MAPPING THE LANDSCAPE

NATIONAL BIOMEDICAL RESEARCH OUTPUTS 1988–95

The Wellcome Trust

The Policy Research Department (PRISM) was established by the Wellcome Trust in 1990 as a centre for independent analysis and advice on science policy. Its mission is to help inform decisions on the most effective means of supporting scientific research. It supports evidence-based policy making particularly by:

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- auditing scientific activity in different research fields and countries;
- applying novel approaches to strategic planning and priority setting.

As well as carrying out independent policy research, the Department offers two unique services to funding organizations, policy makers, government departments, universities and industrialists:

- SPIN (Science Policy Information News) – a weekly round-up of news in biomedical science policy;
- ROD (Research Outputs Database) – developed by the Wellcome Trust to track research outputs in biomedical sciences. For the first time, research-funding agencies are able to identify and acquire details of research papers attributable to them.

MAPPING THE LANDSCAPE

NATIONAL BIOMEDICAL RESEARCH OUTPUTS 1988–95

Policy report No. 9

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Executive Summary

Mapping the Landscape presents an overview of recent trends in the funding and outputs of biomedical research in the UK, with some international comparisons. The main source of information is the Wellcome Trust's Research Outputs Database (ROD), which currently provides data on some 215 000 UK papers in the serial literature during 1988–95. One purpose of ROD is to provide comprehensive national statistics on research performance, to facilitate evidence-based decisions on funding. The data reveal the contribution made by different funding sectors to biomedical research and to research in 20 selected subfields, and the general nature and impact of the research being funded.

The main conclusions are as follows:

- Despite reducing trends in UK Government science funding as a proportion of GDP and of total expenditure, overall civil R&D spending is little changed at 1.7 per cent of GDP. The UK ranks fifth among the G7 countries in this respect. The private-non-profit and industrial sectors have increased their R&D expenditure on biomedicine in real terms.
- There has been little change in the UK's world share of science publications in recent years. Biomedicine accounts for just over half of UK scientific output and its world share is a little higher than for all science and also nearly constant.
- The UK has a rather uniform presence in the world literature in different biomedical subfields. It is relatively strong in tropical medicine and arthritis and rheumatism research. Its shares of papers in cardiology, genetics, nursing and ophthalmology have increased significantly over the eight years, whilst its share of gastroenterology papers has decreased.
- The numbers of UK biomedical papers have increased by one-third between 1988 and 1995. The areas of the UK producing the most papers are London, Cambridge, Oxford and Edinburgh. Belfast and Leicester are the areas where output is increasing most rapidly.
- Both national and international collaboration have increased, with increases in the average numbers of authors, addresses and funding sources acknowledged on each paper. The UK collaborates most with the USA but collaboration is increasing most rapidly with Portugal and Spain.

- Although the UK Government remains the largest acknowledged funder of UK biomedical research and was involved in nearly 34 per cent of papers in 1995, the private-non-profit sector is catching up fast with 32 per cent in 1995 and the industrial sector has also increased its involvement, from 14 to 17 per cent. The Wellcome Trust's share of papers rose from 6 to 10 per cent and the number of papers acknowledging its support doubled. The UK biotechnology subsector is still small but growing rapidly. The proportion of papers with no acknowledged funding source has reduced from 40 per cent in 1988 to 33 per cent in 1995; many of these are from National Health Service Hospitals.
- About 30 per cent of the papers report the results of basic research, and this percentage has been growing slowly. For the Research Councils and the Wellcome Trust more than half their papers cover basic research and their proportion has increased rapidly.
- Genetics and immunology are the most basic subfields in terms of research level and are also the ones most likely to attract specific funding. They, together with multiple sclerosis and oncology, are the ones of greatest impact as measured by citations. Nursing research is the most clinical, followed by anaesthesia and gerontology; and only one-third of its papers have funding acknowledgements.

Introduction

There is an old Hindu story of five blind men examining an elephant. One holds the tail, another touches the leg, others the side, an ear, the trunk – they can neither see the animal nor agree on its description, let alone control it. The metaphor is appropriate for many public and private administrations, as their constituent departments try to manage those areas of the elephantine mass of biomedical research which fall within their competence or perception.

A strong research base is expensive and increasingly in recent years governments and other funding agencies in developed countries have been trimming their expenditure or at least giving closer scrutiny to the size of their budgets and to the elements that they contain. It is inevitable that the unpredictable nature of much scientific research should invite questions about value for money. Nonetheless the analytical tools necessary for establishing the correct balance between basic and applied research, the levels of funding in different subfields, and for determining the quality of the work, have remained for the most part underdeveloped. Questions have even arisen, probably not entirely tongue-in-cheek, about whether medicine is driven by science or by fashion.

The 'elephant' was represented in the present study by data on some 215 000 UK publications on biomedical research and *Mapping the Landscape* is an attempt to describe the nature of the beast and the forces at work in its habitat. The publications, a measure of the outputs of biomedical research, were identified from the Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI) ©The Institute for Scientific Information. They were examined to determine their funding sources, the inputs, as well as their authorship and place of origin. They were also classified into 20 selected biomedical subfields and analysed for their research level (from clinical to basic) and impact on other researchers.

This immensely rich source of data constitutes the Research Outputs Database (ROD). Conceived and developed as an on-going process by the Wellcome Trust, it represents a major step forward in providing funding agencies and practitioners of biomedical research with a coherent infrastructure for decision making. In distilling and interpreting the information, and placing it in an international context, *Mapping the Landscape* reveals fascinating trends in the volume, type and effectiveness of UK research carried out over an eight-year period and relates these variables to the inputs for that time. In sharper focus, analysis of the authorship and addresses of the publications shows who is doing what, where and with whom.

The report has five chapters, a technical Annex and an Appendix in which detailed statistical tables are given (numbered A1 to A73). The contents of the chapters are as follows:

- Chapter 1: A Global View. International spending comparisons; international science and biomedical outputs; relative UK presence within biomedical subfields; international co-authorship.
- Chapter 2: UK National Outputs. The Research Outputs Database; the authors and addresses of UK biomedical papers; their division into subfields and their research level (from clinical to basic).
- Chapter 3: Sources of Funding. UK Government (including the Research Councils), UK private-non-profit (including the Wellcome Trust), industry, international, no acknowledgements; the numbers of papers, leading sub-fields and research levels of each sector.
- Chapter 4: Measuring Impacts. Journal impact factors and categories; comparison of portfolios of different funders and of contributors to sub-fields; patent citations as a measure of technology linkage.
- Chapter 5: Discussion and Policy Issues. Issues for policy decisions; future editions of the report; caveats or health warnings.

Mapping the Landscape should help determine the extent to which strategically important areas of research have been given priority and facilitate more evidence-based research funding allocations in future. The report data will be updated on a regular basis so that changes in UK biomedical research output can be observed and appropriate policies put into effect.

1 A Global View

What is Biomedicine?

It is difficult to provide an elegant definition of biomedicine; for present purposes the term encompasses clinical medicine and basic biology (excluding botany and ecology), together with biochemistry. It also covers animal health and the social sciences allied to medicine, for example nursing and public health. Much of what follows concerns bibliometric analysis (measurements of publication output) and in this area of activity there are eight scientific disciplines (clinical medicine, biomedical research, biology, chemistry, physics, earth and space sciences, engineering and technology, and mathematics) used, for example, for the Science and Engineering Indicators of the US National Science Foundation. Two of them, clinical medicine and biomedical research, concern us here. Later on, biomedicine is split into some 20 selected 'subfields' to help in *Mapping the Landscape*.

1.1 Gross expenditure on research and development

To give some idea of the relative performance of UK biomedical research in the international arena, it is necessary to study the inputs, that is the relative spending power of the leading economies. The Organisation for Economic Cooperation and Development (OECD) publishes international comparisons on R&D expenditure. Of the leading (G7) economies in 1995, the USA spent most on R&D (£440 per caput), followed by Japan (£378), France (£305), Germany (£288), UK (£246), Canada (£220) and Italy (£142). UK gross expenditure on research and development (GERD) can be broken down into support by the Government sector (33 per cent in 1995), business enterprises (48 per cent), private-non-profit organizations (3.5 per cent) and higher education (1 per cent), the remaining 14 per cent being funding from abroad. In 1995, GERD in the UK amounted to £14 328 million (or £246 per caput based on a population figure for the UK of 58.1 million). Compared with the other G7 countries, the UK has the smallest government contribution to its total GERD apart from Japan, and its share has declined from

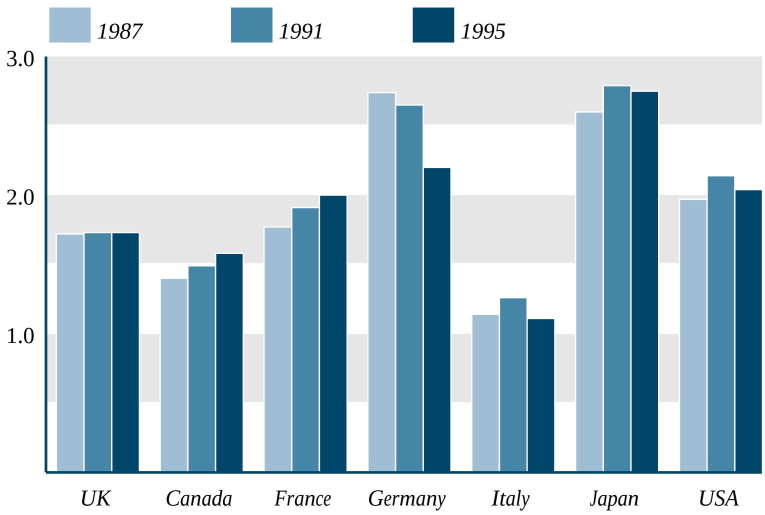

Figure 1.1 Civil GERD for the G7 countries from 1987–95, percentages of GDP.

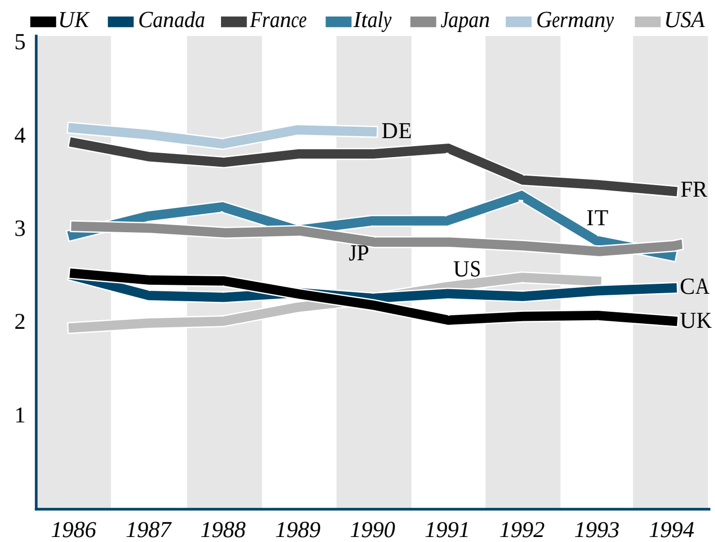

Figure 1.2 Government civil expenditure on R&D as a percentage of government expenditure for the G7 countries, 1986–94.

39.5 per cent in 1987 to 33.3 per cent in 1995 (ONS, SET Statistics, 1997).

Trends in GERD, as a percentage of gross domestic product (GDP), with defence spending excluded, for the G7 countries from 1987–95 are shown in Figure 1.1. The situation in the UK is relatively static with GERD at about 1.74 per cent of GDP whilst other countries show marked increases, such as France and Canada, or marked decline as in Germany (attributable to the unification of the country). UK Government expenditure on R&D for civil purposes has gone down from nearly 0.7 per cent of GDP in the early 1980s to 0.5 per cent in the 1990s (see Table A2).

Government spending on civil R&D as a percentage of total government expenditure is another useful indicator. In the OECD's *Science Technology and Industry Scoreboard of Indicators 1997* this measure is described as identifying “differences in the policy ‘priority’ accorded to investment in R&D among countries”. Figure 1.2 illustrates a fairly consistent trend of decreasing UK Government spending on R&D as a total percentage of Government expenditures from 1986–94. It has gone down from nearly 2.5 per cent to less than 2.0 per cent and is now the lowest of the G7 countries.

1.2 UK spending on biomedical research

Figure 1.3 shows the estimated UK expenditure on biomedical science in 1994–5 that would lead to publications (public domain biomedical research and development). It includes a nominal 10 per cent of the expenditure by the pharmaceutical industry, (see Figure 1.4): this is a very rough estimate of the proportion that is spent extramurally.

