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EFFICIENCY OF THE R&D-FUNDING SYSTEM IN GERMANY AND POLAND (PART I) – THE ROLE OF HIGHER EDUCATION AND NON-ACADEMIC INSTITUTIONS

1. INTRODUCTION

Among the formerly centrally planned economies in Central and Eastern Europe, Poland belongs to those countries which have introduced far-reaching reforms in virtually all parts of society, in order to adjust to the requirements of a market economy. In many fields, it was necessary to reduce the governmental influence and leave more space for private initiatives. In other fields, the public sector will continue to play an important role, even in a fully transformed market economy. Nevertheless, a thorough restructuring of the governmental institutions involved in these fields is often necessary[1]. The system of financing research and development (R&D) belongs to these fields. In order to sustain the strong technological competition when entering the European Union, the private sector, especially the firms, will have to increase their efforts in the field of R&D. At the same time, these research activities have to be supported and supplemented by research activities performed in public or publicly funded institutions, such as universities, academies of science, etc. The means that are

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[1] T. Apolte, D. Cassel, *Osteuropa: Probleme und Perspektiven der Transformation sozialistischer Wirtschaftssysteme*, „List Forum für Wirtschafts- und Finanzpolitik" 1991, Bd. 17, H. 1, p. 22–55; D. Lösch, *Der Weg zur Marktwirtschaft, Grundzüge einer Theorie der Transformationspolitik*, Bd. 4, Veröffentlichung des HWWA-Instituts für Wirtschaftsforschung Hamburg, Baden-Baden 1993.

available for this task are strictly limited. Therefore it is essential that the available funds are spent efficiently. The degree to which the public R&D funds are used efficiently primarily depends on the structure of the R&D financing system.

In this respect, it seems necessary to analyze the R&D funding system of Poland, in order to find out to which extent it works efficiently and what changes in structure can be implemented to improve its efficiency. As a good background for the evaluation of Polish R&D system, the German system can be used. First, Germany has a highly developed and very sophisticated system of financing R&D[2]. Secondly, Germany can serve as a point of reference and comparison because the German solutions were implemented in former East Germany, which, like Poland, had to be transformed to democratic market economy[3].

The analysis of the Polish R&D system and its comparison to the German one requires and systematisation of different agents constituting the R&D funding system. It shall allow the identification of basic structural characteristics, which determine the efficiency of the system. This theoretical base is necessary for the identification of the agents, existing in the R&D financing systems in Germany and Poland and of the financial streams between them. In both systems, the role of higher education and non-academic institutions, as the most important R&D conducting institutions in the public sector, is observed. Therefore a special focus is laid on the allocation of funds within these institutions. The above directions of analysis should commit to formulation of suggestions, that may help in the process of development of the Polish R&D funding system.

2. ORGANIZATION OF THE R&D FINANCING SYSTEM AND ITS PERFORMANCE

2.1. Financial Relations within R&D System

A meaningful comparison of the R&D financing systems in Germany and Poland must first identify the different agents involved. Four basic types of agents can be identified: there are the sources of financing R&D, the R&D conducting institutions, intermediates and advisory institutions (fig. 1).

[2] H. Flitner, *Financing, Budgeting and Controlling of Research in the Federal Republic of Germany*, [in:] A. Orsi-Battaglini, U. Karpen, *Scientific Research in the Federal Republic of Germany, Essays on the Constitutional, Administrative and Financial Problems*, Nomos, Baden-Baden 1990, p. 68–90; W. Gries, *Staatliche Forschungsförderung in Deutschland*, Arbeitspapier der Konrad-Adenauer-Stiftung 1999.

[3] T. Kalinowski, S. Umiński, *Doświadczenia Unii Europejskiej w zakresie polityki proinnowacyjnej*, Instytut Badań nad Gospodarką Rynkową, Gdańsk 1996, p. 6.

