STEERING AND FUNDING OF RESEARCH INSTITUTIONS

COUNTRY REPORT: UK

Introduction

This paper examines the UK public research system[1]. The scope is the system of research performed in public sector research institutions including universities whether funded by the government or other sources. It attempts to highlight its main structural characteristics. These include a decentralised research policy-making structure, a partially indirect funding of public research institutions (universities and other institutions) and the dominance of higher education institutions (HEIs) as research performer in the public sector.

The UK science system has undergone considerable reforms and change during the past two decades, as a part of government reform of public services. This paper presents the current research system and its evolution over the past two decades and reviews the rationale as well as the current direction of reform. The first part presents the trends in R&D expenditures in the public sector[2], as well as the explicit or implicit goals assigned to the UK research system. The paper proceeds to highlight the main structural characteristics of the system, including the decentralised policy making and priority setting procedures and the main funding flows. The unique and important role of UK Research Councils[3], as funder and performer of research and the recent reforms to the system is discussed next. Then the changes taking place in the main research performers, HEIs and government research institutions (called public sector research establishments, PSREs), especially the impact of the Research Assessment Exercise in the former and that of restructuring including partial privatisation in the latter are examined. The impact of the increasing "third" stream of funding to universities from charities and industry is also assessed to the extent possible. The issue of co-ordination between Research Councils and the departmental PSREs, as well as how the research needs of government departments are met are also discussed. Throughout, the increasing role of knowledge transfer activities is also highlighted. Whether the UK science system is working efficiently is assessed in the part on policy review. The conclusion re-examines the issue of whether the pursuit of research excellence conflicts with the push for economic and social relevance of public sector research.

---

1 . This paper is based on information collected through a questionnaire, the interviews conducted during a study visit to UK in April 2002, telephone interviews, as well as official and other sources of documentation. The list of interviewees is found at the end of the document.

2 . The quantitative trends are mainly based on the SET (science engineering and technology) statistics of the UK government. The tables and figures referred to as SET statistics in the text in parentheses are found on the website at www.dti.gov.uk/ost/setstats.

3 . In UK there are seven Research Councils: Biotechnology and Biological Sciences Research Council (BBSRC), Economic and Social Research Council (ESRC), Engineering and Physical Sciences Research Council (EPSRC), Medical Research Council (MRC), Natural Environment Research Council (NERC), Particle Physics and Astronomy Research Council (PPARC), and Council for the Central Laboratory of Research Councils (CCLRC). The last is distinct from the others in that it is concerned with managing common facilities and does not fund research.

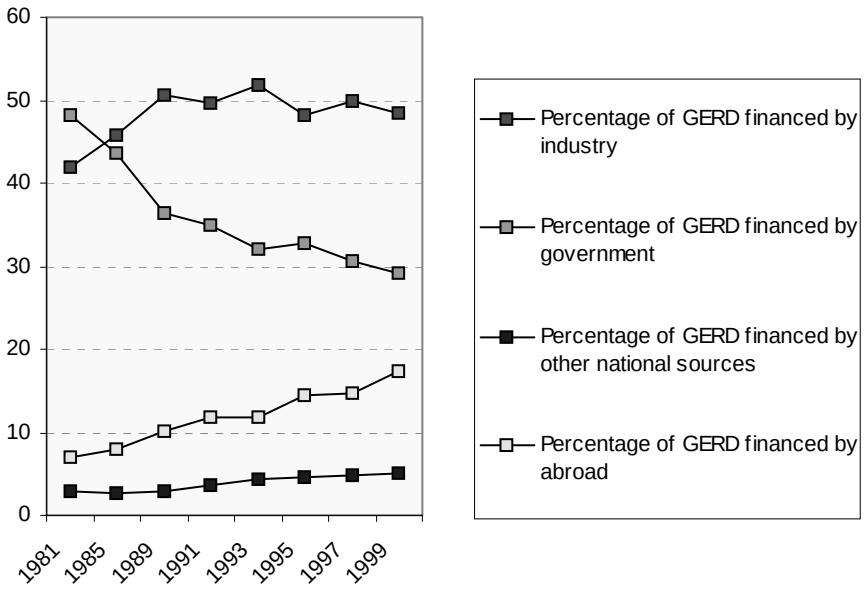
1. Recent research expenditure trends and the goals of the research system

1.1. Research expenditure trends

In the UK, the research intensity, as measured by GERD to GDP ratio, which steadily decreased between 1986 and 1997 is now barely recovering. This ratio in the UK is relatively low at 1.87% and is less than the OECD average of 2.21% (OECD 2001). Also, the UK ranks the twelfth among the OECD membership in terms of the number of R&D personnel per unit labour force, and is one of the few countries where this share has decreased since 1981. However, GERD has been increasing in real terms since mid 1980s, with civil R&D expenditures increasing relatively rapidly, while defence R&D expenditures has been on steady decline.

Long term trends indicate that government funding for R&D has been on decrease since mid 1980s. This is taking place in the context of increasing business and foreign funding of R&D especially since late 1990s. In relative terms the share of business and foreign funding of GERD increased respectively from 42.0% and 6.9% in 1981 to 49.4% and 17.6% in 1999, while the government's share decreased from 48.1% to 27.9% (Figure 1). The share of government budget for R&D (GBAORD) to GDP, at about 0.4% is relatively low in the OECD membership (OECD 2000).

Figure 1. R&D expenditure by source of funds (percentages)



Source: OECD Main Science and Technology Indicators 2002

In terms of performance, in 2000, the higher education sector accounted for 19.5% of all research conducted in the UK, higher than the OECD average of 17.1%. The government sector accounted for 13.4%, and the business enterprises 65.6%. Therefore, universities dominate as research performing institutions in the public sector, and their role as performers of research is growing in importance. Long term trends show the share of R&D performed by higher education institutions is increasing while that performed by the government is decreasing (OECD 2001).

These statistical trends reflect the major forces that have shaped the UK research system over the last two decades. First, in a trend shared also by the US and France, defence R&D expenditures in the UK have been rapidly decreasing. Second, the diminishing defence research expenditures were not matched by concomitant increases in government funding of civil research. The government funding of research stagnated from 1980s through mid 90s, and has picked up again only since 1997. In the meantime, non-government funding of public sector research by industry and non-profit organisations (called charities in the UK) has been on the increase, especially that of one particular charity, the Wellcome Trust's funding of biomedical research. Finally, the higher education funding bodies have adopted selective funding of university research through the Research Assessment Exercise since 1986. The current UK research system should be viewed in the light of these long-term changes.

1.2. Goals of the research system

Since the publication of the key white paper on science and technology entitled *Realising Our Potential* (OST 1993), wealth creation and enhancing the quality of life have been identified as explicit and overarching goals of the national research system. In the most recent white paper, the government identifies three key elements of research and innovation policy: *1)* to enhance excellence in science, by investing in basic scientific research, and bringing in matching investments from foundations and corporations; *2)* extend opportunities for innovation, by correcting market failure and enhancing public/private partnerships; *3)* inspire more consumer confidence and promote public understanding by creating a transparent framework for integrating scientific advice in policy (Department of Trade and Industry, 2001*a*).