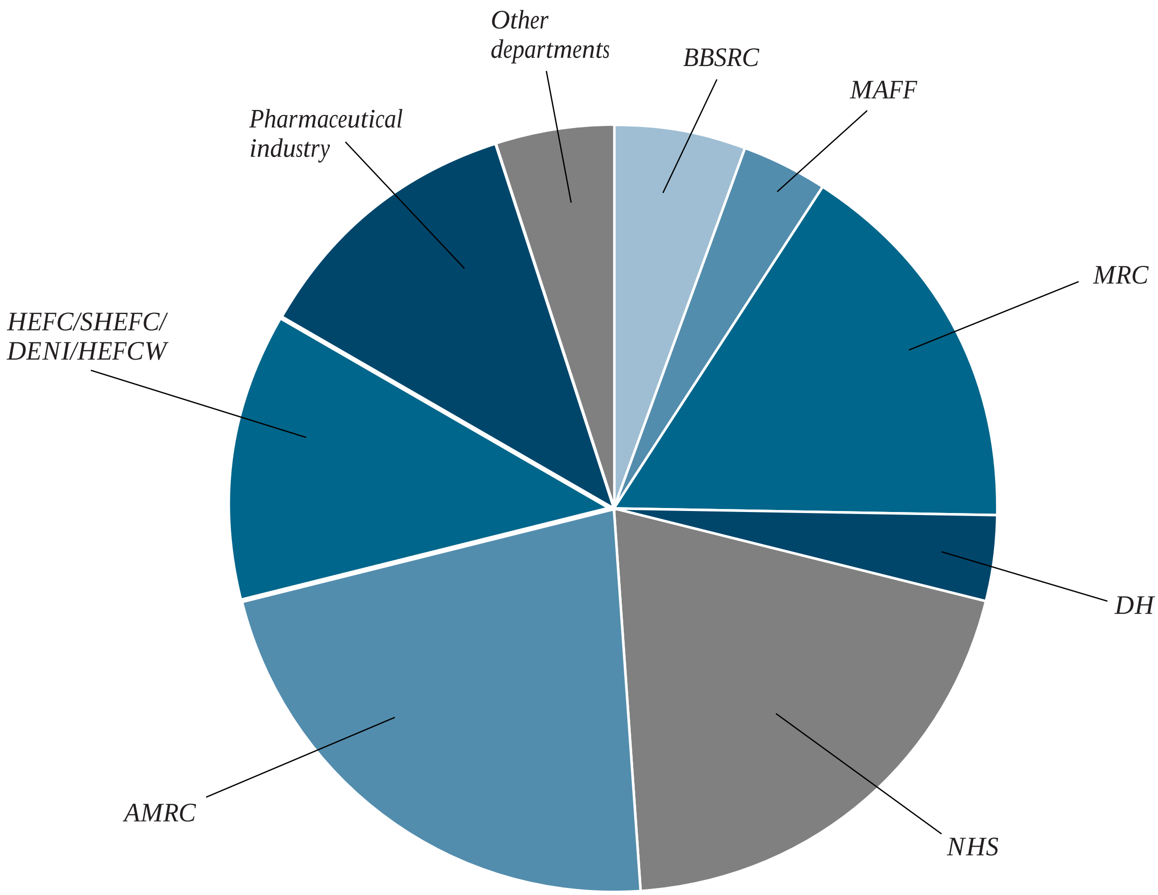

Figure 1.3 Sources of UK public domain biomedical research funding, 1994–95 (see Table A4).

Clearly funding sources for UK public domain biomedical research are diverse. They include not only explicit funding sources, but also the contributions of the Higher Education Funding Councils for academic salaries and infrastructure, and of the National Health Service for clinical costs. The total expenditure amounted to approximately £1636 million compared with the GERD figure of £14 328 million for 1995. The common supposition that biomedical research funding is dominated by the Medical Research Council (as it is in the USA by the National Institutes of Health) is obviously invalid. The significant contributions of the National Health Service, charities, industry and the other Research Councils are often overlooked: indeed NHS expenditure only made an appearance in the *Government's Annual Review of R&D* as late as 1995. Biomedical research spending by both the pharmaceutical industry (which includes foreign firms with operations in the UK but excludes spending abroad by UK firms) and members of the Association for Medical Research Charities (AMRC) is increasing. Expenditure by the pharmaceutical industry has risen quite consistently in real terms over the period (1988–95) with a levelling off in 1995 but an estimated increase again in 1996 to £2078 million. Figures for the AMRC also show a consistent increase in real terms over a similar period. The largest contribution to the latter has been that of the Wellcome Trust whose expenditure has risen from £39 million in 1988 to £235 million in 1995.

During 1988–95, the proportional reduction of government funding of science has been matched, at least in biomedicine, by increases from other sources such as the private-non-profit sector and industry. However the absolute amount of support has not declined, and in recent years the Medical Research Council has seen an increase in real terms in its funding (see Table A5).

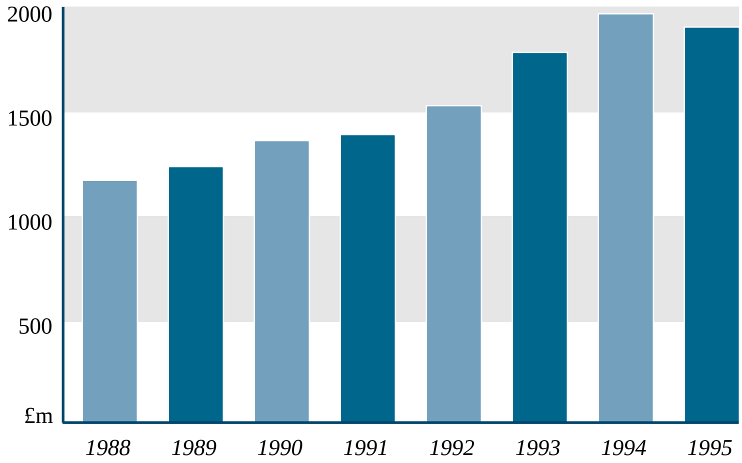

Figure 1.4 Annual research expenditures by members of the Association of British Pharmaceutical Industries, 1995 prices, from 1988–95.

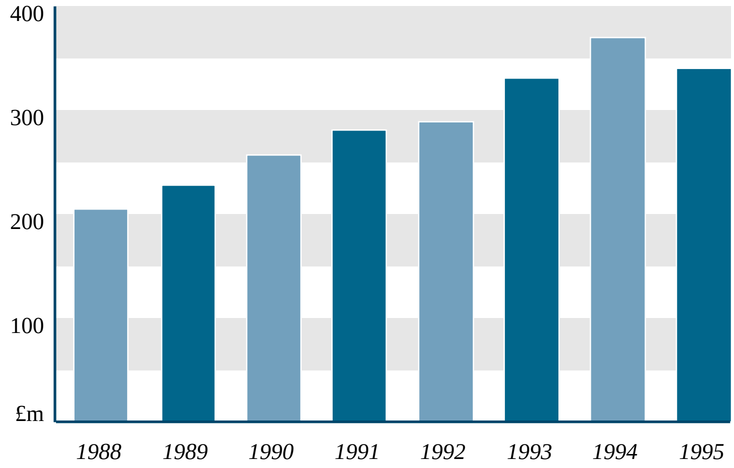

Figure 1.5 Annual research expenditures by members of the Association of Medical Research Charities, 1995 prices, from 1988–95.

Outputs: Problems of estimation

The outputs of scientific research can be monitored by the resulting publications in peer-reviewed journals. As with comparisons of international expenditure on scientific and biomedical research there are problems in comparing the scientific and biomedical outputs of research. At present, virtually all authors analysing research outputs use data from the Institute of Scientific Information (ISI), as recorded in the Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI). However even this source exists in four formats with different journal coverages. Moreover, although it is now standard practice to include only articles, notes and reviews as the main outputs of research for benchmarking studies, not all authors follow this rule. Each country may also have different ways of defining the main fields and subfields of science.

Another consideration involves the method of recording international publications. Sometimes a country's contribution is recorded as a fraction (for example a publication bearing addresses from, say, the UK and France would score as 0.5 for each country) but in other studies integer counting is used, whereby each country would score 1.0. If counts of total publications are fractionated according to the number of addresses, then individual country percentages sum to 100 per cent and shares are lower than with integer counting. For this reason, it is useful to compare estimates of shares of output from different countries using both techniques, and this is done here in the figures that follow.

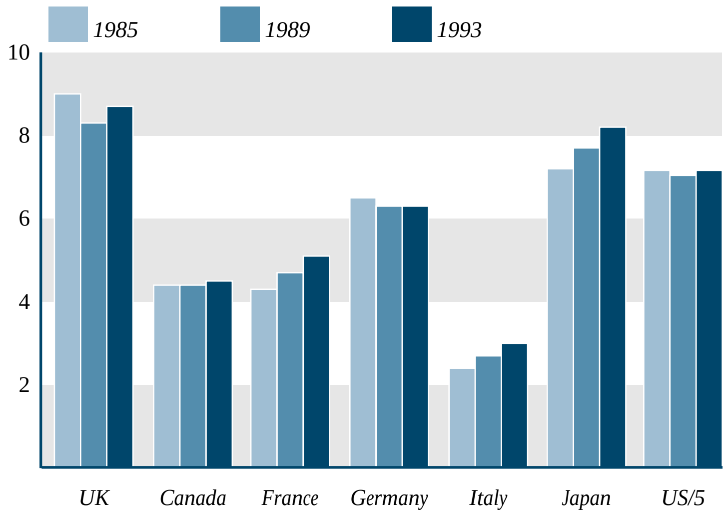

Figure 1.6. Percentage shares of science publications for G7 countries, 1985, 1989, 1993 (from European Union report, using fractional counts).

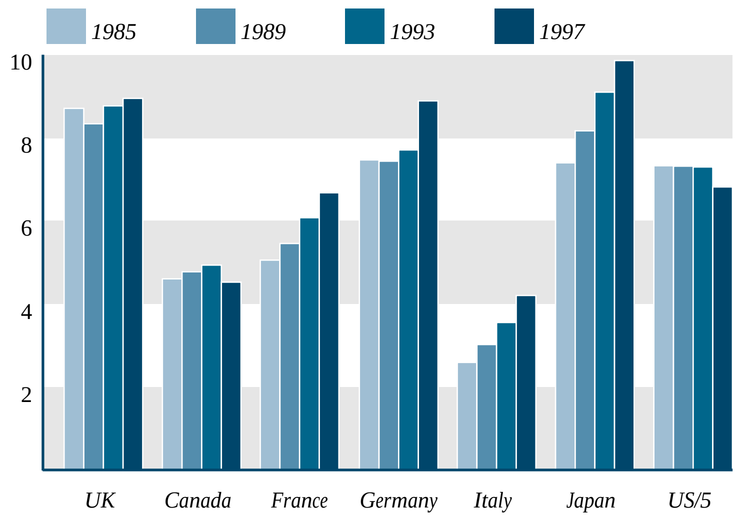

Figure 1.7 Percentage shares of science publications for G7 countries from SCI, 1985, 1989, 1993, 1997.

1.3 Science outputs

The Australian Bureau of Industry Economics (1996) in its overview of Australian performance from published papers (considering peer-reviewed papers in journals covered by the SCI) has the UK second only to the USA at 8 per cent of all scientific outputs between the years 1981 and 1994 (see Table A8). The US National Science Foundation (NSF, National Science Indicators, 1996), also using data from the SCI, puts the UK presence in all science at 8.3 per cent in 1981–85, reducing to 7.6 per cent in 1989 and remaining fairly steady thereafter. International indicators have also been published by the European Union in its 1994 Science and Technology Indicators report (Figure 1.6). These suggest a UK share of between 8 and 9 per cent, declining in the 1980s but now increasing again.

In the present study, the outputs of 12 leading OECD countries were determined using integer counting from the SCI in the CD-ROM version, and data are presented for the odd-numbered years from 1985–97 in Table A10. Figure 1.7 shows the percentage shares of the G7 countries, for four years, 1985, 1989, 1993 and 1997, for comparison with Figure 1.6. These results also show that the UK is more or less maintaining its world share of science output at something between 8 and 9 per cent, although they indicate that it was overtaken by Japan in numbers of publications back in 1991 and is now only in third place internationally.

1.4 Biomedical outputs

The European Report on Science and Technology Indicators (1994) also presented data for country percentage shares of the eight major fields of science (see 'What is Biomedicine?', p.8). The two of concern here are clinical medicine and biomedical research, of which the former is approximately twice the size of the latter. Combining the data for these two fields reveals that the UK share of world biomedical publications was slightly over 11 per cent, but that it reduced from a high of 11.4 per cent in 1985 to a 1993 level of 11.1 per cent. NSF data (Table A11) show lower figures, with a share of 9.7 per cent in 1985 reducing to 9.1 per cent in 1989–93. Thus although this world share is greater than that for all science publications, there is some evidence of decline, on the basis of fractional counting of country shares. The shares of the G7 countries, taken from the EU report for 1985, 1989 and 1993, are shown in Figure 1.8.

Figure 1.9 shows results for 1985–97 obtained in the present study. It is based on papers with biomedical address keywords and using integer counting. The UK, and also the USA, publishes more than half its scientific papers in the two biomedical fields, compared with a world average of 45 per cent, and only 37 per cent for Germany. The graph indicates that UK biomedical output is almost static at 10 per cent rather than declining but this apparent reversal of fortune is in part due to increasing international co-authorship, which boosts total integer counts.

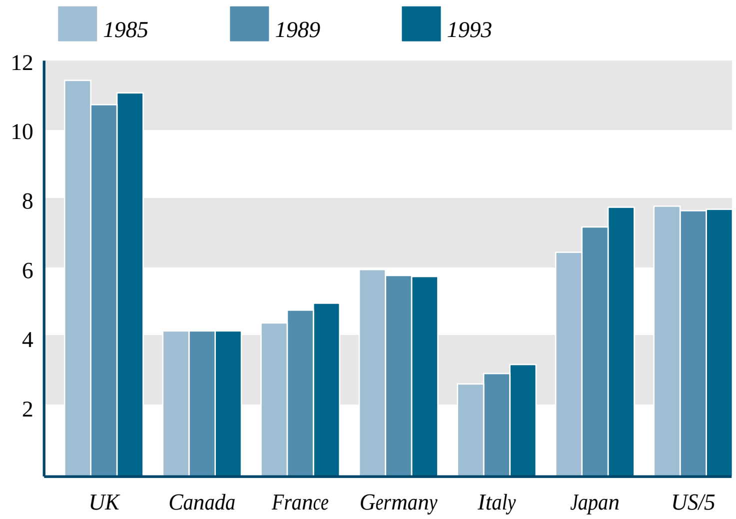

Figure 1.8 Percentage shares of G7 countries in biomedical research, 1985, 1989 and 1993 (EU report, fractional counts).

