Germany actually holds the leading posi-

tion. But these bald figures are of a poor informative value considering the great difference in size of the countries. For this reason (especially when one wants to eliminate currency differences), international comparisons are normally made with the aid of research intensity data (intramural R&D expenditure in proportion to gross domestic product). The particular political significance of this ratio lies in the fact that the member states of the European Union have agreed to increase research intensity to 3% by 2010.

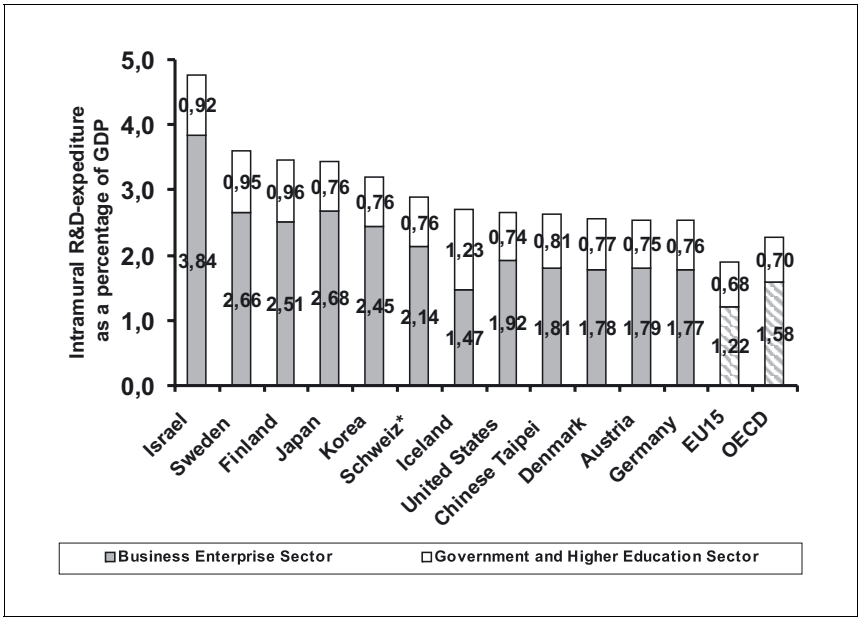
Diagram 1 shows the development of research intensity in Germany since 1995. It illustrates the following points:

1. As from 2002 at the latest, progress towards the 3% target is barely discernible.
2. The modest dynamic of the figures can be traced back almost exclusively to the business enterprise sector. The higher education and government sectors have been at a virtual standstill for over 10 years. To put it another way, this means that the government sector, which provides over 80% of the funding for these sectors, allocates its resources in line with the economic trend. Accordingly, research is not being expanded.

With regard to the international comparison of research intensity (figure 1), it is clear that

- Europe (EU15) is still a long way from achieving its self-defined targets.
- Germany holds – in absolute terms – a leading position within the EU. The equally large national economies of France (2.08%) and Great Britain (1.79%) lag well behind, not only in terms of absolute figures but also in terms of research intensity.
- In a global comparison Germany does not hold a leading position; in fact, according to OECD data, it is not even amongst the best ten.[9] Even though the results from small national economies have to be treated as relative because they are affected by individual phenomena, it has to be said that countries like Japan, Korea or, in Europe, Finland and Sweden, are clearly already significantly further ahead. Furthermore, countries with emerging economies, such as China, which are admittedly at a relatively low level at present, but have built up an extremely high dynamic, are likely to play a key role in future considerations.

[9] OECD, MSTI 2009 / 1.



* 2004.

Source: OECD.

Figure 1: The countries with the highest research intensity world wide

Further Reading

Expertenkommission für Forschung und Entwicklung (EFI, ed.), Studien zum deutschen Innovationssystem, most recently:

Gehrke, B. / *Legler,* H. / *Grenzmann,* Ch. / *Kladroba,* A. / *Kerst,* Ch. / *Troltsch,* K. (2009): Kleine und mittelgroße Unternehmen im Fokus: FuE-Aktivitäten, Wirtschaftsstruktur, Ausbildungsanstrengungen und Nachfrage nach Hochqualifizierten, Studien zum deutschen Innovationssystem 11 – 2009, Hannover / Essen / Bonn.

Gehrke, B. / *Legler,* H. / *Schasse,* U. / *Grenzmann,* Ch. / *Kreuels,* B. (2010): Regionale Verteilung von Innovationspotenzialen in Deutschland, Studien zum deutschen Innovationssystem 3 – 2010, Hannover / Essen.

Legler, H. / *Schasse,* U. / *Grenzmann,* Ch. / *Kladroba,* A. / *Kreuels,* B. (2010): Forschungs- und Entwicklungsaktivitäten der deutschen Wirtschaft – eine strukturelle Langfristbetrachtung, Studien zum deutschen Innovationssystem 2 – 2010, Hannover / Essen.

OECD (2002): Frascati-Manual: Proposed Standard Practice for Surveys on Research and Experimental Development, Paris.

Peters, B. / *Kladroba,* A. (2009): Soziale Erträge der FuE-Tätigkeit in Deutschland, Studien zum deutschen Innovationssystem 15 – 2009, Mannheim / Essen.

Wissenschaftsstatistik (ed.): FuE-Datenreport, most recently:

Grenzmann, Ch. / *Kladroba*, A. / *Kreuels*, B. (2009): FuE-Datereport 2009, Tabellen und Daten, Essen.

Grenzmann, Ch. / *Kladroba*, A. / *Kreuels*, B. (2010): FuE-Datereport 2010, Analysen und Vergleiche, Essen.

Wissenschaftsstatistik (ed.), FuE-Facts, various volumes and topics, (downloadable at www.wissenschaftsstatistik.de).

Wissenschaftsstatistik GmbH (ed.), Materialien zur Wissenschaftsstatistik, most recently:

Grenzmann, Ch. / *Kreuels*, B. (2009): Forschung und Entwicklung in Staat und Wirtschaft des Landes Nordrhein Westfalen, Materialien Heft Nr. 17, Essen.

Grenzmann, Ch. / *Kreuels*, B. / *Niehof*, B. (2010): Forschung und Entwicklung in Nordrhein-Westfalen 2010, Materialien Heft Nr. 18, Essen.

Legler, H. / *Gehrke*, B. / *Belitz*, H. / *Grenzmann*, Ch. (2008): Forschungslandschaft Deutschland, Materialien Heft Nr. 16, Essen.

Wudtke, J. (2005): Was wir messen, in: FuE-Info 2 / 2005, 8 – 11.