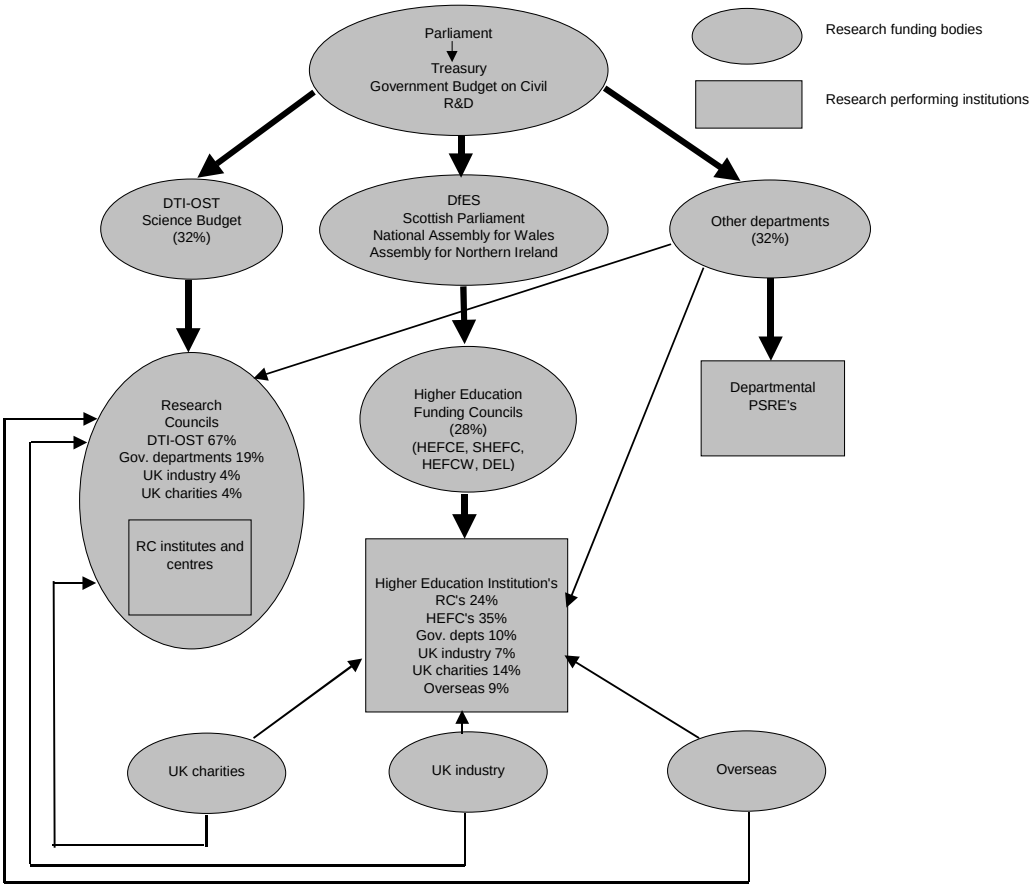
The UK government has recognised the important contribution of science to productivity and growth since the Comprehensive Spending Review of 1998 and 2000 when it increased the Science Budget by seven percent per year in real terms. The most recent *Spending Review* (UK Treasury 2002), which included the Cross-cutting Review of Science and Research, reinforces this view by stating that "closing the productivity gap with our major international competitors will be achieved more quickly by strengthening the UK's innovation performance, which is underpinned by public investment in the science base." Consequently, the government is planning the largest sustained growth in spending on science for a decade (1.25 billion pounds additional investments by 2005-06 compared to 2002-03), including an average 10% increase in real terms for the Science Budget. Department for Education and Skills (DfES) spending for recurrent research as well as capital funding for science infrastructure are also to be increased. There is an awareness of a long-term under-investment in research, especially in infrastructure since the 1980s, which the current government is attempting to overcome.

The increased government spending on science is also to be spent on various measures to improve recruitment of human resources to specialisation and careers in scientific research, in response to the recommendations of the Roberts Review (UK Treasury 2002*a*). The review identified a number of issues in the education and training of scientific human resources in the UK that required government action. Notable was the decreasing number of students specialising in mathematics and the physical sciences, and the inadequate financial support or remuneration accorded to postgraduate students and postdoctoral fellows in science and engineering. The proposed government measures include substantially increasing stipends for postgraduate students and the pay for postdoctoral researchers.

2. Main characteristics of the UK research system

The funding flows, as well as the main research performers of the UK research system are summarised in Figure 2.

Figure 2. UK research system



2.1. Decentralised decision making structure, the role of the Office of Science and Technology

Traditionally, the UK system of research policy making has distinguished research relevant to the missions of government departments funded by the departments themselves on the one hand, and other generally applicable or basic research whose priorities are in principle to be determined autonomously by the scientific community. The government departments make decisions about their research needs and commission research to appropriate research performing bodies. For generally applicable or basic research, Research Councils (RCs) have been established gradually since 1920 to manage and fund this type of research.

Although the UK does not have a research ministry, the governance of the Research Councils is assumed by the Office of Science and Technology (OST), now in the Department of Trade and Industry (DTI). This involves the management of the government's Science Budget, *i.e.*, the research budget allocated to the Research Councils (RCs), which in turn funds a major part of HEI research. The OST also co-ordinates research policy across government, and runs the Foresight programme.

The governing of the RCs and the Science Budget is done by the Science and Engineering Base Group of the OST, headed by the Director General of the Research Councils (DGRC). The DGRC makes decisions

about allocation of the Science Budget to the RCs and has a voice in setting their research priorities. DGRC also negotiates with the Treasury to decide the Science Budget. Although OST is located within the Department of Trade and Industry, it enjoys an independent status, since the Science Budget is "ring-fenced". That is, once decided as such, DTI cannot shift any part of it for other purposes. The allocation of the Science Budget to the Research Councils is decided relatively informally, but as a result of intensive consultation process between the OST and the RCs through which top down and bottom up priorities are discussed and consensus achieved. Business is invited to submit its views.

Another function of OST is dealing with scientific issues that involve more than one department and co-ordinating S&T policy across government departments, for which the Chief Scientific Advisor (CSA) and his Transdepartmental Science and Technology Group are responsible. CSA and the group assist government departments and agencies in improving the way in which S&T research and knowledge are used in support of policy, regulation, operations and procurement. This is done in two ways. One is by drawing up best practice agenda on the use of S&T by government departments; *i.e.*, in their use of scientific advice, and in the way research is done in government departments. The other is to raise awareness in the government decision-making ranks of the S&T related cross-cutting issues such as BSE and GMOs.

A third role of OST is the management of the Foresight programme. As a part of the 1993 White Paper, the government launched the Foresight Programme in 1994[4] process to identify future needs, opportunities and risks involving experts from government, scientific community and notably industry, the main user of research results. Stimulating interaction and networking between them is a role that the Foresight process has played. For the government and the public sector, Foresight promotes consistent and long-term thinking about policy, and can add value to policy by sign-posting regulatory or legal barriers to innovation and involving stakeholders in making decisions about research priorities. The government departments, as well as other public bodies, including the Research Councils, are required to take into account the Foresight results when developing their science and innovation strategies and in making their R&D funding decisions.[5] The results of Foresight are input into research priority setting at any level, or any institution, but it is not the only factor influencing decision making.

2.2. Devolution

Some powers and responsibilities related to science and research policy have been transferred to the regional administrations in Scotland, Wales and Northern Ireland, while others are retained by departments of state of the UK government. Where powers have been retained by the UK government, arrangements exist for consulting the regional administrations on matters that touch on their interests. Local government does not generally have science policy responsibilities. As far as the research system is concerned, it should be noted that the Higher Education Funding Councils are devolved. There are separate funding councils for England, Scotland, and Wales that are responsible for institutional funding of research for the HEIs in their region. In Northern Ireland, the Department for Employment and Learning funds HEIs directly. On the other hand, there is only a single system of Research Councils in the UK and the Science Budget is centralised.

---

4 . The second and the third rounds have been launched in 1999 and 2002 respectively.

5 . Comparing the first and the second rounds, it has been observed that in part because of the change in focus (technology focus was dropped in the second), and the organisation of the exercise (stronger top down element with broader scope and stakeholder involvement in the second), but also because of the location of OST which was moved from the Cabinet Office to DTI in 1995, there were more difficulties in getting other parts of the governments to play effective roles in the second round.

2.3 Autonomy of research funding and performing bodies

Government policies and the broad strategic priorities set by the government, mainly those identified through Foresight are taken into account, but the final decisions are made by the research funding and performing bodies. They set their own research priorities, make decisions about allocating research funds and adopt policies for developing human resources.

Within the context of the decentralised policy-making structure, and the autonomy of the research funding and performing institutions in the system, there is always considerable interaction and balancing of top-down and bottom-up elements in making decisions about priorities and funding. OST and RCs go through an informal but intensive consultation process to agree on priorities and funding decisions. For example, partly on the basis of Foresight but also as a result of the bottom-up consultation process with the Research Councils, OST has identified several priority areas for RC funding for the Science Budget 2001-04 including genomics, e-science and basic technology.[6] A part of the increased funding to RCs was allocated to these priority areas. Thus identified priorities have a direct impact on funding when the Science Budget is increasing. RC research priority setting is a balancing of Foresight priorities and those identified through direct consultation process between OST and RCs. This bottom up element sometimes results in RC priorities being reflected in the Foresight priorities, such as research in the area of water cycle, a priority area of research identified by NERC.