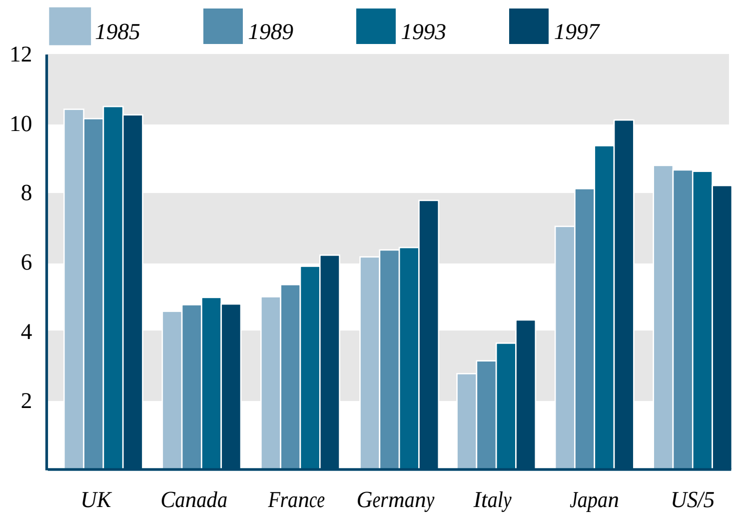

Figure 1.9 Percentage shares of G7 countries in biomedical research, 1985–97 (present study).

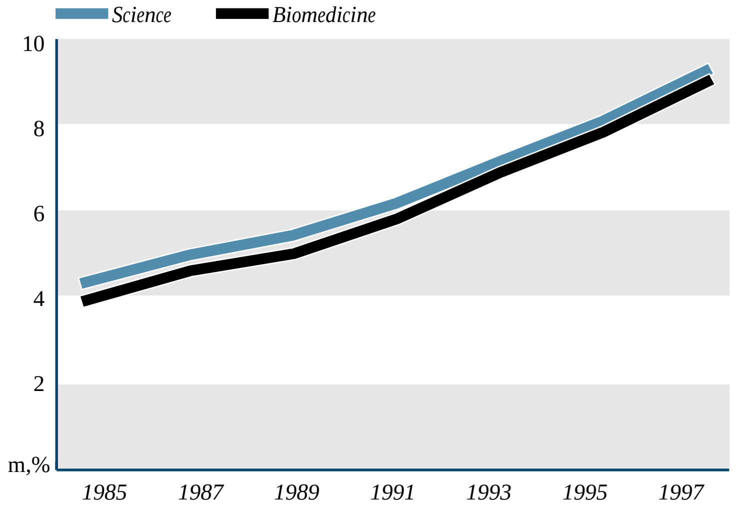

Figure 1.10 Index of international co-authorship in science and in biomedicine among G7 countries, 1985–97.

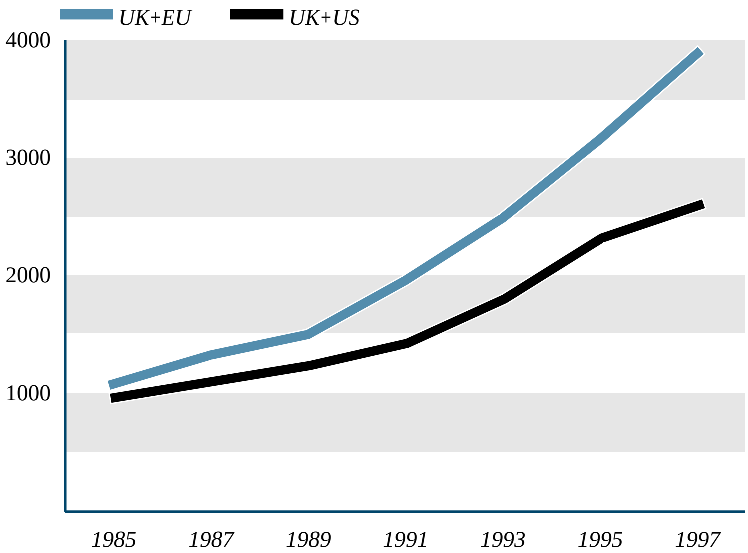

Figure 1.11 UK biomedical papers co-authored with other EU member states and the USA, 1985–97

An index of this co-authorship is shown both for all science and for biomedicine in Figure 1.10, which shows that it has more than doubled in the last 12 years. [This index is the difference between the sum of the number of papers from each of the G7 countries less the number from all of them together, divided by the latter number. It represents the percentage of internationally co-authored papers, with papers from two countries counting one towards the total; papers from three countries counting two, etc.]

Between 1985 and 1997 the UK has increased its co-authorship with nearly all countries, but particularly with other European Union member states. EU support for collaboration and other international programmes have led to nearly a quadrupling of co-authored paper numbers, compared with a 2.5-fold increase with the USA (see Figure 1.11).

Table 1.1 List of subfields showing size, growth, UK percentage presence and growth, 1988–95.

Code	Subfield name	*n* (UK)	*n* (World)	AAPG	UK%	AAPG
TROPM	Tropical medicine	4880	34 793	1.9	14.0	1.6
ARTHR	Arthritis and rheumatism	6703	49 610	4.4	13.5	1.3
ANEST	Anaesthetics	6405	49 707	2.1	12.9	-0.6
MULSC	Multiple sclerosis	726	5679	3.0	12.8	0.6
RESPI	Respiratory medicine	10 149	87 254	3.8	11.6	0.5
NURSE	Nursing research (SSCI)	1843	15 576	8.5	11.8	**7.7**
OBSGY	Obstetrics and gynaecology	12 409	118 143	2.5	10.5	0.5
OPHTH	Ophthalmology	5380	51 210	1.0	10.5	**0.5**
HISTP	Histopathology	10 130	97 196	1.7	10.4	0.4
GERON	Gerontology	3241	32 148	5.8	10.1	-1.8
GASTR	Gastroenterology	15 376	152 154	2.8	10.1	**-0.9**
NEONA	Neonatology	2709	28 043	2.0	9.7	1.9
GENET	Genetics	22 280	232 250	8.1	9.6	**1.9**
HAEMA	Haematology	12 681	133 543	1.5	9.5	0.8
ONCOL	Oncology	19 930	212 941	4.9	9.4	-0.2
IMMUN	Immunology	16 839	179 980	2.1	9.4	-0.3
NEURO	Neurosciences	24 718	275 664	3.5	9.0	-0.1
DEVEL	Developmental biology	6943	77 886	4.3	8.9	0.3
CARDI	Cardiology	19 809	223 548	2.6	8.9	**1.8**
RENAL	Renal medicine/nephrology	4737	55 545	1.4	8.5	0.6

1.5 Biomedical subfield outputs

In order to provide an in-depth analysis of national biomedical outputs, 20 biomedical subfields have been selected and defined for use in this study. [Details of subfield definition are given in the Annex, Sections 1.6 and 1.7.] The subfields are intended to provide examples of biomedical research areas and are by no means exhaustive. In particular, some hard-to-define subfields like biochemistry and pharmacology have not been treated. The subfields vary greatly in size, from oncology to multiple sclerosis research. Table 1.1 lists them in descending order of UK presence and shows their relative size and expansion rate (annual average percentage growth rate, AAPG). For convenience, each subfield will subsequently be designated by a five-letter code, shown in the first column of the table. [Full details of the outputs of all 12 of the OECD countries used for the study over the period 1988–96 are given in the appendix (Tables A54–A73).]

Nursing research, genetics and gerontology are the fastest growing subfields worldwide. The UK appears to have a rather well-balanced research portfolio in terms of its outputs, at least in these 20 subfields, with no noticeably weak areas but a relatively strong presence in some small subfields such as tropical medicine (TROPM) and arthritis and rheumatism (ARTHR). Its relative presence is growing

Table 1.2 Proportion of UK biomedical papers in 20 selected subfields, 1988–95.

Code	Subfield name	CF	*n* (UK) corr.	% of UK biomed.
ONCOL	Oncology	1.24	24 713	13.48
GENET	Genetics	1.04	23 171	12.64
CARDI	Cardiology	1.10	21 790	11.89
NEURO	Neurosciences	0.78	19 280	10.52
IMMUN	Immunology	1.12	18 860	10.29
HISTP	Histopathology	1.63	16 512	9.01
GASTR	Gastroenterology	0.95	14 607	7.97
OBSGY	Obstetrics and gynaecology	1.01	12 533	6.84
RESPI	Respiratory medicine	1.17	11 874	6.48
HAEMA	Haematology	0.93	11 793	6.43
ANEST	Anaesthetics	1.19	7622	4.16
ARTHR	Arthritis and rheumatism	1.11	7440	4.06
TROPM	Tropical medicine	1.19	5807	3.17
RENAL	Renal medicine/nephrology	1.19	5637	3.07
OPHTH	Ophthalmology	1.00	5380	2.93
DEVEL	Developmental biology	0.70	4860	2.65
GERON	Gerontology	1.29	4181	2.28
NEONA	Neonatology	1.02	2763	1.51
NURSE	Nursing research (SSCI)	1.04	1917	1.05
MULSC	Multiple sclerosis	1.02	741	0.40

fastest (statistically significant at $p < 0.05$, and shown in bold in the table) in nursing research (although the language bias of the SSCI may account for this), ophthalmology, genetics and cardiology, but it has declined in gastroenterology.

The next table shows the relative size of the subfields in the UK biomedical output. The numbers of papers in each subfield have been adjusted to account for the recall of the filter (relevant papers not retrieved) being less than unity and its precision (papers retrieved not relevant) also being below one. The ratio of these two factors, precision/recall, is the calibration factor (CF) and is listed in Table 1.2: it is the number by which the apparent number of papers has to be multiplied to give the 'true' number. The percentages in the last column are of the adjusted (true) outputs in each subfield divided by the number of UK biomedical papers in the eight years (183 318). They sum to just over 120 per cent. Because many papers are relevant to more than one subfield, there is a substantial overlap between them. Moreover, the definition of biomedicine excludes papers in biomedical journals without address keywords on the list used to define the field (see previous section), so the 20 subfields together account for only a part of all biomedicine.

Conclusions

- The general trend in the UK appears to be a proportional reduction in the funding of scientific research and development by the UK Government sector.
- Compared with the other G7 countries, the UK has the smallest government contribution to its total GERD apart from Japan, and this has declined from 40 per cent in 1987 to 33 per cent in 1995.
- There is a fairly consistent trend of decreasing UK Government spending on R&D as a total percentage of government expenditure from 1986–94.
- There is increasing spending by the private-non-profit sector and the pharmaceutical industry on biomedical research: this has shifted the balance away from government.
- The UK has approximately maintained its world share of science publications.
- The UK's scientific output was overtaken by that of Japan in 1991.
- The UK has a proportionately larger share of the world biomedical literature than in all science.
- This share is either slightly declining or slightly increasing, according to the particular recording method employed.
- In biomedicine, Japan is about to overtake the UK in output.
- The UK has a well-balanced biomedical research portfolio with no noticeably weak subfields.
- It has a strong presence in some small subfields such as tropical medicine and arthritis research.
- Its presence is growing in nursing research, ophthalmology, genetics and cardiology.
- Its world share in gastroenterology is declining.

UK National Outputs 2

2.1 The development of the Research Outputs Database (ROD)

In the early 1990s, the Wellcome Trust wanted to investigate the effectiveness of different funding mechanisms and to determine what had been achieved with its support. It also wished to know more about the environment in which it was operating, so that opportunities for new initiatives could be identified. Carrying out the first task required details of papers published as a result of its support. However the search for relevant information from grantholders produced unreliable and incomplete data.

An alternative approach was tried in which a large sample of papers was examined in libraries in order to identify papers supported by the Wellcome Trust from their acknowledgements. A pilot study was initiated based on a sample of 12 of the most influential UK journals in the areas of biomedical research supported by the Trust, and covering two years, 1983 and 1988. Data were collected not only on Trust-funded papers but also on ones funded by other sources. As expected, the data showed that there was a significant increase in the number of papers acknowledging the Trust over the study period, reflecting its increased expenditure. A citation analysis of papers with different sources of funding permitted a comparison of the impact of the Trust's papers with those of other funding bodies.

This successful pilot study led to a full-scale Research Outputs Database (ROD) that would capture all UK biomedical papers in the peer-reviewed serial literature. This was primarily intended to assist the Trust in its research management role, but it was made available to a 'club' of other interested organizations, both funders and research performers. The database was designed to cover all scientific areas of interest to the Trust, including clinical and veterinary medicine, basic cell biology and genetics, and some of the social sciences such as psychology and nursing.

The database has been created in a series of campaigns. The first covered the five years 1988–92, and included about 125 000 papers; this was complete by the end of 1994.

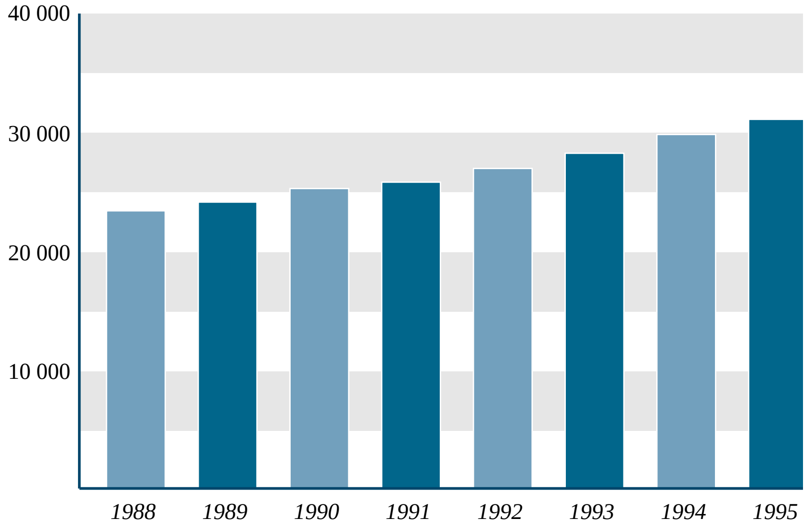

Figure 2.1 Numbers of UK biomedical papers in the ROD, 1988–95.