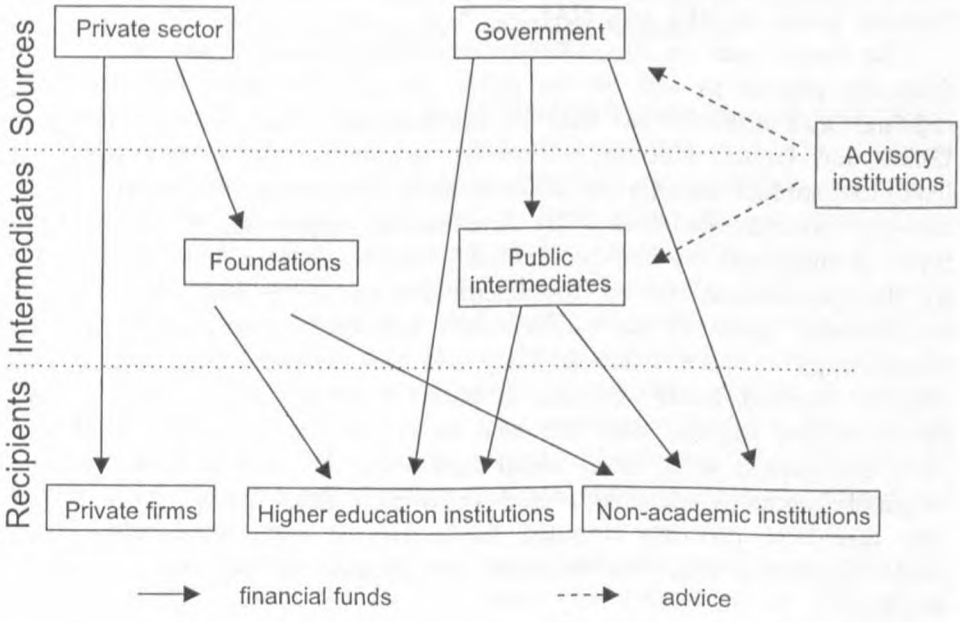

Fig. 1. Agents and financial streams in the system of R&D financing. Source: own calculations

The research-conducting institutions can be divided into four groups. First, research is done in the private firms. In addition, higher education institutions (HEI), especially universities, non-academic institutions (NAI) and government and joint research institutes (GRI) engage in research. The three latter-named institutions largely rely on public funds and are not profit-oriented, so they can be defined as public R&D conducting institutions. Other than NAIs and GRIs, the HEIs do not only engage in research but also in teaching.

While HEI and GRI are installed under public law, most of NAI are private non-profit research-conducting institutions (exception is Polish Academy of Sciences). GRI are installed to do research on fields and topics which are mostly directly determined by the government, in order to support research in industry[4]. The other two types of institutions are substantially more independent in their choice of field of research[5]. The broader scope of possible activities of HEI and NAI, together with more sophisticated system

[4] A. Wyczański, *Nauka w Polsce 2002–2003. Stan i kierunki reformy*, „Nauka" 2003, nr 2, p. 67.

[5] E.g. R. Mayntz, *Scientific Research and Political Reorganisation of Knowledge and Production*, [in:] A. Orsi-Battaglini, F. R. Monaco, 1991, p. 45–62.

of their financing, makes it especially interesting, to focus on those funds that are given to HEI and NAI.

The funds used in the different research-conducting institutions stem from the private as well as the public sector[6]. The latter includes local, regional and national as well as international sources (e.g. European Union and United Nations). A certain amount of the total funds flows from the sources directly to the recipients. A considerable share of means is, however, distributed by intermediate organizations. Two major types of intermediates can be identified. Public intermediates are installed by the government, or by the scientific community itself, to distribute a substantial part of the public funds for R&D. Foundations are the second type of intermediates. They use the interest from their capital stock to support R&D activities in public institutes as well as in private firms. In this respect, they can also be defined to be a source of support. The capital stock from which they draw the interest does, however, originally come from private and (mostly) public funds[7]. In addition, they distribute privately donated funds and in some cases also public funds. Therefore they will hereafter be assigned to the group of intermediates.

2.2. The effects of different structural solutions on the public R&D system efficiency

The extent to which the funds, which flow to public HEI and NAI, are allocated efficiently depends on the structural characteristics of the fund-distribution system. For each of these characteristics, different solutions are possible. There are three characteristics, which are crucial for the overall effectiveness of the system and thus need discussing, producing the result in form of identifying the pros and cons of possible structural solutions. The results of this discussion will build a framework for evaluation of the German but especially the Polish R&D financing system.

[6] E.g. W. Gries, *op. cit.*; B. Rejn, *Źródła finansowania działalności badawczo-rozwojowej (B+R)*, „Nauka" 2003, nr 3, p. 156.

[7] E.g. M. Erhardt, *Knapp, aber Notwendig – Wissenschaftsförderung durch Stiftungen*, [in:] Pro Wissenschaft (ed.), *Forschungsförderung in Deutschland. Aufbau, Akteure, Adressaten*, Raabe, Stuttgart, 1999, p. 22–25.

2.2.1. Institutional versus Project Funding and the Role of Competition between Research-Conducting Institutions

Two types of funds have to be differentiated when analyzing the R&D financing system. First, the R&D conducting institutions receive a certain amount of resources without applying for them or specifying any certain research project for which they will be used. The recipient organization does not offer any specific service or product in exchange for these funds but is merely granted the money for the very broadly defined statutory purpose (i.e. to perform research and teach). In addition to this so-called institutional funding, the research conducting institutions can apply for further means. These means are granted for a certain project. A contract between the granting and the receiving organization specifies the research project and may name services the research conducting institution has to supply in return[8]. The system of institutional funding has both, advantages and disadvantages.

Institutional funding is necessary to ascertain the freedom of research[9]. Both the German and the Polish constitution guarantee the freedom of research. Institutional funding is furthermore necessary to have scientists who can develop good research projects which are worth funding and which can be funded in project funding. In addition, it ensures continuity in research, an essential precondition for success in the field of pure research. Regarding the highly specialised research in virtually all fields of science today, this continuity also allows the scientists to acquire enough knowledge on their specific field of research to be able to contribute to this field. Also there are some institutes which spend large sums of resources on delivering inputs for further research (e.g. Deutsches Institut für Wirtschaftsforschung – DIW, Berlin). This work can only be done, if the institutes get continuous institutional funds.