2.4. The major public R&D funding flows

As seen in Figure 2, there are three major streams of civil R&D funding to higher education institutions and other public research institutions in the UK. One is the Science Budget that flows to the Research Councils; thence to their research institutes and HEIs. Another is the budget of the Higher Education Funding Councils[7] (for England, Scotland, Wales and Northern Ireland) that flows to HEIs. These two funding streams constitute the so-called "dual funding" of university research, and represents the mechanism for funding research performed by the Science and Engineering Base[8]. Third is the government department budgets that go into research institutions attached to departments as well as to the Research Councils and universities. Departmental research budgets are decided by the departments themselves. These streams respectively account for 32%, 28% and 32% of government expenditure on civil R&D with the rest going to contribution to EU R&D.[9]

---

6 . These priorities are likely to change again after this period. RCs have identified a new set of priority areas to follow these including: brain science, regenerative medicine, proteomics, sustainable energy, and rural economy and land use (DTI-Treasury-DfES 2002).

7 The Higher Education Funding Councils are non-departmental public bodies set up to distribute public funding for teaching and research and related activities in universities and colleges (HEIs), within the context of the Government's policy for higher education. There is one for each of the constituent countries of the UK, England, Scotland, and Wales. In Northern Ireland, the responsibility rests with the Department of Employment and Learning. The funds of the Higher Education Funding Council for England come directly from the Department for Education and Skills, whiles those from the HEFCs in Scotland, Wales and Northern Ireland come from the devolved administrations of those countries. The Funding Councils advise their sponsoring bodies on the funding needs of the higher education sector in their territory. In this paper, the four UK higher education funding bodies are collectively referred to as the HEFCs.

8 . In the UK, the Science and Engineering Base refers to the RCs and the HEIs.

9 Or 21%, 17% and 22% of total government funds for science, engineering and technology (SET), with the rest going to defence research and contribution to EU R&D (see SET Statstics Figure 2.1).

The following three sections discuss the roles of the research funders and performers in the three streams of public research funding, and the recent reforms that have taken place.

3. The role of the Research Councils

A salient structural characteristic of the UK research system is the large role played by the Research Councils. The UK Research Councils were established as independent non-Departmental public bodies to support basic, strategic and applied research, postgraduate training and the public understanding of science. They have undergone re-organisation in 1994 as a result of the 1993 White Paper *Realising our Potential.* The *rationale* was to get them closer to potential users and structure them, so that RCs can "identify areas for cross-fertilisation and integration along the continuum of basic, strategic and applied research" (Flanagan and Keenan 1998). The restructuring resulted in seven Research Councils[10]. Each was provided a mission statement recognising the importance of research undertaken to respond to user needs and support wealth creation and quality of life. Each Council came to have a part-time chairman from industry. They receive most of their funding via OST's Science Budget (67%). As shown in Figure 2, they also receive funding from government departments, industry, charities and overseas sources.

3.1 UK Research Councils both fund and perform research

Six of the UK Research Councils are research-funding bodies at the same time as four of them being research performers. A number of them, notably the Medical Research Council (MRC), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Natural Environment Research Council (NERC) have their own institutes, units or centres. The research work of Research Council institutes and centres is funded directly by the Research Council concerned or via contract or grants from other funders, notably other government departments. The share of RC funding to HEIs and their own research bodies varies according to the Research Council. These variations are result of the mission of each Research Council, and to some extent determined by the roles they have played since they were founded.

A question naturally arises as to the distinctive roles of RC institutes, research in HEIs, and the departmental PSREs. Research Council institutes, units and centres provide the critical mass of research capacity in the areas of their mission that are not well-developed in universities. Providing research relevant services useful for research undertaken by universities and other public research institutions is another role of Research Council's research performing bodies such as creating and maintaining relevant data sets. For example, monitoring agricultural yields over long term or developing and maintaining geological databases are done by BBSRC or NERC institutes and centres.

Thus, research performed in RC institutes and centres complements research performed in HEIs; however, some overlaps are inevitable. The current direction is to consolidate research performed by RC institutes/centres, concentrate on their respective core competence and avoid overlaps with university research. As a consequence some research councils (*e.g.*, NERC) are encouraging partnership ventures with universities.

Compared to research performed by departmental public sector research establishments (PSREs), RC institutes perform research that is longer term and more fundamental in nature. They also perform contract research for government departments.

10 . See footnote 3 for the list of the seven Research Councils.

3.2. Governance of Research Councils and the priority setting procedures

Each Research Council has a council as the central decision making body. The membership consists of the chief executive of the particular Research Council and representatives from university and industry sectors and government departments. The Council is supported by scientific boards responsible for developing priority and funding strategies which are in turn, supported by a number of peer review or research committees that review projects submitted for funding and propose topic areas to encourage funding applications and to review them. Industry is also represented in the boards and committees.

As discussed above, it is the responsibility of the OST to make sure that RCs take into account Foresight and other government priorities as well as other user needs. Beyond this, the Research Councils themselves determine priorities and decide upon resource allocation strategies that they deem most appropriate to meet their individual objectives and meet Government's policy objectives. The Councils adhere to the "Haldane" principle, *i.e.*, day-to-day decisions on the scientific merits of different strategies, programmes and projects are taken by the Research Councils without Government involvement. The Research Councils therefore exercise considerable autonomy in deciding scientific priorities in the area of their remit.

The current trend is to involve more stakeholders in the RC priority and funding decision- making process. This has become explicit since the 1993 restructuring. In general, consultation processes involving various stakeholders are more frequent for the Research Councils. Research Councils also review priorities outside the country, such as those of European Framework Programmes or the US NSF. This reflects the government's drive to push for accountability and responsiveness of RC research in terms of national R&D goals of enhancing wealth creation and quality of life. Also, Research Councils are moving toward increasing transparency of their decision making process. For example, for the first time last year, the Natural Environment Research Council, held publicly open council meeting.

3.3. Research Councils' funding mechanism.

RCs fund university research relevant to their missions that fall within their research portfolios. These are quite broad, and range from basic to applied and the development of related services[11]. The grant funding of university research by Research Councils is by responsive mode funding, *i.e.*, funding in response to research proposals rated on the basis of their scientific excellence by a peer review process. University research thus supported ranges from "blue sky" research to development research. The former is normally funded in pure "responsive" mode, *i.e.*, funding in response to unsolicited research proposals in any area relevant to the mission of the Research Council. Latter is funded by thematic schemes that respond to applications for research grants within thematic areas identified by the Research Council. Some Research Councils explicitly decide the share of research funds according to the degree of directedness of the research[12].

---

11 . For example, Medical Research Councils' portfolio consists of six scientific areas: molecular genetics, cell biology, medical physiology, immunology and infection, neuroscience and mental health, population studies including health services and public health.

12 . For example, NERC defines four funding modes and the percentages allocated to each. "Non-thematic" funding (20%) funds "blue sky" research in areas selected by applicants, "thematic" funding (15%) funds basic, strategic, applied and development research within themes identified by NERC, "core strategic" funding supports long term (10-15years) research mainly involving data collection and monitoring, and "infrastructure" mainly funds NERC centres in providing support, equipment and services such as provision of ships and aircrafts.

In evaluating grant applications, scientific excellence is clearly the central criterion for all the Research Councils. Beyond this, applications are assessed in view of relevance to the strategic objectives of the particular Research Council, and the degree that the proposed research addresses the societal needs and the government research priorities.[13] Leveraging industrial funding is also a criterion. For example, in comparing grant applications which in all other cases are of equivalent worth, BBSRC Research Committees and Strategy Board gives priority to those in which strategic relevance is demonstrated by a financial contribution of 15% or more from industry.

Research Councils are also responsible for evaluating Science Budget funded research. They conduct ex ante appraisal of research proposals, and post hoc evaluation of the outcome of research. At project and programme level, the peer review system grades the scientific quality of research by evaluating final research reports. The Research Councils also evaluate the research conducted at their institutes. OST ensures that such processes are in place and monitors the overall situation.

Being "project" type funding as opposed to "institutional" funding, RC funding covers only the direct costs of research, including 46% of the eligible staff costs (which corresponds to the costs of all staff employed on a funded project other than the principal investigator). But RC funding does not account for infrastructure and other overheads. Currently this is becoming an important issue in the UK research system, since over the last decade, combined RC, charities and industry funding of university research, all based on "project" type funding, increased substantially more rapidly than institutional funding of university research by the Funding Councils (see Figure 4). This has resulted in an apparently inadequate funding of university research infrastructure.