Table 2.1 List of 20 biomedical subfields ranked by UK outputs in the ROD, 1988–95, with average annual percentage growth (AAPG).

Code	Subfield	*n* (UK)	AAPG
NEURO	Neurosciences	25240	3.7
GENET	Genetics	20620	9.3
ONCOL	Oncology	19654	4.5
CARDI	Cardiology	19084	4.3
IMMUN	Immunology	17186	1.8
GASTR	Gastroenterology	14945	1.8
OBSGY	Obstetrics and gynaecology	12069	2.3
HAEMA	Haematology	12069	3.4
RESPI	Respiratory medicine	9969	4.5
HISTP	Histopathology	8682	1.9
ARTHR	Arthritis and rheumatism	6672	6.0
ANEST	Anaesthesia	6426	1.4
DEVEL	Developmental biology	6190	5.1
OPHTH	Ophthalmology	5354	3.5
RENAL	Renal medicine	4660	1.7
TROPM	Tropical medicine	4324	3.6
NEONA	Neonatology	3989	5.8
GERON	Gerontology	3728	5.0
NURSE	Nursing research	2583	15.0
MULSC	Multiple sclerosis	725	3.6

The second campaign covered two years, 1993–94, and brought the number of papers to about 180 000: it was completed by the autumn of 1995. The third campaign, covering 1995 publications, was completed in the autumn of 1997, and the results from these three campaigns form the substance of this report. Some of the rich opportunities for analysis of UK biomedical research outputs are illustrated in the following sections.

2.2 Numbers of biomedical publications

The methodology whereby UK biomedical papers are identified and downloaded from the SCI and the SSCI is described in the Annex, Section 3.1. Briefly, all papers (articles, notes and reviews) with a UK address in biomedical and relevant social science journals are included, as are those with a biomedical address keyword in other journals. The numbers of papers are therefore greater than those presented in Chapter 1. The absolute numbers of UK biomedical research publications in the ROD, year by year, are shown in Figure 2.1.

Despite the aforementioned changes in science funding and the possible small decrease in the UK share of world biomedical publications (see Section 1.4), there has been a steady increase in the absolute number of UK biomedical publications in the ROD in the period 1988–95. This overall 33 per cent increase has shown a consistent pattern with an average annual percentage growth (AAPG) of 4.2 per cent. Despite indicators to the contrary, UK biomedical science would appear to be strong and continuing on an upward trend.

2.3 Output of papers in the 20 subfields

Table 2.1 shows the numbers of papers in the 20 selected subfields, and their annual average percentage growth. These figures, and those given subsequently in this report, are not corrected for the lack of precision and recall of the filter because the intention is to analyse papers within each subfield rather than to make cross-subfield comparisons of numbers. Details of annual outputs are shown in Table A17 in the Appendix. The fastest growing subfield is nursing research, followed by genetics. On the other hand, anaesthesia, renal medicine, gastroenterology, immunology and histopathology are growing at less than 2 per cent per annum, which means that they are contracting relative to the overall growth in biomedicine.

2.4 Number of authors

There is evidence that both the number of authors and the number of funding organizations on a paper are associated with increased potential impact (Lewison and Dawson, 1998). Potential impact relates to the average number of citations for all papers in the journal in which the paper is published. For example, a paper published in Nature, a journal where the papers receive a high average number of citations, would potentially accrue more citations in a given time period than one in a small, specialist, journal.

Figure 2.2 shows a distinct trend towards increasing numbers of authors on papers. The proportion of papers with a single author has decreased from 16.6 to 12.9 per cent of papers published in the years 1988 and 1995 respectively. Similarly, the proportion of papers with two authors has reduced from 25.6 to 20.3 per cent. This reduction in papers with few authors contrasts with an increase in propor-

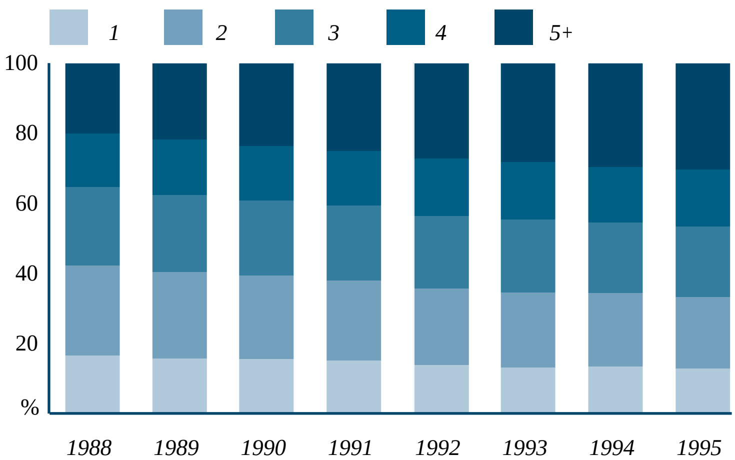

Figure 2.2 Change in percentage of papers with different numbers of authors, 1988–95.

tion, from 35.5 to 46.6 per cent, of those papers with four or more authors. Overall, the average number of authors per paper has risen from 3.2 to 3.8 (AAPG, 2.4 per cent). This is a clear indication of an increasing level of collaboration in biomedical research, and it probably indicates that it has become more multidisciplinary.

2.5 Number of addresses

Figure 2.3 shows a notable decline in the proportion of UK biomedical research papers bearing single addresses. They have dropped from 53.8 per cent in 1988 to 44.3 per cent in 1995 while all the other categories have increased, with the number of papers with three addresses increasing from 10.9 to 14.3 per cent. Overall, the average number of addresses has risen from 1.7 to 2.0 (AAPG, 2.4 per cent). It is a strong indicator of more collaboration between laboratories, which parallels the increase in authorship.

Increases in numbers of authors and addresses are predictable given increasing globalization and collaboration in science. While increases in the numbers of authors and acknowledged funding bodies are positively correlated with impact, the same does not appear to be true of the numbers of addresses. In a recent paper, Lewison and Dawson (1998) showed that for gastroenterology, when other factors influencing potential impact of research were taken into account, increasing numbers of addresses were negatively correlated with impact. Further investigation in this area is required but it seemed that collaboration between institutions was not necessarily desirable in terms of the impact of the research if other factors remained the same.

2.6 Research levels

Achieving the appropriate balance between basic and applied research is both extremely desirable and very difficult. There is no doubt that both types of research are important although it may be difficult to measure the impact of research at the more clinical (applied) end of the spectrum adequately by the conventional means of counting citations. Even if consensus could be reached on what the appropriate balance is, how can we determine where we are now and monitor where we may go in future? One way to gauge recent trends and the current balance is to consider the research published in any given journal and then categorize that journal by the predominance of papers in it. Thus if most of the papers in a journal are found to be of a clinical nature that journal would be categorized as clinical. CHI Research Inc. has developed just such a method of classification, depending partly on expert opinion and partly on journal-to-journal referencing patterns (Narin, Pinski and Gee, 1976), referring to the different categories as ‘research levels’ (see Table 2.2).

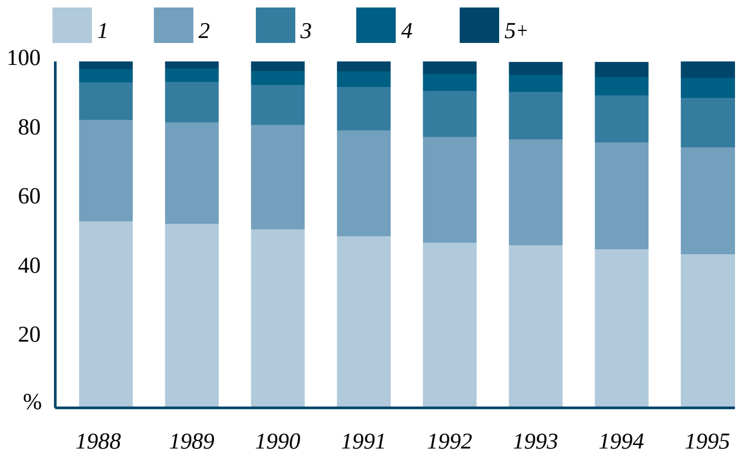

Figure 2.3 Change in percentage of papers with different numbers of addresses, 1988–95.

Table 2.2 Definition of four research levels (RL).

RL	Classification
1	Clinical observation
2	Clinical mix
3	Clinical investigation
4	Basic research

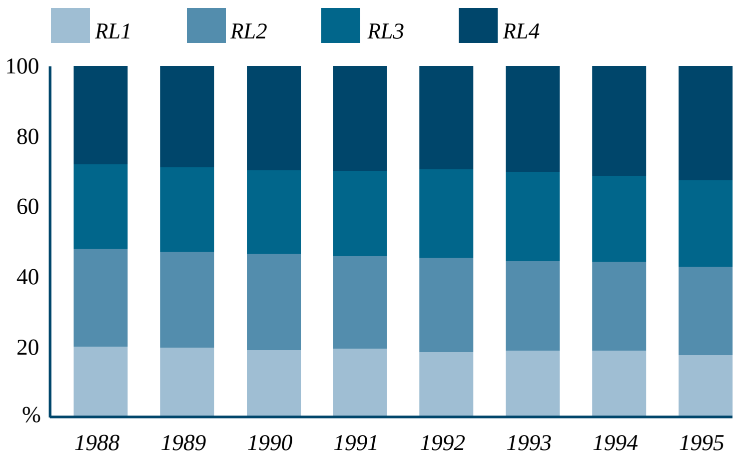

Figure 2.4 Distribution of research levels of ROD papers, 1988 – 95.

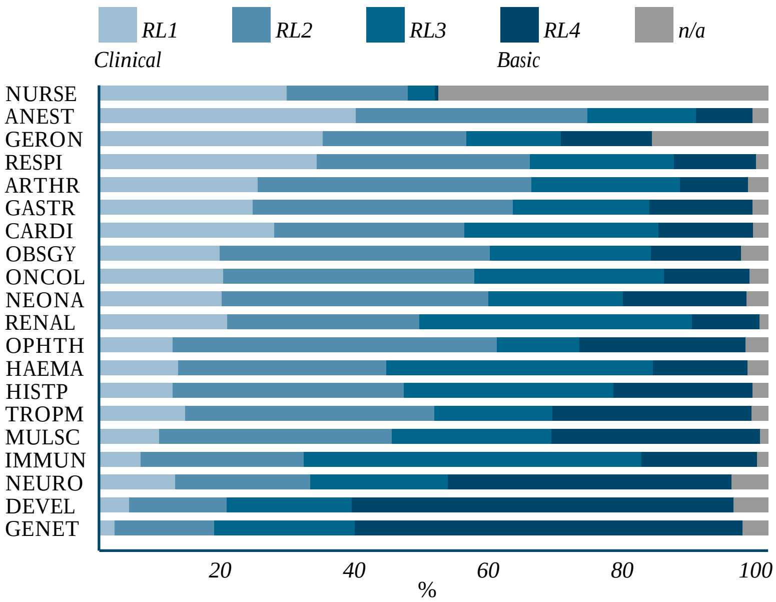

Figure 2.5 Distribution of papers in 20 selected subfields by research level (1 = clinical, 4 = basic).

Figure 2.4 illustrates the numbers of biomedical research publications in the ROD in each of these four journal research levels running from clinical observation to basic research (from RL1 through RL4).

From this figure it is possible to discern an overall reduction, in percentage terms, in the proportion of research in levels one and two and a corresponding increase in research levels three and four. In other words, there appears to have been a reduction in the proportion of clinical papers and a slight increase in the proportion of basic papers. It should be noted that citation impact increases as one moves from clinical to basic research. It is therefore likely that UK biomedical research will show an increasing impact in terms of citations.

Analysis of research levels in the different biomedical subfields (Figure 2.5) reveals that those with the highest percentages of basic research are genetics (GENET) and developmental biology (DEVEL), whilst nursing (NURSE) and anaesthesia (ANEST) involve the highest percentages of clinical research. (The nursing subfield has 49 per cent of RL data missing, mainly because CHI Research have not classified the social science journals, and gerontology 17 per cent; other subfields have 5 per cent or less missing RL data.)

2.7 Geography of national publications

For UK addresses, a simple method of unification was adopted based on postcodes (codes of letters and digits used as part of the postal address to aid in sorting mail). The map (Figure 2.6) illustrates concentrations of research published from each of the 120 UK postcode areas. The total counts, shown in Table A25 in the Appendix, exceed the number of papers published in any one year as a paper may have several addresses and thus stem from more than one postcode area. This index of collaboration rose from 20 per cent in 1988 to 27 per cent in 1995. London WC, London W, London SE and London SW,

Figure 2.6 Map of the UK showing percentage of ROD papers in each postcode area, 1988–95.