On the other hand, generous institutional funding has a number of disadvantages. First, the granting institutions cannot influence the directions of research but leave this decision to the research conducting institutes. Their priorities may deviate from those of the fund-granting agents. This bears the danger that large sums of resources are spent on problems which are not considered urgent by the society and the government. At the same

[8] J. Jabłecka, *Koordynacja badań akademickich. Teorie, koncepcje i rzeczywistość*, Centrum Badań Polityki Naukowej i Szkolnictwa Wyższego Uniwersytet Warszawski, Warszawa 2002, p. 143–154.

[9] E.g. A. Brünneck, *Freedom of Research in Constitutional Theory and Practice*, [in:] A. Orsi-Battaglini, U. Karpen, *op. cit.*, p. 11–28.

time, too little effort may be made to find solutions for really urgent problems. By giving project funding in addition to institutional funding, the granting institutions can allocate resources in accordance with their current preferences[10].

The researchers in public research conducting institutions are bureaucrats in the definition of the economic theory of bureaucracy. Accordingly the professors can be considered chief bureaucrats. They can be expected to try to maximize their budget and number of employees, because this brings prestige and sometimes leads to additional income[11]. As the total research funds are scarce, project funding initiates competition among them. This sets incentives for researchers to develop new projects which are high in standard and promise to produce valuable results[12]. In addition, they have to define scientific objectives and search for possible applications of their research. After the means are granted, the researchers face incentives to work efficiently, because they have to report on their results. Poor results reduce the chance of being granted additional funds in future.

The high costs of refereeing and evaluating projects constitute the primary disadvantage of project funding compared to institutional funding. These costs are incurred by the granting institutions. In addition, the researchers have to spend resources on formulating applications and reports. Part of these resources represents social waste, especially if they are spent on mere window-dressing or on applications which are rejected later[13]. If these costs exceed the gains resulting from an increasing outputquality induced by the system of project funding, the latter reduces overall efficiency.

In sum, an efficient system of financing R&D in the public sector has to provide institutional funding which is sufficient to guarantee continuity and at the same time grant additional funding for special projects.

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[10] E.g. A. Blankennagel, *Participation of Scientists in Science Policy*, [in:] A. Orsi-Battaglini, U. Karpen, *op. cit.*, p. 44–67; A. Geuna, *The Changing Rationale for European University Research Funding: Are there Negative Unintended Consequences?*, „Journal of Economic Issues" 2001, Vol. 35, p. 607–633.

[11] E.g. U. Roppel, *Ökonomische Theorie der Bürokratie*, Freiburg i.Br. 1979.

[12] E.g. F. Neidhardt, *Selbststeuerung in der Forschungsförderung: das Gutachterwesen der DFG*, Westdeutscher Verlag, Opladen 1988.

[13] E.g. H. Brennan, R. Tollison, *Rent-seeking in Academia*, [in:] J. M. Buchanan, R. D. Tollison, G. Tullock, G. (eds), *Toward a Theory of the Rent-seeking Society*, College Station, 1980, p. 344–356.

2.2.2. Freedom of Research and the Role of Scientists in the Process of Funds Allocation

The financial means available for R&D activities are scarce. Consequently, there will always be more promising institutions and projects to support than can be funded. This makes it necessary to set priorities, select the most promising institutes and projects and turn down others. The decision about the structure of research institutes is a long-term decision, while the decision between different research projects does not imply comparably long-term financial commitments. Nevertheless, both types of decisions must be based on a thorough evaluation of the prospects of the fields of research at hand. Naturally, the scientific community itself has the most valuable "insider" information which is necessary for this purpose[14]. This raises the question concerning the role of scientists in the process of allocating R&D funds[15]. In order to use the expertise of the scientists, it is absolutely necessary to involve them as advisors or referees when it comes to choosing between different projects in the same field of research. When it comes to choosing between different fields of research, two solutions are possible. First, the granting organisation can predefine the fields of research. Second, it can leave the decision to the scientific community itself. The latter appoints a committee which allocates the funds.

The first form is advised in those cases where a private firm or a governmental institution has a specific problem to solve and needs scientific assistance. In this case, the scientists' know how is solely needed to identify the institution or approach which seems most promising in terms of finding a solution. A large part of this type of research is done in GRI. Here, the scientific freedom is restricted to the choice of methods[16].

In HEI and NAI, this is by far not the only type of research. A large part of the research is guided by questions developed by the scientists themselves. Due to the scarcity of funds, not all these questions can be addressed. Therefore it is not only necessary to decide between different ways of trying to solve a pre-determined problem but also to decide about the fields of research in which solutions are searched for. When making these research funding decisions, both forms of involving the scientific community have their pros and cons.

Some authors point out that scientists are better equipped than politicians or administrative bureaucrats to identify the fields of research that are most

[14] E.g. F. Neidhardt, *op. cit.*

[15] E.g. A. Blankennagel, *op. cit.*, p. 44–67.