3.4. Human resources

RCs play an important role in developing human resources for S&T research by funding post-graduate training through studentships and fellowships. The studentships are allocated to university departments. RC resources allocated to studentships are increasing to stimulate young people to go into careers in research, as postgraduate stipends are to be increased in the next few years. As a result of the recent Roberts Review (UK-Treasury-2002*a*) which suggested the likely shortage of highly qualified skills in mathematics, engineering and the physical sciences in the near future, the government has decided to increase minimum stipend for RC funded students considerably. Also, in view of the unattractive and uncompetitive salaries of postdoctoral research assistants suggested by the Review, the salaries of RC funded postdoctoral researchers are also to be significantly increased. RCs also sponsor a number of fellowship schemes to encourage high quality research by young as well as established researchers and the numbers of these are proposed to increase. This move has been stimulated by the large amounts of fellowships coming from the Wellcome Trust's fellowship programmes. RCs also sponsor a number of fellowship schemes to encourage high quality research by young as well as established researchers.

RCs are now paying more attention to encouraging young researchers in UK to pursue research careers and help establish them as researchers. MRC feels that there is a gap between post-doctoral research and more established levels. Hence it increasingly funds career establishment grants for younger researchers by giving them support in the initial years of their tenured positions so that they can build research groups of

13 . For example, after scientific excellence, BBSRC assesses applications for their relevance to its six key science objectives (exploiting new opportunities in genomics, underpinning economic and environmental sustainability, understanding of biological systems and its application in wealth creation, underpinning healthcare, food and agriculture, applying technology and tools for biological research and innovation, research underpinning evaluation of issues in animal welfare, food safety and environment).

their own and become "established". Some research councils see brain drain as a problem, and developing research human resources who stay in UK is a challenge.

3.5. Co-ordination and co-operation with other research funding and performing institutions

Given the current trend of the increasing role of interdisciplinary and problem-oriented research, as well as the need to respond to societal needs, Research Councils need to co-ordinate and co-operate with each other, government departments, and increasingly charities and industry. Joint or co-operative funding schemes with other Research Councils as well as other public and private research funding bodies are increasing.

Interdisciplinary centres and programmes operated jointly by Research Councils are increasing, such as BBSRC-NERC programme on environmental impacts of GM crops or BBSRC-MRC programme on stem cell research. Some new programmes of the Research Councils deliberately bring together researchers or research groups from different disciplines and universities, such as collaborative grant schemes of NERC or the co-operative group schemes of the MRC. The former has been successful in building research groups across universities, and the latter in stimulating "translational" research that linked basic research to clinical research and applications. The MRC scheme also allowed for funding from other sources including the private sector into the scheme. In general at present, the increased ear-marked funding allocated to government priority areas (genomics, e-science, basic technology) is generating joint efforts between RCs.

Research Councils are obliged to define their relationship with government departments through formal concordats, which provide framework to develop and assess each other's needs and priorities. These are drawn up jointly by the Research Councils and the government departments with which they have policy connection and whose research needs they respond to. To the extent that Research Councils need to respond to such departmental needs, government departments influence the priorities of the Research Councils. For example, the Department of Health advises MRC on health issues of importance to the department. In the areas of common interest, Research Councils and government departments co-fund particular RC funding programmes, or be involved in activities of RC research centres. BBSRC and DEFRA jointly fund research on foot and mouth disease and BSE. In this joint effort DEFRA funds the strategic and applied end, while BBSRC funds the fundamental end. DTI is involved in Tyndall Centre for Climate Change (a joint NERC-EPSRC-ESRC venture) to stimulate its partnership with industry.

The most recent issue in inter-Research Council co-ordination is co-operation at the strategic level. Improving accountability and transparency as well flexibility in funding and decision making of Research Councils is also sought. The institutional innovation to address these issues is the creation in April 2002 of the "Research Councils UK". RCUK is expected to define a vision for the UK Research Councils as well as for research in the UK in general. It is also expected that the new body would develop roadmap and performance metrics to deliver the strategy and evaluate the performance of the Research Councils.

3.6 Knowledge transfer

The Research Councils are increasingly active in knowledge transfer. All the Research Councils take part in the public/private partnership schemes that the government has introduced in recent years to stimulate knowledge transfer and industrial co-funding of research. LINK is the central mechanism in this, but there are others including the Faraday scheme, TCS, SBRI, CASE and CONNECT.[14] Some research councils promote spin-outs. MRC has set up MRC Technology Ltd., which owns IPRs emerging from their own

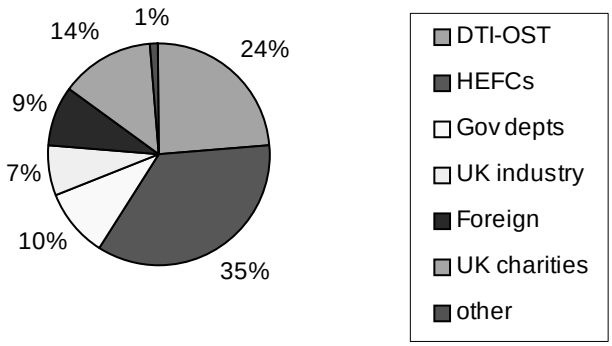
14 . Many of these schemes are discussed in OECD (2002).

research units. Based on these, there have been start-ups that originated from MRC research units. The Research Councils also partner with UK charities on research programmes and building databases. MRC partners with Wellcome Trust on human genome project, and building databases on genetic information related to diseases. The biomedical research funding bodies have created a Research Funders Forum to co-ordinate research strategy on stem cells research or cardiovascular diseases.

4. The Higher Education Institutions: the trends and issues in research funding and performance

As research performing institutions, HEIs are autonomous institutions that are held accountable for the public funds that they receive. Government is not directly involved in the management of universities. HEIs are funded for research by the so-called dual funding system, in which Research Councils and the Higher Education Funding Councils (HEFCs) provide the two main streams of public funding to HEIs. As Figure 1 shows, HEFCs administer and distribute the funds including institutional funding for research to HEIs which are made available by the Department for Education and Skills in England and the devolved administrations in Scotland, Wales and Northern Ireland. The HEFCs provide core funding for university research, covering general research infrastructure, "blue sky" or basic research, costs of staff, premises, libraries and central computing and some researcher training costs. The HEFCs fund HEIs for teaching as well as research, and the decision on the division of funding between teaching and research is taken jointly by the HEFC and its sponsoring body – the DfES in England and the devolved administrations in Scotland, Wales and Northern Ireland[15]. Research Councils allocate research funding to universities in response to grant applications. The two streams account for 59% of the research funds of universities. The rest comes from other sources, government departments, UK industry, UK-based charities and overseas funds. Figure 3 shows the relative shares in 1999.

Figure 3. University funding in UK



Source: UK government SET statistics.

4.1. Recent reforms and trends in funding

HEIs and their funding structure have undergone quite a bit of change and restructuring in the past two decades. A major direction has been the expansion of research capacity resulting from the abolition of the

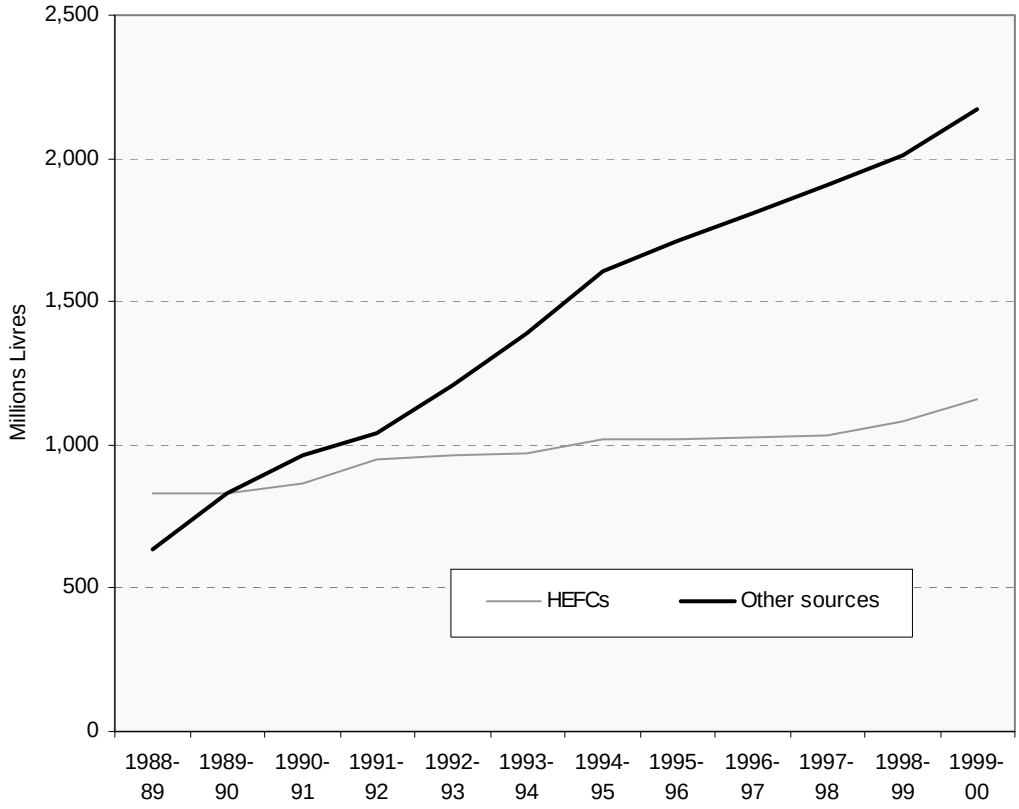
15 Once allocated to HEIs, they have the freedom to decide on the exact division of the use of funds between teaching and research.

so-called ‘binary divide’ which gave polytechnics university status and access to HEFC funds for research.[16] Another important change has been the increasingly selective funding of university research based on periodic performance assessments, the Research Assessment Exercise conducted jointly by the four UK HEFCs. Not only research capacity, but also enrolment in HEIs has been increasing and the trend is likely to continue. The Department for Education and Skills has adopted a target for HEI participation of 18-30 year olds to reach 50% by 2010 in England. Other arrangements apply elsewhere in the UK.