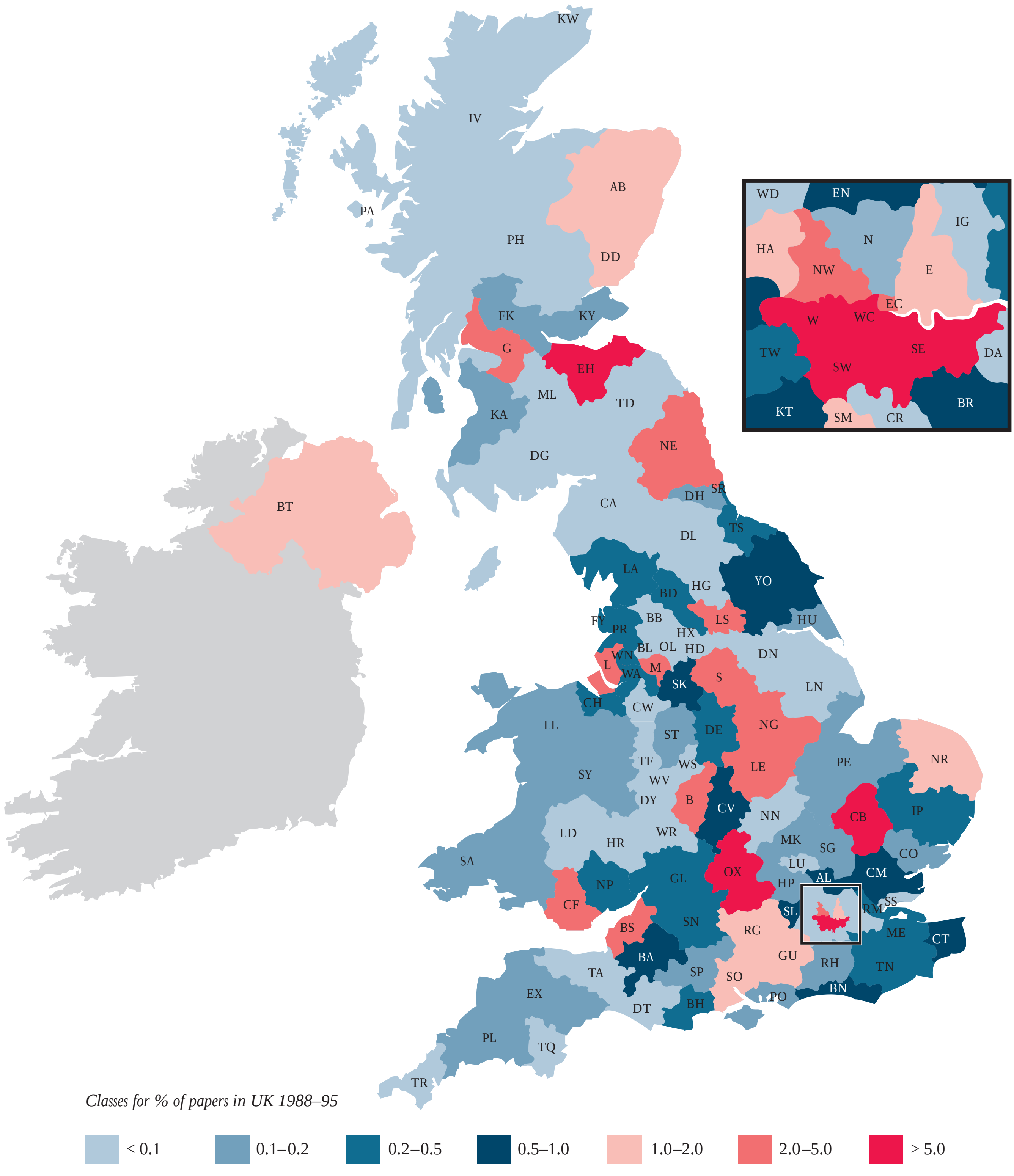

Table 2.3 List of 15 leading postcode areas, showing output and growth rate, 1988–95.

Code	City	***n*** 88–95	% of UK	AAPG
WC	London	19 663	9.17	4.38
W	London	15 605	7.28	3.32
CB	Cambridge	14 835	6.92	6.43
OX	Oxford	14 167	6.61	5.17
SE	London	12 938	6.04	4.35
SW	London	12 008	5.60	4.76
EH	Edinburgh	11 065	5.16	5.59
G	Glasgow	10 357	4.83	2.42
M	Manchester	9899	4.62	5.12
NW	London	8570	4.00	4.33
B	Birmingham	8133	3.79	3.61
BS	Bristol	6542	3.05	5.60
L	Liverpool	6447	3.01	4.50
NE	Newcastle upon Tyne	5761	2.69	5.26
CF	Cardiff	5711	2.66	2.72

Oxford (OX) and Cambridge (CB) postcode areas, often known as the ‘Golden Triangle’, evidently publish by far the largest proportions of UK biomedical research, with each area contributing well over 5 per cent. (London WC, the largest, includes University College Hospital and the Institute of Child Health.) The other area producing more than 5 per cent is Edinburgh, EH. Six other postcode areas (Glasgow, G; Manchester, M; London NW; Birmingham, B; Bristol, BS; and Liverpool, L) each account for 3 per cent or more of UK biomedical research. Postcode areas exhibiting the fastest growth are Belfast (BT) and Leicester (LE) (AAPG > 8 per cent), Dundee (DD, AAPG = 7.5 per cent) and Aberdeen (AB), Sheffield (S) and Cambridge (AAPG > 6 per cent) while the Cardiff (CF) and Glasgow areas show a relative decline in output.

Table 2.4 Papers in the ROD with foreign addresses, 1995.

Country	%
USA	7.8
Germany	2.6
France	2.4
Netherlands	1.9
Italy	1.8
Canada	1.6
Australia	1.4
Japan	1.1
Switzerland	1.1
Spain	1.0

2.8 International cooperation

Another indicator of changes in collaboration can be found from consideration of the extent to which researchers with foreign addresses are involved in what is here defined as UK research. Table A27 in the appendix shows that virtually all countries (with the notable exception of Iraq) have increased their percentage shares of papers in the ROD over the eight-year period. The top ten countries in terms of share of ROD papers in 1995 were as shown in Table 2.4. This list largely reflects the relative biomedical research output of the different countries (see for example Figure 1.7) and geographical and cultural factors.

Of these, Spain has had the largest proportional increase over the period (more than 2.5 times), followed by Japan, The Netherlands, Italy and France (all of which doubled their percentages). Among scientifically smaller countries, Portugal's presence increased by more than seven times, and Belgium, Brazil, Finland and the People's Republic of China all more than doubled their percentages of ROD papers.

Conclusions

- The number of UK biomedical research publications within the ROD increased by one-third during the period 1988–95.
- Growing evidence of larger research teams and of multidisciplinarity is indicated by the rise in the mean number of authors per paper from 3.2 to 3.8.
- There is also evidence of increasing cooperation between laboratories, with the mean number of addresses per paper rising from 1.7 to 2.0.
- Analysis of output by 'research level' reveals a modest increase in the proportion of basic (level 4) research papers (from 28 to 33 per cent) and a concomitant reduction in clinical papers.
- Analysis by subfield shows that, of the larger ones, genetics exhibits the most rapid growth followed by oncology and cardiology.
- Genetics and developmental biology are revealed as the most basic subfields, whilst nursing and anaesthesia are the most clinical.
- Geographical analysis of outputs shows that the areas of greatest output are London (five of the top ten postcode areas are in the capital), followed by Cambridge, Oxford, Edinburgh, Glasgow and Manchester.
- The fastest growth in output is in Belfast and Leicester, followed by Dundee, Aberdeen, Sheffield and Cambridge, while Glasgow and Cardiff show a relative decline.

Sources of Funding 3

3.1 Acknowledgements of funding support

The papers in the ROD were all looked up in libraries to determine their funding sources. For extramural funding this was taken from the formal acknowledgement section, following detailed guidelines (see Annex, Sections 3.3, 3.4). Intramural funding from addresses was included in the analysis: this is particularly important for Government and Research Council labs, industrial companies and charity-funded labs. The funding bodies were individually identified from a thesaurus and additionally characterized by their country and category. It proved impossible to locate a few papers (0.5 per cent for 1988–91 ones but 3.5 per cent for 1992–95 ones, mainly because some 1995 papers were processed late for the SCI and would not have been inspected until the 1996 campaign, see Section 2.1). The data have therefore been scaled up to the total number of papers in the ROD on the assumption that the missing papers would have been similar in their funding to those that were inspected.

The three main funding sectors for UK biomedical research are

- UK Government;
- UK private-non-profit;
- industry.

Each of these sectors, and some of the categories within them, are profiled in detail below. Papers that do not have an explicit acknowledgement of funding are often published from National Health Service hospitals, much of this research being of a clinical nature, see Section 3.8.

The recent reduction in the number of papers without acknowledgements (see Sections 3.2, 3.8 below) suggests that with increasing requirements for accountability authors are being encouraged more keenly to acknowledge funding sources. In practice, it has been found (Lewison *et al.*, 1995) that only seven out of eight papers actually acknowledge extramural support that has been given in significant quantity. The figures for funding sources given below are likely therefore to underestimate the amount of support actually given.

3.2 Number of funding bodies

There has been a dramatic increase in the proportion of papers acknowledging two or more funding bodies and a corresponding decrease in the proportion of papers acknowledging only one or no funders. This is shown in Table 3.1 for two four-year periods, 1988–91 and 1992–95. The mean number of funding bodies acknowledged per paper has risen from 1.13 to 1.37, and for those papers with at least one acknowledgement, it has risen from 1.85 to 2.08.

This may reflect an increase in the number of funding bodies that support biomedical research, or a relative decrease in funds avail-

Table 3.1 Percentages of ROD papers with given numbers of acknowledged funding sources, 1988–91 and 1992–95.

	88–91	92–95
0	38.9	34.3
1	32.5	29.9
2	15.6	17.7
3	7.4	9.2
4	3.1	4.6
5	1.4	2.1
6	0.6	1.0
7	0.3	0.5
8	0.1	0.3
9+	0.2	0.3
n	98 434	115 930

able and the consequent necessity to pursue several sources, or seek external collaborators. Previous studies (Maclean *et al.*, 1997, Lewison and Dawson, 1998) indicated that there was a correlation between increasing numbers of funding bodies and the potential impact of the research, higher numbers of funders generating greater impact. A possible explanation is that research proposals that have passed through the peer-review process several times may indeed be of superior quality, and give rise to better and more influential research. Expressed another way, outstanding scientists are able to obtain funding for different projects from diverse sources and then use their teams in a flexible way so their papers acknowledge multiple funding.

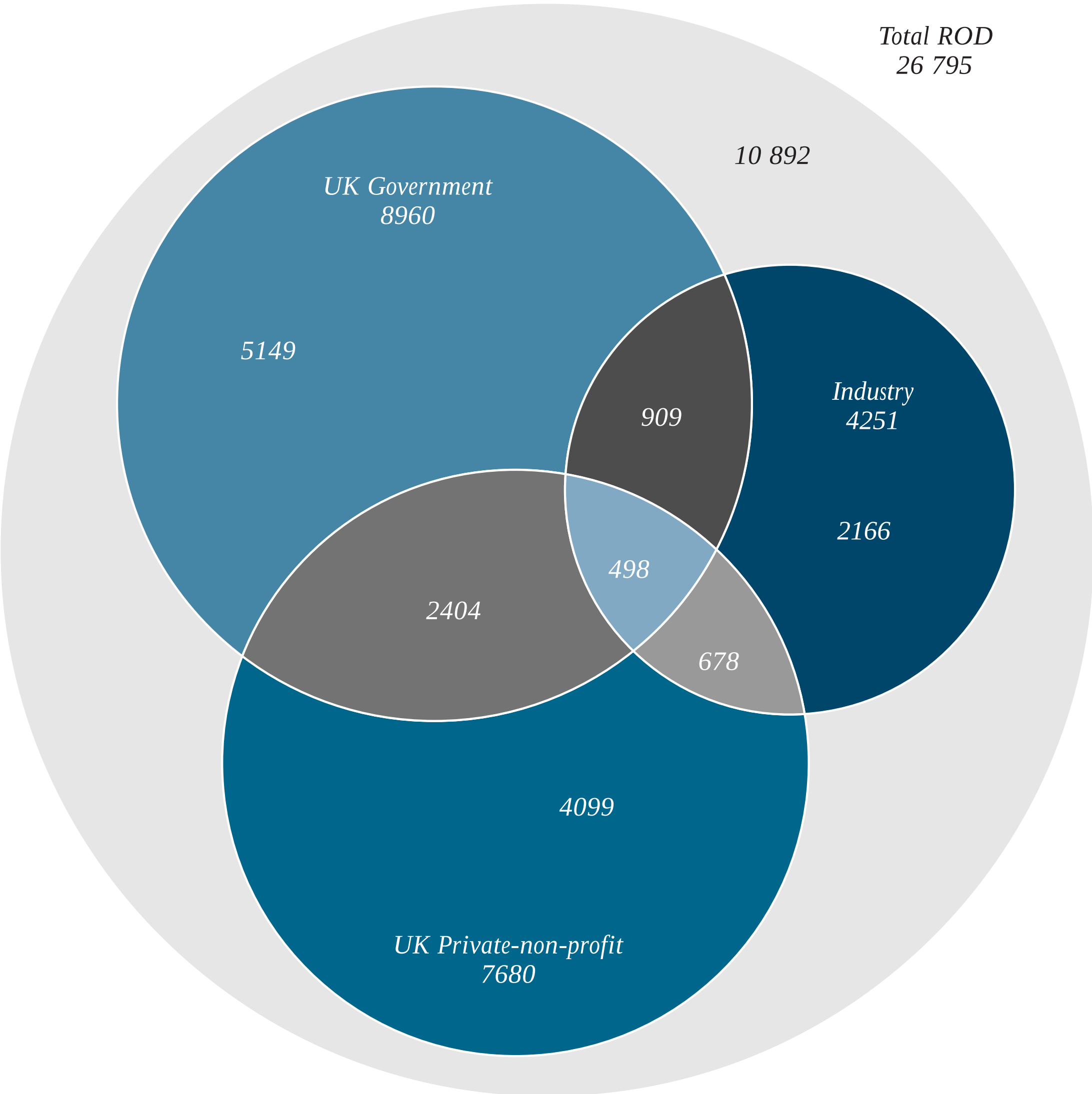

Figure 3.1 Venn diagram showing the main funding sectors for ROD papers, 1988–95 (papers per year).

Table 3.2 Numbers of ROD papers acknowledging main sectors and subsectors, 1988–95 (adjusted to allow for papers not inspected).