[16] E.g. O. Kimminich, *Organisation and Financing of Research*, [in:] A. Orsi-Battaglini, U. Karpen, *op. cit.*, p. 44–67.

promising[17]. Therefore a self-governing scientific community is expected to produce better results than a scientific community which is under strict government control. On the other hand, it bears the danger that the selection of projects follows the interest of the scientists rather than the needs of society[18]. Predominant role of the scientists in the process of determining the directions of the scientific activities was observed until the 1960 s. It was believed, that only the scientists have the ability to distinguish between research projects of different quality. They were also supposed to be the experts in the area of financial needs of scientific research. This view changed towards the opinion, that the government plays an important role in the process of allocation of R&D resources and therefore has to cooperate with the scientific community in creating the R&D policy. The advantages of such a dual system of decision-making in the field of R&D are stemming from the utilitarian function and competitiveness of R&D activities, induced by the governmental control[19]. The role of the state administration in creating R&D, and broader – scientific, policy could be defined as follows[20]:

– investigation of the needs of science and scientist, but on the basis of scientists' advice;

– looking for the possibilities of applying the scientific approach in solving the problems the state has to cope with;

– helping the scientific community achieve maximum efficiency of its activities, eliminating existing inefficiencies;

– providing the scientific community with sufficient means for its material existence.

The balance between the influence of the state and the scientists on the directions of R&D development has to exist, as the dominance of self-government of the scientific community can lead to inefficiencies.

An additional disadvantage of self-governance in the scientific community results from the composition of the relevant committees. These represent the interest of all fields of science and meet the decision concerning the division of funds among different fields of research in a consensus. Thus the allocation of means across different fields of research follows the political power of the different departments or branches. It can lead to great

[17] E.g. F. Neidhardt, *op. cit.*

[18] *Ibidem*; J. Kozłowski, *Three Myths of Scientific Community in Poland*, [in:] I. Sińska (ed.), *SCI-TECH Programme (Reform Programme for the Science and Technology Sector) 1992–1997*, 1997, p. 95.

[19] J. Kozłowski, *Od samorządu nauki do polityki naukowej*, „Nauka i Szkolnictwo Wyższe" 1999, nr 13, s. 66–81.

[20] P. Hübner, *Polityka naukowa w Polsce w latach 1944–1953. Geneza systemu*, t. 1, Ossolineum, Wrocław, Warszawa, Kraków 1992, p. 12.

dispersion of research topics and financial means[21]. Very often, the funds are allocated by head count, weighed with the field-specific cost-intensity of research[22], because this is the only consensus that can be reached among the different interests represented in the committee. This procedure regularly violates the pursuit of maximizing the expected scientific output.

As a result, it furthermore causes structural conservatism in the allocation of means, because each branch will try to defend "its" share of funds. This makes it very difficult to react to new research opportunities, especially if these are not represented by existing branches or departments. In addition, the committees may only very slowly react to changes in the society's requirements to research[23]. Blankennagel[24] points out that scientists are not neutral in their judgement but are influenced by their own scientific background, e.g. the methods applied and the degree of practical applicability. This can increase the structural conservatism further and lead to an under-representation of scientific minorities. Though this problem affects both forms of involving the scientific community in the fund-allocation process, it is easier to control for if the scientists' role is confined to giving advice.

On the other hand, the private sector as well as the government is likely to systematically underestimate the merits of basic research. Following their limited time horizon, especially of elected governments, they will prefer to finance research which promises short-term and readily applicable results in the near future[25].

Further inefficiencies may result from the often very fast changes in public opinion and priorities of research in combination with a large share of research funding being distributed as project – rather than institutional funding. If the changes in opinion lead to frequent changes in research emphases, these will produce large sunk costs because previously established research fields and methods are no longer funded and thus applied. Especially in the field of natural science and medicine, it is inefficient to buy and install the very specific and expensive apparatus only for one project and take the risk of not using it any further.

Summing up, it becomes obvious that both radical forms of involving the scientific community in the decision-making process concerning the allocation of research funds have their pros and cons. Consequently an

[21] B. Jałowiecki, *Nauka a rozwój społeczny*, [in:] J. Gościkowski, S. Marmuszewski, *Nauka. Tożsamość i tradycja*, Universitas, Kraków 1995.

[22] E.g. O. Kimminich, *op. cit.*, p. 44–67.

[23] W. Gries, *op. cit.*; A. Geuna, *op. cit.*, p. 607–633.

[24] A. Blankennagel, *op. cit.*, p. 44–67.

[25] A. Geuna, *op. cit.*, p. 607–633.

efficient system of R&D funding cannot rely on just one of these forms. Instead, it must make use of both methods, allocating some means in accordance with the preferences of the granting agent while leaving other means to the disposition of the scientific community itself.

2.2.3. The Importance of Competition among the R&D Funding Institutions

An efficient system of deciding about research funding has to guarantee competition between different funding organizations. First of all, this competition sets incentives for the fund-granting institutions to work efficiently and compete for the highest-standard research projects in order to build up a good reputation. Second, it ensures that the scientists of existing branches of research do not use their position to form closed shops. This danger is small in those fields where the role of scientists is confined to giving advice but especially large if the scientific community has a far-reaching autonomy in allocating research funds. If, however, scientists can address a large number of different funding organizations, the probability that one of them accepts a project outside the standard fields (or methodology) of research rises. Following the course of reasoning of Schumpeter or von Hayek, competition among funding organizations will lead to a larger variety of methods and fields of research and thereby increases the research efficiency[26].