Figure 4 shows the recent changes in the funding of research in HEIs in the UK. This shows that the institutional funding of universities through the HEFC stream has been increasing much less rapidly than the “project” funding stream coming from RCs, charities, government departments, industry and foreign sources combined. Moreover, the HEFC funding is allocated on a selective basis since the introduction of the Research Assessment Exercise. The research capacity expansion, the rapidly increasing competitive grant funding of research compared to institutional funding and the selective allocation of funding by the HEFCs have placed university research under pressure.

Figure 3. Research expenditures of HEIs

16 . This resulted from the 1991 White Paper on education and science (DES 1991).



Note: Other sources includes grant funding by RCs, charities, industry and foreign sources.
Source: OST

As discussed below, a clear consequence of the rapidly increasing "project" funding of research is the under-investment in university research infrastructure, an issue that the UK government is now in full recognition, and is adopting measures to boost investment in. However, a less obvious issue that this trend raises is the possible impact on the HEIs' ability to maintain capacity in conducting basic or blue-sky research. HEFC funding is supposed to, among other things, enable HEIs to conduct research that is *not* supported by others. As the proportion of "project" funding increases, research work funded with such funds consumes the staff time and infrastructure funded by HEFCs. The situation is aggravated in research areas where the proportion of HEFC funds accounts for a much smaller portion of total research, notably in biomedicine in the UK. In effect, the widening distortion between "project" and "institutional" funding may result in "squeezing out" of long-term basic research.

The argument may arise that Research Councils do fund "basic" research through the "responsive" mode funding. However, the RC funding through this mode may fail to support research at the cutting edge, as there may be time lag for RC peer review committees to be responsive to research needs at the real frontier. Also, different types of funding may induce different behaviours on the part of the researchers, i.e., the basic research that researchers undertake with RC funding and with HEFC funding could well be different. The full impact of the diverging funding trends on long-term basic research requires careful assessment.

4.2. The Research Assessment Exercise and its impacts

The Research Assessment Exercise[17] aims to improve research performance of HEIs by assessing and rating the research performance of university departments and institutes and selectively funding those that perform the best. It is conducted jointly by the four HEFCs on a UK wide basis. The first RAE took place in 1986, and the fifth and the most recent in 2001.

In the exercise, HEIs are invited to submit their research activity for assessment. The submitted information goes through peer review assessment of research quality by specialist panels who base their judgement in accordance to specified criteria and working methods. The scope of research activities subject to assessment is broad. Basic, strategic and applied research is given equal weight, and all forms of research output are treated on equitable basis. The assessment gives rating of 1 to 5* to each academic unit, with 5* being the highest. The HEFCs all allocate research funding on the basis of these ratings, using slightly differing allocation methods. In all cases, the allocation of funding is highly selective, although the precise degree of selectivity varies between the HEFCs. In England for example, the highest rating of 5* attracts four times as the lowest rating, and in 2001-02, 75% of HEFCE research funds were allocated to 25 higher education institutions. In Scotland, the allocation of research funding based on RAE results has enabled the creation of Research Development Foundation Grant that selectively funds research in new and emerging subject areas and the Strategic Research and Development Grant that is allocated to research in areas of strategic importance to Scotland.

RAE has stimulated HEIs to improve their research performance. In the most recent exercise, across the UK as a whole the percentage of higher ranking units (rating of 4 or above) increased from 43% in1996 to 65% in 2001 and lower rated units (rated 1 or 2) decreased from 24% to 6%. Also, 55% of research active staff in UK HEIs now worked in the highest-ranking units (5 and 5*) compared to 31% in 1996.

Among the funding councils, there is a view that the exercise has now fulfilled its original mission of improving the research performance of the HEIs to a desirable level. It was even "too" successful in doing so, since undertaken in the context of slowly increasing funds for research, HEFCE in particular, it was found that the funding levels for higher performing institutions could no longer be sustained. HEFCE and DfES also recognise that along-side a "premature" success, there have been some unintended consequences in the way universities came to handle RAE.

For the HEIs, the exercise has become an increasingly resource intensive process. A major task of intra-university organisations such as research management service, itself a relatively recent organisational innovation, is in working out strategies to perform well in RAE.[18] The process takes up staff resources as well as long-range planning and strategies. Some academic units have in fact started to plan for the next exercise, immediately after one had finished, and this could be a general tendency. Compared to the amount of effort that needs to be put into the process, with the slow increase in the absolute funding levels, some observers assess that RAE has come to the point of "diminishing returns" (Geuna and Martin forthcoming). The four UK HEFCs have organised a review of research assessment in June 2002. Led by a steering group comprised of representatives from universities, business and charities, the review is investigating different approaches to the evaluation of research quality drawing both on RAE and other models of research assessment, for the aim of identifying a number of alternative models of research

---

17 Details of the Research Assessment Exercise are provided on the Higher Education and Research Opportunities (HERO) website: www.hero.ac.uk/rae.

18 . Some of the lessons that universities have drawn out of RAE include experience that in some cases it makes a difference to which units of assessment assessment applications are made. The same academic unit can perform better by applying to a certain unit of assessment than another. This suggests that for universities, there may be an element of game playing in the exercise.

assessment. The review process involved a public invitation to contribute to the debate on fundamental issues and approaches to assessment. The next exercise will be based on the result of this review and is likely to be a different type of exercise.

4.3. Inadequate infrastructure funding

The relatively diminishing funding through the HEFC stream of the dual funding system and the increasing grant funding has resulted in inadequate funding of university research infrastructure. This is a problem recognised by not only universities themselves, and by the HEFCs and their sponsoring bodies, but also by OST and RCs. In addition, the tightening public budgets, the need for renewals of infrastructure built in 60s and 70s, the recent expansion of research capacity and enrolment in universities, and the neglect of strategic asset management on the part of HEIs has contributed to recurrent under-investment in infrastructure.

The extent of the needed investment was recently assessed in a report to the OST (JM Consulting Ltd. 2001).[19] Remedial investments are needed in generic institutional infrastructure (buildings, plant and services, IT networks and library), the minimum level of research equipment and facilities to attract external funding (the 'well-found laboratory'), and improvements in advanced scientific equipment to maintain infrastructure for world-class science. The report assesses that despite the favourable performance of HEIs in the Research Assessment Exercise, continued infrastructure under-investment would be detrimental to research productivity of the UK universities. Four recommendations are made in the report. First, that HEIs should take strategic and managerial responsibility for asset maintenance, backed up by government and the HEFCs. Second, that government should provide a capital funding scheme to fund remedial investment. Third, that HEIs should be able to cover full costs of research, so that they are not required to subsidise their research sponsors. Fourth, that there should be a project-based scheme to maintain advanced research facilities.

The government had set up the Joint Infrastructure Fund (JIF) and its successor, The Science Research Investment Fund (SRIF) to meet the needs of university infrastructure. But the above report contends that these are inadequate in view of the need of very large remedial investment. Hence the government has decided to allocate a significant part of the annual Science Budget increase to boost university infrastructure. The recent Government paper, *Investing in Innovation*, announced that the government will institute a dedicated ear-marked capital stream for university science research infrastructure. Also, in the paper, the Government agreed that grant funding of university research should move toward covering the full costs of research (UK Treasury-DTI-DfES 2002). The HEFCs, with the encouragement of their sponsoring bodies, are working to help HEIs develop a standardised methodology for assessing the full costs of research, which is needed to move toward covering full research costs by grant funders.