Year	1988	1989	1990	1991	1992	1993	1994	1995
ROD	23 354	24 087	25 228	25 765	26 916	28 195	29 772	31 047
Gov.	7903	8108	8311	8505	8937	9540	9887	10 492
RCs	5977	6172	6243	6417	6673	7029	7279	7792
P-n-p	5698	6293	6628	7138	7675	8720	9413	9877
WT	1385	1542	1692	1804	2001	2281	2669	3141
Ind.	3252	3509	3793	4020	4199	4830	5019	5388
Pharm.	2282	2481	2622	2825	2959	3330	3332	3660
Biotech.	36	57	87	140	151	176	204	213
No Ack.	9366	9285	9823	9767	9929	9525	10 095	10 158

3.3 The main funding sectors

Figure 3.1, derived from ROD data, illustrates the relative importance of each of the three main funding sectors: UK Government, UK private-non-profit, and industrial, as well as the degree of overlap between them. About 37 per cent of papers have no acknowledgement of the source of funding: these are represented by the area outside the three coloured circles, but this area also includes papers with other funding sources (e.g. international agencies).

Table 3.2 illustrates changes in shares of funding by the three main sectors over the eight-year period, with the numbers adjusted up to take account of papers that were not inspected. The performance of the major subsectors is also shown. In 1988, the UK Government contributed 33.9 per cent of all UK biomedical research funding, the UK private-non-profit sector 24.4 per cent and the industrial sector 13.9 per cent. The Government remained the largest contributor to public domain medical research in 1995 with 33.8 per cent; however the private-non-profit sector had risen substantially to 31.8 per cent and industry had also increased to a level of 17.4 per cent. Although the Government remains the largest contributor to biomedical research, the private-non-profit sector now contributes on an almost equal basis and the industrial sector is showing an increased presence.

It is also apparent from the table that the proportion of funding provided by Research Councils has remained relatively stable at 75 per cent of all Government-funded biomedical research throughout the period. By contrast, the contribution of the Wellcome Trust to the private-non-profit sector total rose from 24 per cent in 1988 to about 32 per cent in 1995. The pharmaceutical industry, although increasing by more than 60 per cent from 1988 to 1995, actually made up a slightly reduced share of the overall industrial sector, funding about 70 per cent of that sector's share of biomedical papers in 1988 and 68 per cent in 1995.

3.4 The UK Government sector

This sector includes all Government Research Councils, which are also profiled separately. Figure 3.2 confirms that Government sector contribution to biomedical research has remained relatively static, funding about 33–34 per cent of all biomedical research over the eight-year period. By far the greatest contributions come from the Research Councils, which between them are involved in 25 per cent of all UK biomedical research outputs.

The leading governmental funders are shown in Table 3.3. It is not the policy of the ROD club members to reveal the exact numbers of papers funded by individual organizations but an indication of numbers is given by means of a 'star' system. Table 3.4 shows the subfields with the five highest and five lowest proportions of papers acknowledging support from the UK Government sector. Of the latter, the subfields ONCOL and ARTHR both receive a lot of support from the charitable sector (see below); NURSE has very little research with acknowledgements.

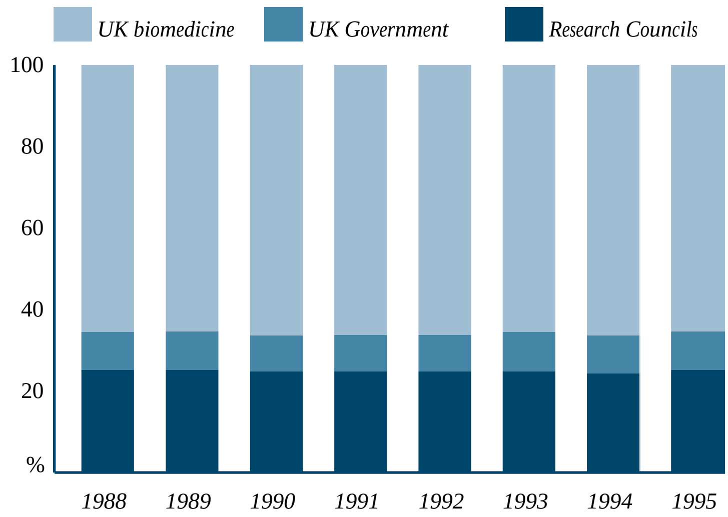

Figure 3.2 UK Government share of ROD papers, 1988–95.

Table 3.3 Top UK Government funding bodies by acknowledgement, 1995.

Name	Contribution
Medical Research Council (MRC)	★★★★★★
Biotechnology and Biological Sciences Research Council (BBSRC) including Science and Engineering Research Council (SERC) and Agricultural and Food Research Council (AFRC)	★★★★★
Department of Health (and Social Security)	★★★★
Ministry of Agriculture, Fisheries and Food (MAFF)	★★★★
Scottish Office Agriculture and Fisheries Department (SOAFD)	★★★★
Natural Environment Research Council (NERC)	★★★★
British Council	★★★★
Scottish Office Home and Health Department (SOHHD)	★★★
Engineering and Physical Sciences Research Council (EPSRC)	★★★
Overseas Development Administration (ODA) (now, the DfID)	★★★
Economic and Social Research Council (ESRC)	★★★

Contribution key

Papers, 1995	Star category
>3000	★★★★★★
1001–3000	★★★★★
301–1000	★★★★
101–300	★★★
31–100	★★
11–30	★

Within the UK Government sector, the large majority of papers are supported by one of the Research Councils. These were reorganized in 1994 into six:

- Biotechnology and Biological Sciences Research Council;
- Economic and Social Research Council;
- Engineering and Physical Sciences Research Council;
- Medical Research Council;
- Natural Environment Research Council;
- Particle Physics and Astronomy Research Council;

but acknowledgements were also found to two former research councils whose functions have been largely taken over by the BBSRC:

- Agricultural and Food Research Council;
- Science and Engineering Research Council.

Figure 3.3 indicates that the majority of research funded by the Research Councils is of a basic nature and the proportion of this type of research (RL4) has increased significantly (by 7 percentage points) over the period. In 1988 there was a ratio of 10:1 between RL4 and RL1 papers and in 1995 this ratio had increased to 14:1. The Research Councils, proportionately, were funding far more basic than clinical/applied research.

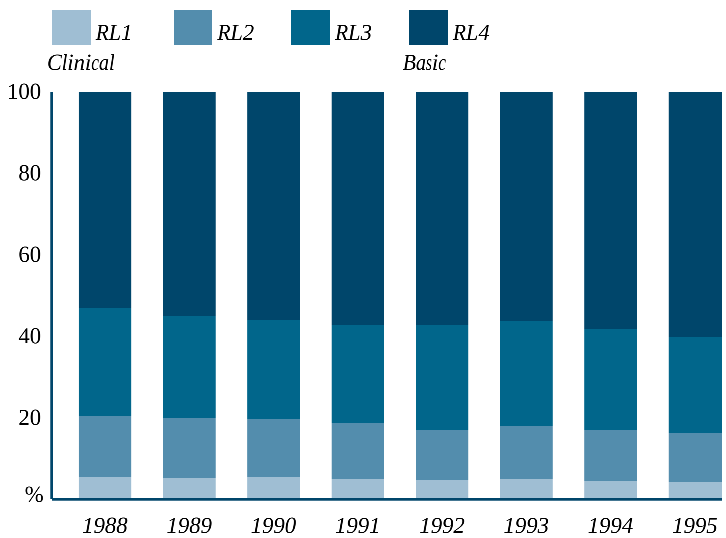

Figure 3.3 Distribution of Research Council-funded research by research level, 1988–95.

Table 3.4 Subfields ranked by the percentage of papers in them acknowledging support from UK Government.

Top five Code	%	Bottom five Code	%
GENET	52	ONCOL	20
DEVEL	48	ARTHR	20
TROPM	41	CARDI	19
IMMUN	40	NURSE	18
NEURO	38	ANEST	15

Table 3.5 Subfields ranked by the percentage of papers in them acknowledging support from Research Councils.

Top five Code	%	Bottom five Code	%
GENET	46	ONCOL	14
DEVEL	42	CARDI	14
NEURO	34	RENAL	13
IMMUN	31	ANEST	10
TROPM	30	NURSE	5

3.5 The UK private-non-profit sector

The UK private-non-profit sector includes those funding organizations falling into one of the following categories (see Table A31):

- Charities: organizations collecting money;
- Foundations: endowed organizations or dependent on a single source;
- Hospital trustees, including independent charities associated with one hospital;
- Mixed (mainly university funds);
- Other not-for-profit: mostly not primarily involved in medical research.

The Wellcome Trust is the largest UK member of the biomedical private-non-profit sector and it is profiled separately below. From Figure 3.4 the private-non-profit sector is seen to have increased from supporting 24.4 per cent of all biomedical research in 1988 to as much as 31.8 per cent in 1995 – an increase of over 7 percentage points. This sector is now involved in supporting almost a third of all UK biomedical research.

The subfields of greatest and least interest to the private-non-profit sector (Table 3.6) in

Table 3.6 Subfields ranked by the percentage of papers in them acknowledging support from the UK private-non-profit sector.

Top five Code	%	Bottom five Code	%
MULSC	61	RENAL	28
ONCOL	46	GASTR	26
GENET	45	GERON	26
DEVEL	44	ANEST	16
ARTHR	42	NURSE	14

Table 3.7 Subfields ranked by the percentage of papers in them acknowledging support from the Wellcome Trust.

Top five Code	%	Bottom five Code	%
TROPM	26	OBSGY	6
MULSC	16	GERON	6
NEURO	15	ANEST	5
IMMUN	13	ONCOL	3
DEVEL	12	NURSE	1

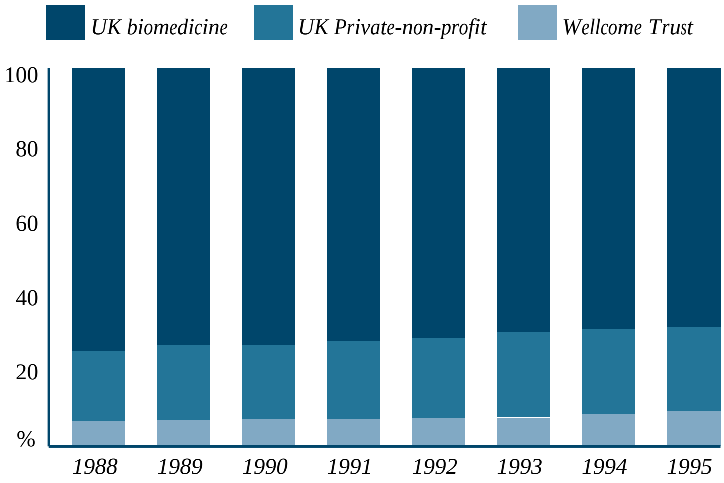

Figure 3.4 Percentage of private-non-profit-funded research papers in the ROD.

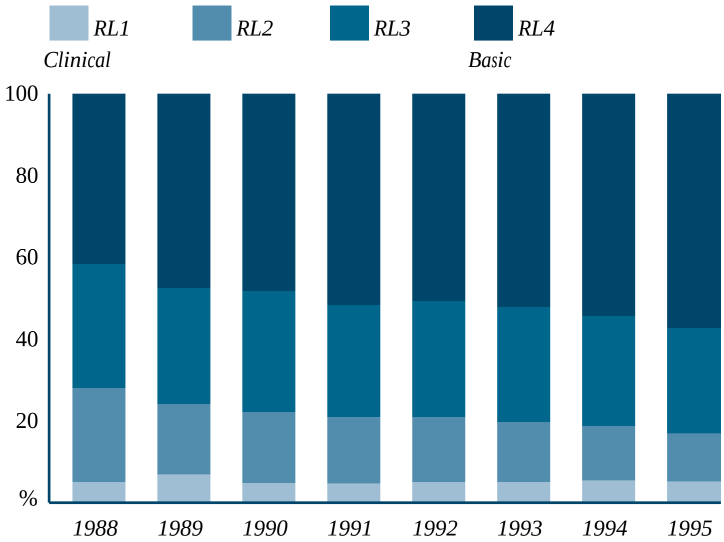

Figure 3.5 Research level distribution of Wellcome Trust-funded research.

part reflect the possibilities of obtaining funds from the public. Multiple sclerosis, cancer and arthritis all have popular appeal, and medical charities are active in the fundamental subfields of genetics and developmental biology (see Table A32). On the other hand, renal medicine and gastroenterology have only small specialist medical research charities, and gerontology and nursing do not attract much research support.

Within the UK private-non-profit sector (see Table A31), there have been rises not only in the numbers of papers supported by collecting charities (up from 13.9 to 16.6 per cent of all ROD papers) but also those funded by hospital trustees (up from 2.4 to 3.7 per cent in 1994, but with a dip to 2.5 per cent in 1995) and by mixed sources, mainly academic own funds (from 1.6 to 2.5 per cent). Over the same period, Wellcome Trust-funded biomedical research has more than doubled, with a rise from 6 to 10 per cent between 1988 and 1995 and an increase of almost one-fifth in its numbers of papers in the last year. Its most favoured and least favoured subfields, in terms of volume of output, were as shown in Table 3.7.

The pattern of support from the Trust is quite different from that of the medical collecting charities who comprise most of the rest of the sector (see also Table A32). It should be noted that the Wellcome Trust, as a matter of policy, "does not normally consider support for cancer research (as funds are available from other sources) or the care of patients" (*Grants and Support for Biomedical Research*, 1997). The distribution of Trust-funded papers by research level is shown in Figure 3.5. It shows a substantial increase in the proportion of papers published in more basic journals (RL4) over the period. In 1988 there was a ratio of 8:1 between RL4 and RL1 papers and by 1995 this ratio had increased to 11:1. This is similar to the Research Council profile described above, but not quite so basic.