3. THE ORGANIZATION OF R&D FINANCING SYSTEM IN GERMANY AND POLAND

The R&D systems in Germany and Poland can be analyzed on basis of the previously presented general model, showing the institutional agents and financial streams between them.

The precise comparison of the basic features of both systems is extremely difficult, due to different way of gathering information and lack of detailed statistical data in Poland. That is why the latest representative year for both countries is the 1999. In that year, the gross expenditures on R&D (hereafter GERD) amounted to 94 440 m DM in Germany and 2295 m DM in Poland. Comparing the R&D expenditures *per capita* – 1180 DM (2000) in Germany versus 123 DM (2000) in Poland – points to a ratio of

[26] E.g. H. Grupp, *Messung und Erklaerung des technischen Wandels*, Springer, Berlin 1997; A. von Brünneck, *op. cit.*, p. 11–28.

9.6 : 1[27]. A more sophisticated and giving better overview of the country's effort in R&D support is the ratio of GERD to GDP[28]. This ratio was 2.5% in Germany in 2000. This is 3.5 times higher than in Poland (0.7%). Similar disproportions can be observed when comparing Poland to other highly developed countries like Japan (3%) or the United States (2.7%)[29].

Apart from the mere volume, the structure of R&D expenditures differs substantially between Germany and Poland. First, the countries differ in their source structure. In Germany, R&D activities are primarily financed by the private sector[30]. It accounts for 64.4% of the total R&D expenditures in 1998. In Poland, only 41% of the R&D expenditures stem from private sources[31].

Also the recipient structure differs, only 28 930 m DM (30.6%) in Germany and 1342.7 m DM (58.5%) in Poland were used for R&D activities in public R&D conducting institutions. In Germany, the financial support of the public institutions is the obligation of the states (Länder) but the federal government provides additional funds for R&D activities. In Poland, the central government is in charge of R&D policy and thus serves as the primary source of R&D supporting funds. In addition to the different national sources, public R&D conducting institutions in both countries also receive some funds from supra-national institutions such as the European Union or the United Nations. In both countries, R&D activities in public institutions are primarily funded by public sources. These account for 74% of their own budget in Germany[32] and 91.4% in Poland[33]. These means are partly transferred directly from the governmental source to the R&D conducting institutions, while other means are transferred through public intermediates. In Germany, the DFG and the DAAD are the largest public intermediates, while the KBN takes this role in Poland. The foundations' contribution to financing R&D in public institutions is limited. In 1999, they accounted for 0.8% in Germany[34] and 0.4% in Poland[35].

[27] Organisation for Economic Cooperation and Development (ed.), *OECD in Figures. Statistics on the Member Countries*, „OECD Observer" 2002, Supplement 1, http://www1.oecd.org/publications/e-book/ 0102071E.PDF, 20.08.2002; recalculated using current exchange rates.

[28] B. Rejn, *op. cit.*, p. 160.

[29] Organisation for Economic Cooperation and Development (ed.), *op. cit.*

[30] All not-budgetary sources are here defined to be private.

[31] Główny Urząd Statystyczny (ed.), *Science and Technology in Poland 1999*, Warsaw 2001, p. 26.

[32] Bundesministerium für Bildung und Forschung (ed.), *Zahlenbarometer 2000–2001*, Bonn 2001, p. 53.

[33] Główny Urząd Statystyczny (ed.), *Nauka i technika dla rozwoju w 1999 roku*, Warszawa 2001, p. 46.

[34] Bundesministerium für Bildung und Forschung (ed.), *Bundesbericht Forschung 2000* (English version), Bonn 2001, p. 456, 457.

[35] Główny Urząd Statystyczny (ed.), *op. cit.*, p. 46.

Comparing the recipient structure, 59% of the total expenditures on science within public institutions in Germany flows to HEI (as of 1999)[36]. The remaining 41% flow to NAIs. Corresponding data for Poland is more difficult to present. About 40% of public expenditures within public sector flows to HEI, but the majority of remaining funds flow to research units in industry (to state-owned institutions), with only 16.1% flowing to Polska Akademia Nauk (PAN). If the expenditures in public industrial sector are not taken into account, the share of expenditures flowing to HEI grows to about 68.8%[37].

4. THE ROLE OF HEI AND NAI IN THE NATIONAL R&D SYSTEMS

4.1. Research in HEI

The system of Higher Education Institutions in Germany differs from the Polish one not only because of the number of HEIs. In addition, the different educational systems have substantial impact on the structural characteristics of the HEI.