It is worth noting that both JIF and SRIF benefited from a substantial participation of the Wellcome Trust in funding biomedical research infrastructure. Wellcome Trust is the largest independent UK charity, and is different from others in that it gets funding sources from stock market share sales, much like the Howard Hughes or Gates Foundation in US. Its funds grew rapidly in the past decade, and Wellcome Trust alone accounts for most of the total UK charity funding of research[20]. This sector's contribution to university research is larger than the share of UK industry.

---

19 . It assesses that there is a need for about 3 billion pound remedial infrastructure investment need in UK HEIs

20. There are other players, *e.g.*, Cancer Research UK, but their funding sources are limited to donations.

4.4. Knowledge transfer

HEIs in recent years have become increasingly active in knowledge transfer. One of the central roles of internal organisations such as university research management service, is to support this and to manage associated affairs such as IPR management. In recent years, IP revenues are providing HEIs with 'untied' income which they need.

HEFCs fund a number of knowledge transfer activities of the HEIs. Arrangements for this vary in the different parts of the UK. For example, in England, HEFCE partners with RCs in the Higher Education Innovation Fund, which grants project-based funding for commercialising university research, and has impacts in terms of infrastructure for commercialising research. In Wales, the HEFCW operates Knowledge Exploitation Fund with similar objectives. In Scotland, the SHEFC created Knowledge Transfer Grants scheme to help universities invest in infrastructure for knowledge transfer activities. This grant can be used to set up technology transfer offices, employ and train staff working in university knowledge transfer such as legal training in handling intellectual property. There is also a number of UK-wide programmes to promote knowledge transfer activities of HEIs such as University Challenge Fund and Science Enterprise Challenge Fund[21].

5. Government research institutions: the departmental public sector research establishments (PSREs) and their restructuring

Other than HEIs, the research performing institutions that are mainly funded by the public sector are institutes and centres attached to Research Councils, and government department laboratories. These are called public sector research establishments (PSRE's). These PSREs vary greatly in size and legal status. The largest Defence Evaluation and Research Agency has over 10,000 employees and the smallest MRC Unit has less than twenty people. Some departmental PSREs have become executive agencies as seen below. Many remain as departmental bodies. As discussed above, compared to universities, PSREs' importance as research performer has diminished in recent years. PSREs affiliated to government departments provide research services required by the departments to fulfil their missions, and those attached to Research Councils provide research and related services related to the missions of each Research Council.

As seen in Figure 1, government departments commission research to their own departmental PSREs (some of which are executive agencies), Research Councils as well as HEIs. The departments commission part of this, but increasingly elements of research needs are put out for competitive bids, for which the departmental PSREs are one of the competitors.

Better co-operation and co-ordination with Research Councils is becoming an issue of increasing importance for government departments in meeting their research needs. In principle, RCs fund and perform more basic research, whereas the government departments require more strategic and applied research. However, where appropriate, government departments recognise the need for strengthened collaboration to avoid duplication of research effort as well as gaps in research needs, and to maximise efficiency of research. At the strategy level DEFRA works closely with BBSRC and NERC in order to align strategies.

[21] From 2004-05 University Challenge and Science Enterprise funding will be rolled into the Higher Education Innovation Fund to create a single permanent stream of funding to support knowledge transfer from universities and research institutes.

5.1. The Process of Restructuring

The departmental PSREs have undergone fairly drastic restructuring in the past two decades. Since mid 80s they were scrutinised repeatedly to determine whether they should remain public bodies. As a consequence, many were turned into 'arm's length' executive agencies, with an increasing part of its work financed by contracts outside the government. In the 90s some of these were privatised. This process constitutes "perhaps the most important structural change in public science in the UK over the last 20 years" (Flanagan and Keenan 1998).

The restructuring was a gradual process, involving reviews or "scrutinies" by the government to assess which establishments were appropriate to become executive agencies, and then privatised. The restructuring took place in the context of general civil service reforms, in which business management practices were introduced in order to improve efficiency. This included privatising those areas of government services that would operate more efficiently as such.

The first sweep of restructuring was implemented as a result of the government report, *Improving Management in Government: the Next Steps* in 1988, which concluded that executive agencies should be established to carry out the executive functions of government within policy frameworks set by government departments. As a result, fifteen PSREs became executive agencies by 1993, mostly those belonging to DTI, MAFF and MoD. Another review in 1993, recommended improving the customer-contractor relationship, the extended use of competitive tender and serious consideration of the privatisation of government laboratories.

The explicit policy for privatising certain government services came with the 1993 White Paper, *Realising Our Potential* which stated that many services of PSREs could be carried out in the private sector, and privatisation was a realistic prospect. As a result, another scrutiny was organised in 1994 to identify those PSREs that could be privatised, excluding defence research establishments. The criteria for assessing suitability included the nature of activities undertaken and the extent to which the PSRE was in shape to thrive in the private sector. Again a list was drawn up from those which had already become executive agencies.

The consequent privatisation process was not uniform, but proceeded in varied ways. This is illustrated in the restructuring of DTI PSREs discussed in the next section. The PSREs of DTI have so far progressed most rapidly toward privatisation. This is probably of little surprise, since many of them had industry related or industry serving activities along with serving the government. Privatisation of other departmental PSREs has not progressed so much. In general, it is pointed out that although more commercial methods of operation and have permeated departmental PSREs, the number of actual privatisations remained small. Also, the process had quite high costs in terms of review and selection process by the government, and the impact on the morale of those working in the PSREs (Beesley *et al* 1998).

Although departmental PSREs have been at the centre of the sweep of restructuring, RC institutes and centres have also undergone restructuring. Some MRC units have been restructured and/or disbanded over time. NERC's Plymouth Marine Laboratory has become a company, mainly because this laboratory was already developing partnerships with industry in the region.

The suitability and the eventual success in restructuring, especially privatisation, depends partly on the nature of the missions of PSREs, and the extent that they respond to the needs of the parent department. Those whose missions are more public in nature, such as those in the areas of health or environment may not be suited to go down this road to privatisation. Department of Health does not plan to privatise its departmental PSREs, because of the public nature of the mission of this department. Likewise, privatisation is not considered an option for DEFRA's PSREs, all of which are now executive agencies.

This is due not only to the public nature of their mission, but also to the department's need for emergency response (*e.g.*, foot and mouth disease in 2001) and the cost and market failure in providing the unique services and facilities often required only by the government.

In general the conversion to agency status yielded benefits in delivery and efficiency, but questions are now raised about the long-term prospects in developing suitable research capacity. DEFRA recently launched a review of its five executive agencies, as a result of concern about lack of strategy in developing skills and facilities in the long term and in identifying future science requirements. Also, the financial management operated on an annual basis is seen to prohibit longer-term investment decisions. This demonstrates that the restructuring process has improved efficiency in the short term, but doubt remains as to its long-term effects in securing high quality research.

5.2. Restructuring of DTI PSREs.

The DTI PSREs that have become executive agencies include the National Engineering Laboratory (NEL), the Laboratory of Government Chemists (LGC), the National Physical Laboratory (NPL).[22] In the process of privatisation NEL was sold to a company in the Siemens group in 1995. Because the laboratory had become an engineering consultancy, this was described as relatively 'simple' task by the DTI, although the DTI had to pay for its operating deficit at the time of the sale. LGC was sold to a consortium comprising its own management, the Royal Society of Chemistry, and a venture capital company. In this case, the DTI had to pay for building and site remediation, a sum larger than the sales revenue. In both cases, DTI committed to contract certain amount of work for a period of five years.

In contrast to NEL and LGC, NPL was moved to a government-owned contractor-operated (goco) status, because of the large share (more than 80%) of the DTI contracts it had. A contractor to lease the major assets and buy the minor ones was found, but the government remained the owner. DTI guaranteed a core programme of work for five years, but additional work was to be bid competitively. Although intended as transitional structure before privatisation, NPL remains in this status.

The impacts of the restructuring have been both positive and negative. The move to executive agency and some form of privatisation has improved flexibility and efficiency in operation. Also some reduction in operating costs was achieved. The downside was the impact on the morale of the employees, as well as loss of scientific human resource in some cases. These effects were, however, short-lived, since the staff that have remained or who have been recruited since the change of status are generally content with the new structure.