3.6 The industry sector

The industry-funded sector is dominated by the pharmaceutical industry, defined here as companies licensed to manufacture and sell medicines. However, it also contains some substantial non-pharmaceutical organizations such as Unilever, Amersham International (now Nycomed Amersham), Novo Nordisk and Shell. It should be noted that because of the international nature of industrial operations all such organizations worldwide are included. Many foreign pharmaceutical companies, for example, now have laboratories that both support and carry out work in the UK.

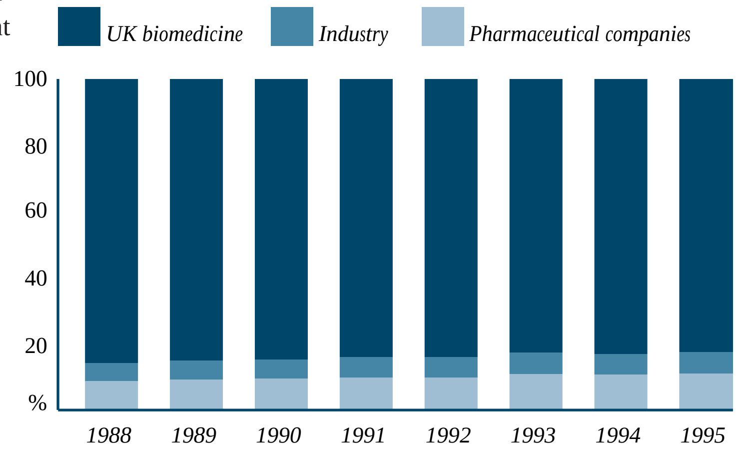

Figure 3.6 Percentage share of ROD papers funded by industry, 1998–95

Table 3.8 Leading UK private-non-profit sector funding organizations, 1995.

Contribution key

Papers, 1995	Star category
>3000	★★★★★★
1001–3000	★★★★★
301–1000	★★★★
101–300	★★★
31–100	★★
11–30	★

Name	Contribution
Wellcome Trust	★★★★★
Cancer Research Campaign (CRC)	★★★★★
Imperial Cancer Research Fund (ICRF)	★★★★
British Heart Foundation (BHF)	★★★★
Royal Society	★★★★
Arthritis Research Campaign (ARC)	★★★★
Leukaemia Research Fund	★★★
Action Research	★★★
Nuffield Foundation	★★★
British Diabetic Association (BDA)	★★★
Leverhulme Trust	★★★
Lister Institute of Preventive Medicine	★★

Table 3.9 Leading pharmaceutical companies funding UK research, 1995.

Name	Contribution
Glaxo plc	★★★★
Zeneca plc	★★★★
SmithKline Beecham plc	★★★★
Wellcome Foundation/Wellcome plc	★★★★
Merck and Co. Inc.	★★★
Sandoz Pharmaceuticals SA	★★★
Pfizer (formerly Invicta) Pharmaceuticals Ltd	★★
Fisons plc	★★
Eli Lilly and Co Inc	★★
Bristol-Myers Squibb Inc.	★★
Warner Lambert Co Inc.	★★
Pfizer Inc.	★★
CIBA-Geigy AG	★★
Hoffmann-La Roche sa	★★
Roche Products Ltd	★★
Kabi Pharmacia/Farmitalia	★★

Table 3.10 Subfields ranked by the percentages of papers in them acknowledging support from industry.

Top five		Bottom five	
Code	%	Code	%
TROPM	26	MULSC	10
ANEST	20	DEVEL	10
CARDI	18	HISTP	9
NEURO	17	OPHTH	8
RESPI	17	NURSE	5

Table 3.11 Subfields ranked by the percentage of papers in them acknowledging support from the pharmaceutical industry.

Top five		Bottom five	
Code	%	Code	%
ANEST	15	HISTP	6
CARDI	14	MULSC	6
NEURO	14	DEVEL	5
RESPI	13	OPHTH	4
ARTHR	12	NURSE	3

Table 3.12 Subfields ranked by the percentages of papers in them acknowledging support from the UK biotechnology subsector.

Top five	
Code	%
IMMUN	1.14
GENET	0.70
ONCOL	0.69
CARDI	0.47
NEURO	0.29

Industrial sector funding has risen substantially over the period, from 13.9 per cent in 1988 to 17.4 per cent in 1995. The pharmaceutical industry's contribution has been approximately 70 per cent, which is about 11 per cent of all biomedical research over the period, rising from 10 per cent in 1988 to 12 per cent in 1995. There has been an increase of industrial funding of UK research of 66 per cent over the period and an increase in pharmaceutical funding of 60 per cent. This reflects increasing contributions by other industry subsectors including UK biotechnology firms whose acknowledgements have risen almost six-fold over the period (see Table 3.2). Both the pharmaceutical and UK biotechnology subsectors are described in more detail below.

Table 3.10 shows the leading subfields in terms of industrial funding. The high position of tropical medicine in this list is because the World Bank has been classified as a bank, and therefore as industry, since it raises its capital primarily on the world financial markets and not from taxpayers.

Table 3.11 shows the subfields most and least supported by the pharmaceutical industry. These are similar to those for all industry (Table 3.10), with the exception of tropical medicine, which does not seem to attract the pharmaceutical companies.

The UK biotechnology subsector is still quite small in comparison with that in the USA, but it is growing rapidly, with a number of companies achieving a full listing on the London Stock Exchange as a result of the relaxation of the requirements (see the list in Table A38). The leading ones are Celltech plc, British Biotech plc, Scotia Pharmaceuticals plc and Axis Genetics. Table 3.2 shows a large increase in the numbers of papers produced by the subsector, its percentage share rising from 0.15 per cent of the ROD to 0.7 per cent. For these small firms, publication is particularly important as it is a prime means of attracting the attention of the scientists in the large companies with whom they hope to make licensing deals.

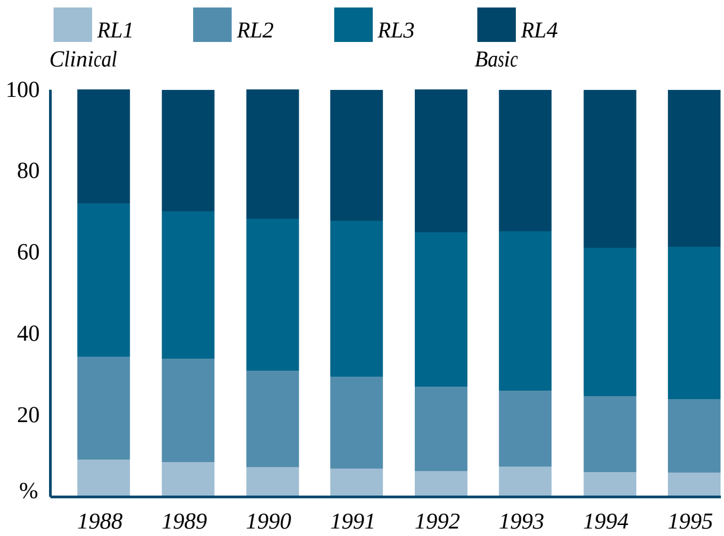

Figure 3.7 Research levels of papers funded by the pharmaceutical industry, 1988–95.

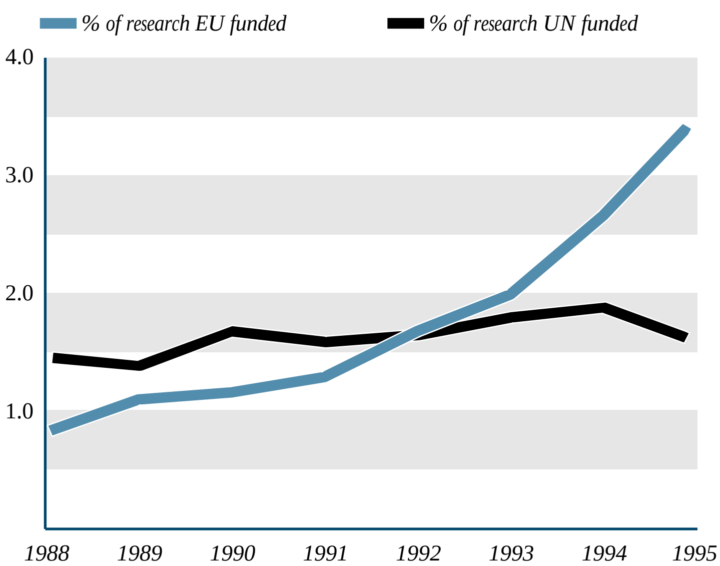

Figure 3.8 European Union and United Nations funding shares of ROD papers, 1988–95.

Table 3.12 shows that the UK biotech industry is concentrating its efforts on the large subfields with relevance to the development of new pharmaceuticals.

3.7 International funding

The USA was the largest overseas provider of funds for UK-based research (measured in terms of the quantity of acknowledging papers), contributing to some 10 per cent of research publications in 1995. The other countries, in order of their contributions in 1995, included Germany (2.8 per cent); France (2.3 per cent); Switzerland (1.7 per cent); Australia (1.3 per cent); Italy (1.2 per cent); Japan and Canada (1.1 per cent); and The Netherlands and Sweden (1.0 per cent). The European Union contributed to 3.5 per cent of all UK biomedical research, and the percentage quadrupled in eight years (see Figure 3.8) whilst the United Nations contributed to 1.6 per cent and this percentage remained approximately static. If these data on funding are compared with those for international co-authorship (Table 2.4), it is clear that largely the same countries co-author as co-fund, suggesting that foreign co-authors bring their funding with them.

Table 3.13 Countries co-authoring and co-funding ROD papers, 1988–95.

Code	Country	% with address	% with funding	Ratio
CH	Switzerland	0.88	1.64	1.86
US	USA	6.39	8.86	1.39
BR	Brazil	0.29	0.36	1.24
DE	Germany	2.02	2.34	1.16
SE	Sweden	0.91	1.05	1.15
FR	France	1.80	1.86	1.03
DK	Denmark	0.64	0.55	0.86
ES	Spain	0.70	0.59	0.84
JP	Japan	0.74	0.62	0.84
PT	Portugal	0.13	0.10	0.77
CA	Canada	1.17	0.86	0.74
BE	Belgium	0.69	0.49	0.71
AU	Australia	1.08	0.72	0.67
FI	Finland	0.31	0.21	0.67
IT	Italy	1.42	0.86	0.60
GR	Greece	0.21	0.12	0.57
NZ	New Zealand	0.27	0.15	0.55
NO	Norway	0.28	0.15	0.54
NL	Netherlands	1.36	0.71	0.52
IE	Ireland	0.33	0.13	0.41

However, there are some notable differences as Table 3.13 reveals.

European Union countries with ratios below 1.00 are mostly getting EU funding (there are nine of them in the above table, and NO = Norway also participates in EU COST programmes which are quite important in the medical field). The leading countries in terms of ratio are the ones with strong international pharmaceutical industries, with the exception of Brazil, whose presence is probably due to its policy of sending people abroad to do doctoral and postdoctoral training.

3.8 Unacknowledged papers

From 1988 to 1995, there was a reduction from 40 to 33 per cent in the number of ROD papers without acknowledgements. Table 3.14 shows the subfields with the highest and lowest proportions of such papers and Table A41 in the Appendix examines their provenance. For most of the subfields, the large majority of the papers stem from National Health Service hospitals. The exceptions are developmental biology, genetics, nursing research and tropical medicine, where most of the papers come from universities and medical schools: tropical medicine is clearly of secondary interest to the NHS.

Much of this unacknowledged research is of a clinical nature (see Figure 3.9): two-thirds of the papers are classed as clinical observation or clinical mix (RL = 1, 2). Given that clinical papers tend to lack funding acknowledgements, the decline in the percentage of papers without acknowledgements is not surprisingly correlated with the overall trend of UK biomedical research becoming more basic (see Figure 2.4).

Table 3.14 Subfields ranked by the percentage of papers in them that have no acknowledgements.

Top five		Bottom five	
Code	%	Code	%
NURSE	67	IMMUN	24
ANEST	58	MULSC	23
RENAL	49	TROPM	21
GERON	48	DEVEL	18
GASTR	46	GENET	14

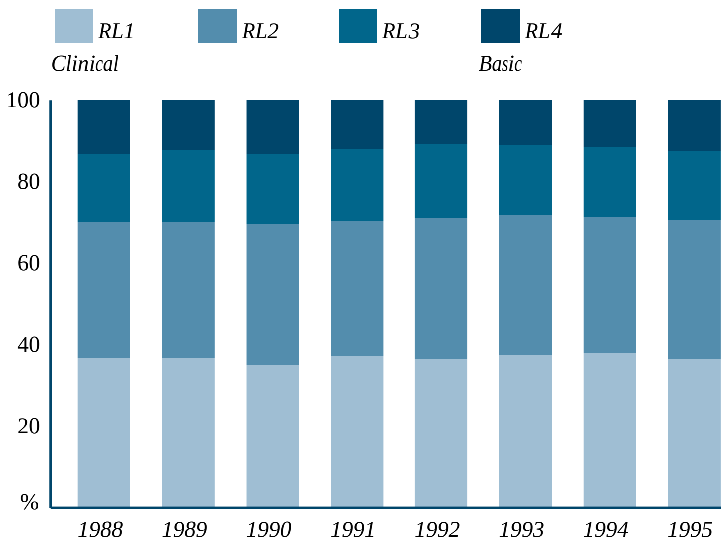

Figure 3.9 Research levels of papers without acknowledgements, 1988–95.