Most of German HEIs are public. The overall number of HEIs in 1999 was 348. There are three major sources of financing of German HEIs: institutional financing, income from administrative activities and supplementary financing, especially project funding. The states are in charge of providing institutional funding for the HEI (exception: Universities of armed forces). The funds are transferred to university in a so-called "Globalhaushalt". The allocation across departments and institutes is decided upon by inner-university committees[38]. The means that the HEI receive as institutional funding are given to them for both teaching and research. The decision how to use them is made by the scientists. In 1999, these institutional funds from the States amounted to 29 767.7 m DM[39], which equals 87% of the total public funds of HEIs. In addition, the HEIs receive funds for investment, which are not granted for special projects but for the development of the HEI as a whole.

The analysis of the financial situation of HEIs in Germany in the 1990s (1993–1998)[40] shows the consistently slowing down dynamics of institutional

[36] Bundesministerium für Bildung und Forschung (ed.), *op. cit.*, p. 458.
[37] Główny Urząd Statystyczny (ed.), *op. cit.*, p. 37.
[38] O. Kimminich, *op. cit.*, p. 42.
[39] Bundesministerium für Bildung und Forschung (ed.), *op. cit.*, p. 458.
[40] Wissenschaftsrat (ed.), *Drittmittel und Grundmittel der Hochschulen*, Köln 2000, p. 11.

financing. Although the share of this source is about 61% on average, the real yearly growth rate in the analyzed period was only 1.3%. The other important source of income of HEIs are administrative inflows, which account for 30% of total income of HEIs. The remaining 9% are so-called Drittmittel (supplementary funding), the largest part of which are project funding means, granted upon application for specific research projects. The analysis of the supplementary funding dynamics shows a growth rate of more than 4.2%, which is more than 3 times higher than the corresponding number for institutional funding. The role of institutional financing, administrative income and supplementary funds varies among different groups of HEIs. For example in universities, after excluding medical faculties, 83% of money is the institutional funding, but in medical faculties only 32%, with the dominant role of administrative sources of income (reaching even 64% of total income). In Fachhochschulen, which are primarily installed for teaching applied science and not for conducting research, the role of institutional funding is even higher than in universities (94%). The importance of supplementary funding is easier to see if the medical faculties are not taken into account. Then the share of supplementary funding is approximately 15%. In the medical faculties and vocational schools the role of supplementary funding is less important (4% of total income). The administrative inflows in HEIs (without medical faculties) are marginal and amount to merely 2%.

The influence of HEIs on the volume of institutional financing available is minimal. The biggest possibilities are in the field of supplementary funding, especially project funding. They are especially important for research activities. In the period 1992–1997 different non-governmental institutions (such as DFG, foundations, international organizations) have become increasingly important as a source of funding R&D at HEIs (fig. 2). Among the supplementary funding of HEIs the financing through DFG plays the most important role, accounting for 35% of the means in 1997. The private sector represents the second largest source (26%). Two thirds of total supplementary funding at HEIs stem from public sources. The role of foundations can be defined by a 5% share. It leads to the conclusion, that, still, the state is the main financing institution for HEIs, even in the project funding.

In sum, the increasing share of project funding suggests that government and society in Germany try to control and direct R&D activities. Due to the still small share of funds given through project funding, the continuity and freedom of research is not endangered by this shift in funding method.

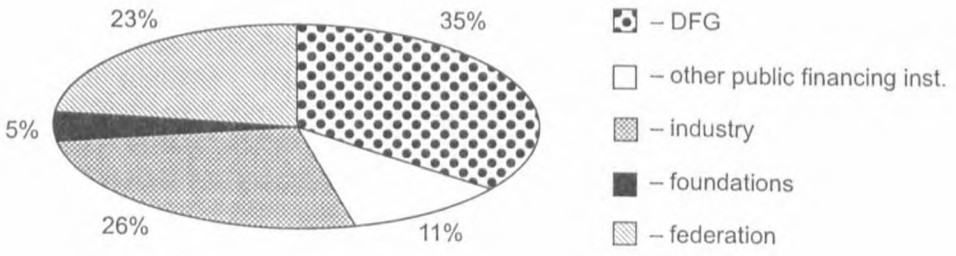

Fig. 2. Sources of supplementary funding (*Drittmittel*) in HEIs 1997. Source: Wissenschaftsrat (ed.), *Drittmittel und Grundmittel der Hochschulen*, Köln 2000, p. 61

The Polish higher education system is undergoing substantial changes, compared to its structure before the 1990s[41]. A strong need for tertiary education caused rapid development of private HEIs. They are similar to German Fachhochschulen and serve mainly the aim of teaching students the knowledge and techniques needed for future work. Most of the private HEIs do not have the right to grant master degree, not mentioning doctoral title. They grant mostly only bachelor degree. The students can then continue education at another school, or even public university.

In 1999 the total number of HEIs in Poland was 244, with 101 public institutions. They had together 4331 m DM at their disposal, with majority of funds flowing to public HEIs (3787 m DM)[42]. Polish public HEIs receive two major streams of financing – from the Ministry of Education (these must be used exclusively for teaching purposes and cannot be shifted to support research), and from KBN, which are devoted to R&D conducted at HEIs. This money is divided directly on faculties. These two streams cannot be mixed, so that the teaching needs of the school do not jeopardize the R&D activities.