5.3. Knowledge Transfer

PSREs engage in a number of knowledge transfer activities including collaboration with industry to solve problems (in contract research), licensing of technology to industry, and sale of services, data and software to the business sector, but as a whole not as advanced as the university sector. This is due in part to the opportunities PSREs have for commercialising research. According to a recent government review, the scale of the opportunity varies greatly depending on the size and mission of the PSRE, the kind of science it does and the nature of the industry sectors for which the science is most relevant. Only a minority of the

22 . NEL provides engineering technology services for industry in energy, defence, transport and process and chemical engineering, while LGC analytical chemistry and related research services for the government. NPL develops and disseminates national measurement standards and provides high quality expertise in materials testing, characterisation and information technology.

intellectual property generated in PSREs is likely to have large commercial potential. Demand from industry is probably the single biggest determinant of the commercialisation opportunity (HM Treasury 1999).

The above review also points out that PSREs are subject to bureaucratic rigidities in ownership and control of IPR and financial control, that inhibit knowledge transfer particularly in departmental PSREs compared to Research Council institutes and centres. Also departmental PSRE staff are not encouraged nor rewarded for knowledge transfer activities because of the application of civil service management code. Also some PSREs have limited access to government programmes for promoting knowledge transfer such as the University Challenge Fund.

6. Review of recent policies and practices and the emergent issues

This section addresses three questions that aim to assess the performance of the UK research system. As discussed above, the broad direction adopted in recent years is to increase government spending on research. The increase in government spending is based upon the understanding expressed in 2000 Spending Review that publicly funded science is increasingly important for the UK's innovation and productivity performance in a globalising knowledge economy. Also, in UK there is recognition that during 1980s and early 90s the government failed to invest adequately in public research, with the result that compared to other large OECD countries, the share of GDP devoted to research is lagging in the UK. The proposed increase is intended to correct this trend. As it is likely that the quantitative trends may take some time to change to a significant degree, the central question is whether the public research funds are used in an optimal manner.

6.1. Is there a good balance between pursuit of research excellence and enhancing societal relevance of research?

The reforms in the S&T policy and funding implemented in the UK in the past two decades was part of the general drive for scaling down the role of the public sector, and make the public research base responsive to societal needs, especially in enhancing productivity and economic performance.[23] This policy direction was adopted on the assumption that research excellence and the pursuit of relevance agenda would not conflict. The question is whether there is no conflict, and whether the UK policies have been able to keep a good balance, especially between government policies in pursuing research excellence on the one hand and enhancing knowledge transfer on the other.

It may be noted that some analyses point to the dangers of overemphasising knowledge transfer and university research commercialisation. Public research sector, especially universities should be seen as source of talent not technology (Florida 1999). Geuna (1999) argues that knowledge transfer is optimised when universities pursue high quality research, and aggressive drives toward commercialising technology can be counterproductive by diverting resources away from research. In support of this it has been argued that the pursuit of research excellence in universities, and not the measures to stimulate university research commercialisation, was central to US success in knowledge transfer and innovation in 1990s (Pavitt 2000). Moreover, the benefits of public research extend well beyond commercially useful knowledge (Salter and Martin 2001, Scott *et al* 2001). These analyses do not argue against knowledge transfer *per se*, but argue that knowledge transfer activities need to be counter-balanced by adequate funding for research excellence.

23. It is observed that OST's move from the Cabinet Office to DTI in 1995 exemplified government's push for relevance of research to the industry and the economy.

The stagnating public funding of research observed in the UK in the 1980s to late 1990s shows that if the government pushed the relevance agenda and implemented various knowledge transfer schemes during this period, it must have been done indeed by diverting resources from funding high quality research. In other words, the relevance agenda in the UK until the late 1990s was pursued at the expense of reducing funding for basic research (Mulvey 1998). The stagnating FC funding of university research reflects this trend.

However, since late 1990s, the government is in full recognition of the years of insufficient support of research excellence in the public sector, and is boosting public funding of research. Most recently, the government announced a package of strategies confirming:

- Dedicated capital stream to strengthen university research infrastructure.
- Increasing support for RC funded PhD students.
- 5 percent real annual growth in research programmes to 2006 including funding for new priority areas of brain science, regenerative medicine, proteomics, sustainable energy and rural land use.
- Consolidating Higher Education Innovation Fund which is provided in England to promote knowledge transfer from HEIs and PSREs (UK Treasury-DTI-FfES 2002).

Thus, the government support of research in UK is becoming more balanced in terms of attempting to channel increasing funds to both enhancing research excellence and knowledge transfer. The current perception is that research excellence and knowledge transfer are complementary and should not be seen as conflicting. The remaining question would be whether the current measures are adequate to compensate for the years of insufficient research funding.

6.2 Is the dual funding system efficient in enhancing research excellence and balancing basic and more strategic research?

A salient characteristic of the UK science system is the dual funding of university research. In the view of the government this is functioning efficiently. The Spending Review (UK Treasury 2002) concluded that the dual funding system is helping the universities "achieve critical mass in research effort and to deliver a satisfactory spread of effort across modes and disciplines of research." A key strength of the system is that it maintains plurality and balance. HEFC funding gives universities the flexibility to pursue "blue sky" research in developing new areas of excellence; whereas Research Council funding ensures that research responds to government's strategic concerns, such as genomics. The Review saw the need for further refinement of the system in balancing core and project funding, and blue skies and strategically driven research, so that the government will not be "over-determining the direction of university research". Also, although universities and RCs feel positive about the system, some problems were felt in building capacity in new areas of research.

As this review concluded, the system itself is functional in as far as the *structure* for funding university research is concerned. The two funding streams can ensure autonomous decision of university researchers as well as reflecting priorities of the scientific community as well as the government and business. However as discussed above, the recent funding trends have demonstrated imbalances between core institutional funding through the HEFC stream and grant or project funding of university research through RCs, business and charities. Also, an observation has been made that in the years following the 1993 White Paper, the balance of RC support has shifted further away from 'curiosity-driven' basic research toward

research perceived to be of more direct relevance to industrial competitiveness and 'wealth creation' (Mulvey 1998).

There does seem to be a trend on the part of RCs toward stressing directed research through thematic and other managed programmes. But a major part of RC funding is through pure 'responsive mode'. RCs say that their responsive mode funding is directed towards curiosity driven basic research, and to this extent basic research can be and is funded by RC grants. However, as discussed above whether the research funded through this mode is the same as the type of research done with FC funding is not clear**.** Whether this type of funding can and is indeed accommodating long-termism, high risk and uncertainties involved in a major part of scientific research is an issue that warrants closer examination.

It was discussed above that the stagnating funding through the FC stream of the dual funding system is exerting pressure on the HEI research system in the UK. The most obvious effect is the inadequate infrastructure funding of in universities. This is a problem that can arise in this type system when the balance is tipped. Moreover, for RCs, it is cheaper to support university research than support research in their own institutes, since RCs do not need to cover infrastructure costs and overheads. The government is responding to this issue through special funds to strengthen university infrastructure, and moving toward a regime of having grant funders cover full costs of research. The extent these measures are effective is yet to be seen. Another impact of the widening imbalance within the dual funding system is the possible squeezing out of long-term basic research. As discussed above, in areas where there is an abundance of RC and other "project" funds, the research work supported by these funds consumes staff resources and infrastructure funded by FC stream. This trend also suggests the need to carefully assess the impacts of the distortions in funding trends.

HEIs have been subject to another type of pressure in the last decades by the selective funding of core institutional funds coming from the FC stream through the Research Assessment Exercise, which is now subject to a major review. While the RAE was successful in improving the quality of university research, in the most recent recent exercise in 2001, the HEFC funding stream in some parts of the UK, and particularly in England, turned out to be too low for the excellence of HEI research demonstrated in the results. Moreover, for HEIs, the resources that had to be put into the exercise has come to a phase in which the returns for them are no longer rewarding. This experience demonstrates that while performance exercises of this type is effective in stimulating universities to improve research performance, it should be accompanied by an increased funding stream to reward improved performance.

6.3 Has the restructuring of PSREs been effective?

As part of the general drive for "smaller" public sector, and enhancing efficiency in operation, the government pursued an ambitious programme of scrutinising and restructuring PSREs to be executive agencies; then privatise some of them. This procedure resulted in some departmental PSREs moving along this restructuring process fairly quickly, most notably some of those affiliated to DTI. Many others still remain in government ownership as departmental PSREs. As a government effort, as discussed above, some observers assessed that for the resources the government put into the process, the outcome has been a relatively small few number of PSREs arriving at privatised status. What took place raises many questions about the costs and benefits of the restructuring process.

The UK experience suggests that it is not appropriate to privatise those PSREs whose mission is largely public in nature, *i.e.*, whose services and facilities mainly serve unique needs of the government. On the other hand, as seen in the case of some DTI PSREs, those that have industry-related activities can be restructured more easily. For those that have been restructured, there have been efficiency gains and responsiveness has been enhanced. But it may be noted that even for DTI PSREs, NPL, which mainly

served the government, has remained in government ownership. Also, the process of identifying PSREs appropriate for restructuring and actually implementing restructuring is a difficult and costly effort for the government.

Conclusions

Among the OECD member countries, UK is one of the few that has implemented rapid and drastic reforms in its research system in the past few decades. The reforms pushed towards increased relevance of public research to societal needs, improving the performance of university research, and restructuring of PSREs.

Structurally, the basically decentralised policy-making and funding system of the UK, assures pluralistic sources of funding and assessment of public sector research. The dual funding system for university research balances "core, institutional" funding with grant funding adapted to the different types of research that universities carry out.

However, the years of reform resulted in certain imbalances in the principal funding flows within the system. This is clearly observed in the relatively stagnating core institutional funding through the FC stream compared to project or grant funding through RC and other sources. This may influence the ability of the universities to carry out some areas of curiosity driven basic research in the long range. The diverging funding trend brought about another manifest problem of inadequate funding of university research infrastructure.

The current government strategy in increasing R&D spending is the right direction in making up for the imbalances and deficiencies in the system, and in compensating for the relative under-investment since 1980s. More difficult to assess at this point are the full impacts of the major reforms introduced in the system in recent years. This includes the push for more societal relevance of research funded through the Research Council system, the impact of the Research Assessment Exercise in the university system and the restructuring of the government research institutions. Given the long-term nature of scientific research the real effects of the reforms in the past decades and whether the current ones are adequate in making up for them is yet to be seen.

The UK science system and the reforms it was subject to in recent years demonstrate that it is not easy to maintain balance between research excellence and the push for societal relevance of research, in the context of stagnating public investments in research. UK experience demonstrates that pushing the relevance agenda at the expense of funding for research excellence can bring about distortions in the research system such as the infrastructure issue that may take long time to remedy. This implies that the policies to push for societal relevance of research need to be accompanied by matching efforts to invest in research excellence. The importance of serendipity in scientific research demonstrates that in the long term, society can well benefit from all kinds of research that the public sector can invest in.

REFERENCES

Beesley, A.E., P. Cunningham and L. Georghiou (1998) 'Convergence of research: the government, public and independent sectors' in Cunningham (1998).

Cunningham, P., ed. (1998), *Science and Technology in the United Kingdom*, Catermill International 1998.

Department of Education and Science (1991) *Education and Training for the 21st Century*, London, HMSO.

Department of Trade and Industry (2001a) *Excellence and Opportunity – a science and innovation policy for the 21st century.*

Department of Trade and Industry (2001b) *Science and Innovation Strategy 2001*.

Department of Trade and Industry Office of Science and Technology (2001c) *SET Statistics* (www.dti.gov.uk/ost/setstats).

DTI-OST (2001e) *Science Budget 2001-02 to 2003-04*, (available from DTI-OST website).

Flanagan, K. and M. Keenan (1998), 'Trends in UK Science Policy' in Cunningham 1998.

Florida, R. (1999) "The role of the university: leveraging talent, not technology", *Issues in Science and Technology*, 15(4).

Geuna, A. (1999) *The Economics of Knowledge Production*, London, Pinter.

Geuna, A. and B.R. Martin, "University Research Evaluation and Funding: an international comparison", *Minerva*, forthcoming.

JM Consulting Ltd. (2001), *Study of Science Research Infrastructure: a Report for the Office of Science and Technology*.

Mulvey, J. (1998) 'UK science in the 21st century: critical issues' in Cunningham, P., ed. (1998), *Science and Technology in the United Kingdom*, Catermill International 1998.

OECD (2000) *Science, Technology and Industry Outlook*, Paris.

OECD (2001) *OECD Science, Technology and Industry Scoreboard*, Paris.

OECD (2002) *Benchmarking Industry-Science Relationships*, Paris.

Office of Science and Technology (1993), *Realising Our Potential: a Strategy for Science, Engineering and Technology*, London, HMSO.

Pavitt, K. (2000), "Public policies to support basic research: what can the rest of the world learn from US theory and practice?", SPRU Electronic Working Papers, No. 53.

Salter, A.J. and B. Martin (2001) "The economic benefits of publicly funded basic research: a critical review" *Research Policy* 27(6), 394-396.

Scott. A., G. Steyn, A. Geuna, S. Brusoni, E. Steinmueller, "The Economic Returns to Basic Research and the Benefits of University-Industry Relationships", report for the Office of Science and Technology by SPRU.

UK Treasury (1999), *Creating Knowledge Creating Wealth – realising the economic potential of public sector research establishments (a report by John Baker to the Minister for Science and the Financial Secretary to the Treasury*, (www.hm-treasury.gov.uk/docs/1999/baker.html)

UK Treasury (2002), *2002 Spending Review*, (http://www.hm-treasury.gov.uk/Spending_Review/spend_sr02/report/spend_sr02_repindex.cfm?)

UK Treasury (2002a), *SET for Success: the supply of people with science, technology, engineering and mathematics skills – the report of Sir Gareth Roberts' Review* (http://www.hm-treasury.gov.uk/Documents/Enterprise_and_Productivity/Research_and_Enterprise/ent_res_roberts.cfm?)

UK Treassury-DTI-DfES (2002), *Investing in Innovation: a strategy for science, engineering and technology*, (www.ost.gov.uk/whats_new.htm)

INTERVIEWEES

Office of Science and Technology

- Mr. Stephen Speed, Director, Policy and Funding, Science and Engineering Base Group
- Ms. Frances Saunders, Director, Research Councils
- Mr. Edmund Quilty, Director, Science in Government Directorate
- Ms. Peta Pascoe, Science in Government Directorate

Department of Trade and Industry

- Mr. John Barber, Director of Technology, Economics, Statistics and Evaluation.
- Mr. Robert Gunn, Deputy Director, National Measurement System Directorate.
- Mr. David Legg, National Measurement System Directorate.

National Physical Laboratory

- Ms. Paula Knee, Programme Manager

Department for Education and Skills

- Mr. Peter D. Clark, Team Leader, HE Research, Innovation and Science

Higher Education Council of England

- Mr. Tom Sastry, Research Policy Officer
- Ms. Vanessa Johnson, formally Deputy RAE Manager

Scottish Higher Education Funding Council

- Mr. Richard Hancock, Head of Research Strategy and Policy

Department of Health

- Dr. John R. Stephenson, Programme manager for CJD and vaccine research, Research and Development Directorate

Department for Environment, Food and Rural Affairs

- Dr. Tony Burne, Head, Research Policy & International Division, Science Directorate
- Mr. Clive Porro, Agency Ownership Unit

Medical Research Council

- Mrs. Jane Lee, Director of Corporate Affairs
- Dr. Rob Buckle, Scientific Programme Manager, Policy and International

Biotechnology and Biological Sciences Research Council

- Dr. Doug Yarrow, Director, Corporate Science Group

Natural Environment Research Council

- Dr. David Lynn, Director, NERC Planning and Communications

Wellcome Trust

- Mr. Robert Terry, Senior Policy Adviser, Policy Unit
- Dr. Liz Allen, Senior Policy Adviser, Policy Unit

University of Sussex

- Mr. Peter G. Brooks, Director, Research Services Division
- Professor Ben Martin, Director SPRU
- Dr. Jacqueline Senker, Senior Fellow, SPRU
- Mr. Pari Patel, Senior Fellow, SPRU

In addition the report benefited from written comments from Ms. Linda Tiller of Higher Education Funding Council for Wales.

ACRONYMS

BBSRC	Biotechnology and Biological Sciences Research Council
DEFRA	Department for Environment Food and Rural Affairs
DEL	Department for Employment and Learning in Northern Ireland
DfES	Department for Education and Skills
DH	Department of Health
DTI	Department of Trade and Industry
FC	Funding Council
HEFC	Higher Education Funding Council
HEFCE	Higher Education Funding Council for England
HEFCW	Higher Education Funding Council for Wales
MAFF	Ministry of Agriculture, Fisheries and Food
MRC	Medical Research Council
NERC	Natural Environment Research Council
PSRE	Public Sector Research Establishment
RAE	Research Assessment Exercise
RC	Research Council
RCUK	Research Councils UK
SHEFC	Scottish Higher Education Funding Council