The degree of influence of the HEIs authorities on the distribution of funds within the institution depends on source of funds. The subvention from the Ministry of Education is used to cover the teaching expenses of the HEI. It has to be supported by the income from student fees. These amounts are enough to merely cover the current expenses in the field of teaching and sustaining the facilities.

The expenditures on R&D in Polish HEIs amounted to about 650 m DM 8.9% stem from the industrial sector. Only 3.2% are their own

[41] Within just 3 years (1999–2000) the number of HEIs grew by about 20%, but there is a clear difference between public and private HEIs growth rates (public 14%, private 26%).

[42] Główny Urząd Statystyczny (ed.), *Szkoły wyższe i ich finanse w 1999 roku*, Warszawa 2000, p. 321.

resources. The role of foundations can be measured by a share of less than 0.5%[43].

The crucial role in financing R&D is played by the KBN. Some of KBN financial means are granted upon project application and are thus direct project funds. In addition, the HEIs get institutional funds, also through the hands of KBN. The amount of resources a faculty gets, does, however, depend on the evaluation of the specific faculties. The institutional financing comprises of statutory financing and financing of university's own research. The HEI has no influence on the division of statutory means, as they are divided directly on the faculties by KBN, after special evaluation of faculties. The resources dedicated to university's own research are further divided among the faculties by the university itself. Project funding means are transferred to the subunits of HEI, being only administrated by the HEI in a process of stepwise distribution among faculties and then institutes. A special inner-evaluation of faculties is conducted by university's authorities. It is however expected, that KBN will introduce the similar procedure as in case of statutory means. Thus, other than the German HEIs, their Polish counterparts cannot count on a stable financial basis for conducting research independent of short-term success in their R&D activities.

Taking the above into account, the biggest possibilities of self-governing the funds by the HEI apply to the means gained from the unit's own activity, especially student fees. Most of R&D subventions flowing from the state budget are predestined by the owner of the financial means, and the HEI's authorities play merely administrative role.

4.2. Research in NAI

The number of NAIs and their emphases are too heterogeneous to be discussed in detail. There are however institutions, which are representative for both systems, playing at the same time a dominant role in non-academic research in both countries. These are: the largest NAI in Germany – Max Planck Society for the Advancement of Science e. V. (MPG) and Polish Academy of Sciences (PAN) in Poland.

The Max Planck Society is a non-profit organization, established under private law, in the form of a registered association. The highest-ranking decision-making body of the Max Planck Society is the Senate. Its members come from major sectors of academic and public life. The Max Planck Society was founded in 1948 to succeed the Kaiser Wilhelm Society, which was founded in 1911. Max Planck Institutes conduct basic research in the

[43] Główny Urząd Statystyczny (ed.), *op. cit.*, p. 46.

sciences and arts and humanities and concentrate on particular areas of research to supplement research carried out by the universities. As of January 1, 2002 there are 80 institutes, research centres, laboratories and project groups employing approximately 11 600 people, among them about 3200 scientists and scholars. In addition, there were also about 8500 doctoral candidates, post-doctoral fellows and guest scientists and scholars from abroad.

About 95% of the financial support received by the Max Planck Institute comes from public funds provided by the Federal Government and the states. The remaining 5% comes from members' donations, contributions, own income and funded projects. Within 10 years its expenditures have been growing from nearly 1500 in 1991 to 2338 million DM in 2000. In the total Max Planck Society budget for 1999 revenues and expenditures amounted to 2341.3 million DM. This included DM 1982.4 million earmarked for institutional funding and 245.9 million DM for project funding. The administrative costs amounted to approximately 3–5% of total expenditures[44]. The funds dedicated to project funding are relatively small (10%). In addition, the work of the MPG is evaluated regularly by the Wissenschaftsrat (German Board of Science).

Although funded by federal and states funds, the Max Planck Society is not a state-run institution. Membership is open to any natural or legal person desirous of advancing science and scholarship. In addition, association members are the Scientific Members appointed by the Max Planck Society. The majority of them are also directors of the individual Max Planck Institutes. The necessary decisions ensuring that the Max Planck Society functions as a large scientific organization are taken by the individual organs within the Society.

The Polish Academy of Sciences (PAN) is Poland's largest research centre. It was created in 1952 and historically has continued the activities of the Societas Scientiarum Varsoviensis (Society of the Friends of Science) created in 1800 by Stanisław Staszic. PAN is composed of over 81 scientific units. In 2000 it employed 8162 people, of whom approximately 10% with the title of professor, 8% habilitated doctors, 23.4% of researches with doctoral degree and 30% scientists without PhD level. The remaining 28.6% are employees without higher education[45]. Similarly to MPG, PAN is concentrating its activities on basic research.

The rules of financing PAN are determined in government decree. The 99% of the financial support, obtained by PAN for research activity, comes

[44] Interview with MPG-officials.

[45] Central Statistical Office (ed.), *Statistical Yearbook of the Republic of Poland. Year LXI*, Warsaw 2001, p. 307.

from public funds provided by the government. These are the funds from the state budget called "Polish Academy of Science Budget" and KBN budget. The remaining about 1% comes from own income and non-public subsidies (e.g. Polish Science Foundation – FNP). The president of PAN, after the consultation with members of the Presidium, divides the funds into particular research units and assigns them to pre-defined research tasks. The total PAN budget for 1999 amounted to 254.2 million DM. Except for the own income of PAN (20 m DM) and 0.4% share of FNP funds, it comprises of more than 90% earmarked for institutional funding and almost 10% for project funding[46]. There is exactly the same procedure of evaluation of PAN research units as applied to universities. The units undergo this assessment procedure every four years.

Generally, the freedom of choosing methods as well as fields of research within MPG and PAN is considerable. As basic research cannot be expected to produce a steady flow of short-term results, the large share of institutional funding is difficult to control in the terms of research quality. Nevertheless, the regular evaluation of the R&D activities gives the society a possibility to ensure a high standard of research.

5. CONCLUSION

The presented overview of the major characteristics of the Polish and the German R&D funding system, with special stress on R&D in public institutions, allows for formulating some conclusions, with respect to the theoretical considerations put forth earlier. The importance of HEIs and NAIs as the major research conducting institutions in the system of allocating R&D funds is evident. The analysis has revealed a number of similarities but also pointed at some fundamental differences between R&D systems in Germany and Poland. The critical discussion of the structural characteristics, in particular of the Polish system, should allow to draw a number of conclusions concerning possible reforms.

- shortage of comparable data;
- influence of the R&D system organisation on freedom of research;
- separation of teaching and R&D resources.

The largest obstacle of comparing the R&D funding system in Germany and Poland was the shortage of comparable data. This shortage is partly caused by the differences in the system as such. In addition, however, there exists a fundamental shortage in data on the most vital questions, such as the ratio of institutional and project funding in general as for different

[46] Polska Akademia Nauk, *Sprawozdanie 1999*, Warszawa, May 2000, p. 272.

types of R&D conducting institutions. It diminishes the possibilities of drawing far reaching conclusions and therefore they have to be regarded as preliminary.

In Germany, the universities have the most far-reaching freedom to decide about their fields of research[47]. At the same time, the increasing number of students and an overbearing bureaucracy has continuously reduced the share of time that the scientists at university can spend on research[48]. In addition, the institutional funds grow, if at all, only very slowly, thereby forcing scientists to more heavily rely on project-funding. The freedom of research in Polish public universities is not as far-reaching. This is first due to the continuous evaluation of their scientific work by KBN, which forces them to concentrate on short-term results. Second, as a result of this procedure, the university is less autonomous in allocating the institutional funds across different departments. As KBN is essentially government-controlled, the Polish system does not make sufficient use of the expertise of the scientific community in identifying the most promising projects. When comparing the NAIs, MPG and PAN are also funded by public sources but, other than PAN, the MPG is not a state run institution. The expenditures of MPG and PAN had growing tendency in the last decade, but MPG destined more money for all fields of research than the Polish institution. In sum, the MPG is granted a substantial freedom of research in the short-run perspective, guaranteed by a high degree of institutional funds. At the same time, the freedom is restricted by the fact that the performance of MPG, like all German NAIs, is evaluated every two years by the Wissenschaftsrat. The freedom of research of Polish NAIs is essentially guaranteed to a similar extent.

One fundamental difference between Poland and Germany is the differentiation between means for teaching and research as practiced in Poland. The reforms in this area seem to be strongly advisable, because such an artificial separation of funds is impossible to control and leads to inefficiencies if it is applied. This results from the fact that equipment (e.g. computers, copying machines, laboratory equipment). which could be used for both purposes cannot be used in such a way. Instead, the legal procedures require that these means are bought twice, thereby unnecessarily raising the costs of both research and teaching. By restricting the division of means to areas where the division of purpose is clear (e.g. additional means for teaching staff), the costs of research and teaching could be reduced considerably.

[47] A. Blankennagel, *op. cit.*, p. 44–67; U. Karpen, *Scientific Research and Political Reorganisation of Knowledge and Production*, [in:] A. Orsi-Battaglini, F. R. Monaco, *op. cit.*, p. 135–160.

[48] P. Badura, *Government and Selfgovernment of Science. Constitutional Safeguards and Scientific Research and Teaching*, [in:] A. Orsi-Battaglini, F. R. Monaco, *op. cit.*, p. 63–84.

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EFEKTYWNOŚĆ SYSTEMU FINANSOWANIA BADAŃ NAUKOWYCH I ROZWOJU W NIEMCZECH I W POLSCE (CZĘŚĆ I) – ZNACZENIE INSTYTUCJI AKADEMICKICH I POZAAKADEMICKICH

Przedstawiono teoretyczne podstawy systemu finansowania działalności badawczo-rozwojowej. Skoncentrowano się na zagadnieniach efektywności systemu i czynnikach ją warunkujących. Na tym tle zaprezentowano podobieństwa i różnice występujące w systemach niemieckim i polskim. Wykazano znaczenie akademickich i pozaakademickich instytucji naukowych dla ukształtowania systemów finansowania badań naukowych i rozwoju w obu krajach. Wskazano możliwe rozwiązania, służące poprawie efektywności prowadzenia działalności badawczo-rozwojowej w Polsce.