Conclusions

- The three main funding sectors for UK biomedical research are the UK Government, UK private-non-profit and industry.
- The Government share has remained stable at 33 per cent of papers of which three-quarters acknowledged the Research Councils. These are predominantly basic and have become more so.
- Papers acknowledging the private-non-profit sector have increased from 24 to 32 per cent between 1988 and 1995. Increased spending by the Wellcome Trust has been a significant factor in the growth of this sector and its share of papers rose from 6 to 10 per cent. Its papers have also become more basic over the period.
- Papers acknowledging industrial funding have increased from 14 to 17 per cent. Most of these are from the pharmaceutical industry.
- About 37 per cent of papers have no funding acknowledgement. Most come from National Health Service hospitals and the percentage has declined although the actual numbers have increased.
- There has been a marked increase in the number of papers making multiple funding acknowledgements. This has important implications for the different individual funding bodies because such papers tend to have more impact.
- Subfields vary widely in their capacity to attract grant funding, corresponding to their mean research levels (the more basic ones acknowledging funding more often).
- The highest proportions of papers acknowledging Government funding are in genetics and developmental biology.
- The private-non-profit sector is most often acknowledged on multiple sclerosis and oncology papers, although for the Wellcome Trust, it is in tropical medicine.
- In the industrial sector, tropical medicine again has the highest percentage of funding, followed by anaesthesia, whereas the pharmaceutical subsector is also often acknowledged by cardiology and neuroscience papers. The biotechnology subsector's highest level of support is for immunology.

- Two-thirds of papers in the nursing subfield have no funding acknowledgement, but only one-seventh of papers in genetics.
- Foreign funding is dominated by the USA (8.9 per cent), followed by Germany, France, and Switzerland.
- European Union funding increased significantly from 0.8 to 3.5 per cent between 1988 and 1995 while United Nations funding averaged 1.6 per cent and remained fairly constant.

4 Measuring Impacts

4.1 Introduction

Accountability, as far as biomedical science-funding bodies are concerned, can be defined in terms of how funded research feeds through to the welfare of society through health and wealth creation. Wealth might be reflected in the development of, for example, new pharmaceuticals, diagnostic reagents or other medical technology. Health benefits, however, are manifest in better patient care and preventative measures based on regulation or advice. The development of the ROD is invaluable in providing the starting point for tracing the complex network of interactions that lead from research publications to measurable benefits. Such work is currently in its early stages.

For impacts on wealth creation some preliminary patent citation indicators are presented below in Section 4.3. The routes to health creation may be considered in terms of research papers leading to, for example:

- improved medical education and training;
- better clinical care based on clear evidence-based guidelines and recommendations;
- new techniques for diagnosis and treatment.

However, in the absence of such information, the effect of research on other researchers is used here as a surrogate measure of benefit. It may reflect the importance or quality of the research *qua* research but it is not necessarily an indicator of clinical utility.

Such investigations seek to determine the impact of biomedical publications either by counting the number of references, or citations, to individual papers, or by determining the impact category of the journals in which the papers appear. For this evaluation process, the considered decisions of editors and reviewers replace the more heterogeneous process of citation by other scientists as a measure of esteem. The impact category is the one used in *Mapping the Landscape*. This is partly because it yields more immediate results (it takes some years for citations to accumulate to give a reliable estimate of impact) but also because it is much less costly for the evaluation of large numbers of papers.

4.2 Journal impact factors

In this study, each journal was assigned a weighting or ‘W’ value indicating the potential impact of a paper from a journal, with W = 4 being high potential impact (the top-rated 10 per cent of journals) and W = 1 low potential impact (the bottom 40 per cent of journals). [More details of the methodology are given in Section 1.3 in the Annex.] These measures were used in preference to ‘raw’ impact factors (average numbers of citations in a given time period to papers published in a journal) because they are more likely to reflect the perceptions of scientific administrators and medical researchers. [In two separate polls (Lewison, 1996, 1998) they voted the relative importance of papers in ‘excellent’ journals about five to six times that of papers in ‘ordinary’ journals, and that of papers in ‘good’ journals about two to three times that of the latter.]

However, the set of journal W values for each subfield of biomedical research was based on a different ‘core’ set of journals. For example, for a paper to be classified as W = 4 in the field of multiple sclerosis, its journal impact factor would need to exceed 45 citations over a five-year period. In nursing research, on the other hand, a ‘W = 4’ journal would only need a five-year impact factor of 10.5 citations. It is not therefore possible to compare an average W value for a given funding sector in one subfield with that for another subfield. All the W values are subfield specific and the average figure for the different funding sectors may only be compared within subfields.

Table A42 in the Appendix shows that, according to this scheme, the five highest impact subfields are multiple sclerosis, genetics,

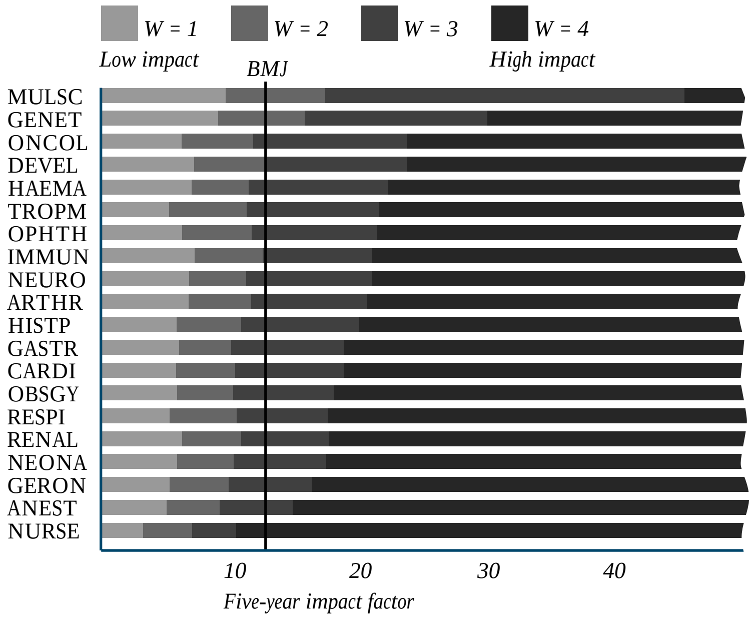

Figure 4.1 Graph showing distribution of five-year impact factors determining W values for 20 subfields.

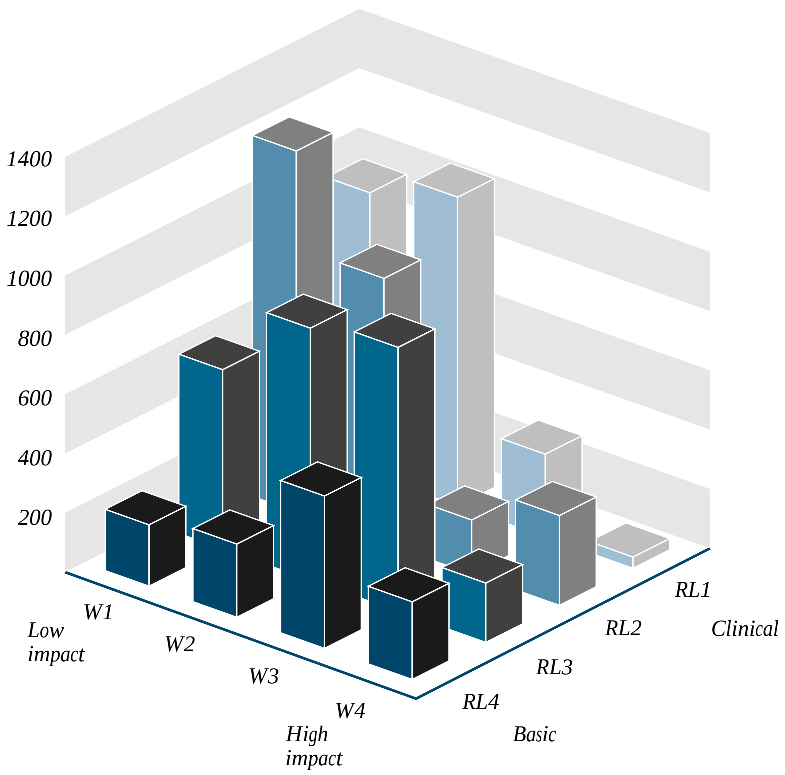

Figure 4.2 Example of a carpet plot to illustrate where average W and RLs are derived from, cardiology research 1988–91.

developmental biology, oncology and haematology, whilst the lowest five are respiratory medicine, neonatology, gerontology, anaesthetics and nursing research. For illustrative purposes Figure 4.1 shows the relative five-year impact factors determining impact categories for each subfield, and how papers in the *BMJ* (formerly the *British Medical Journal*), which has a five-year impact factor of 13, would be ranked within the different 'value systems' in each subfield.

From Figure 4.1 it can be seen that for the multiple sclerosis subfield, the *BMJ* would be classed as having weighting W = 2, whereas for gastroenterology it would be W = 3, and for nursing it would be W = 4.

Comparison with data in section 2.6 shows that the subfields with highest impact are also the most basic in terms of research level (RL). Using the combinations of W and RL data, profiles of the research in each subfield may be displayed which indicate the number of papers falling into each of sixteen cells (W = 1–4 x RL = 1–4). These are referred to as 'carpet plots' and show the numbers of papers in, for instance, the category of RL = 1, W = 1 (clinical observation papers in low impact journals) and all the other RL–W combinations. An example of one such carpet plot, for UK cardiology research in 1988–91, is shown in Figure 4.2. The mean value of RL for the 8684 papers is 2.31 and the mean value of W is 2.06.

The portfolio of papers funded by the different sectors can conveniently be evaluated by plotting the difference between the mean W for the sector and the mean W for all UK-funded papers (see Table A50), against the difference between the mean RL for the sector and the mean RL for the UK (also shown in Table A50). Figures 4.3–4.5 show such plots for the Research Councils, the Wellcome Trust and the pharmaceutical industry, respectively, with the data taken from Tables A44, A46 and A48.

Figure 4.3 shows that Research Council-funded research is all more basic than the average for funded papers, although the subfield characteristics vary. The plot also reveals the characteristics of each Research Council-funded subfield. For this funding subsector, the most clinical subfield relative to all UK-funded papers is multiple sclerosis, while the most basic is ophthalmology. The papers are also consistently published in higher impact journals than the UK mean. Research in multiple sclerosis, gerontology, anaesthesia and ophthalmology has relatively the highest impact relative to UK-funded papers, while the Research Councils' gastroenterology, neonatology and genetics papers have a low impact relative to their overall portfolios.

Figure 4.4 indicates that Wellcome Trust-funded research also has relatively high W and RL values, being more basic than the UK mean for funded papers in all subfields. Genetics, for example, although a very basic subfield, is relatively clinical in terms of Trust-supported papers. By contrast, anaesthesia is at the basic end of the spectrum, relative to the overall Wellcome Trust portfolio. Research in multiple sclerosis is of relatively low impact; the best relative performances of Trust-funded researchers being in haematology, developmental biology, ophthalmology and gerontology. Such analysis provides the Wellcome Trust (and, through the ROD, other individual funding bodies) with a powerful means of tracking the performance of researchers in different subfields.

The overall characteristics of pharmaceutical industry-funded research are rather different, with a more clinical profile. For this sector, ophthalmology is the most clinical subfield relative to the UK, with nursing the most basic (although it is, overall, a clinical subfield). Most of the other subfields are very close to the UK average in research level and slightly above it in terms of journal impact. The exception is neonatology, where impact is relatively high.

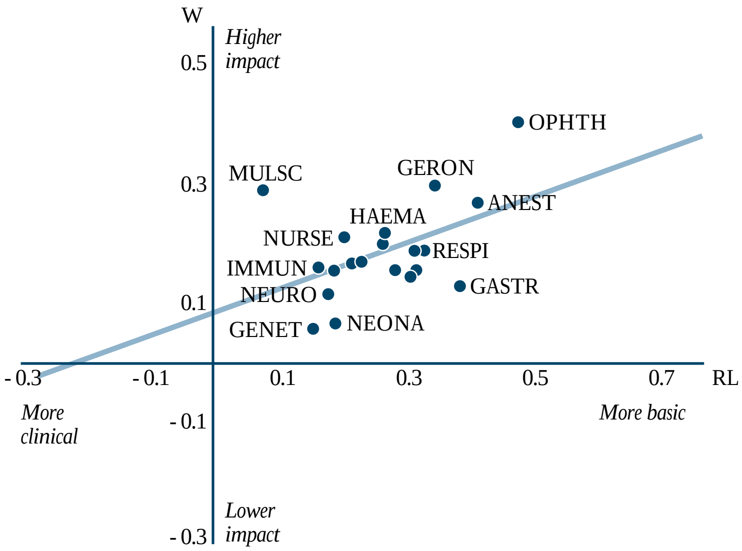

Figure 4.3 Research Council (mainly MRC/BBSRC) subfields – differences in average W/RLs from all funded papers.

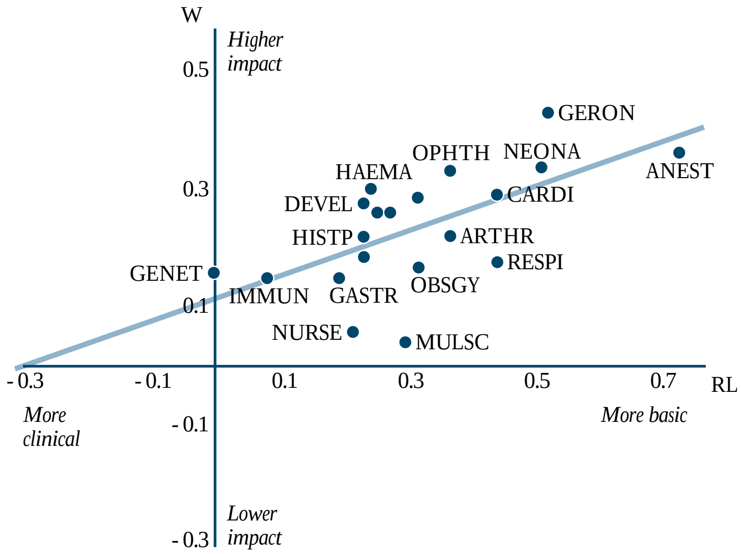

Figure 4.4 Wellcome Trust subfields – differences in average W/RLs from all funded papers.

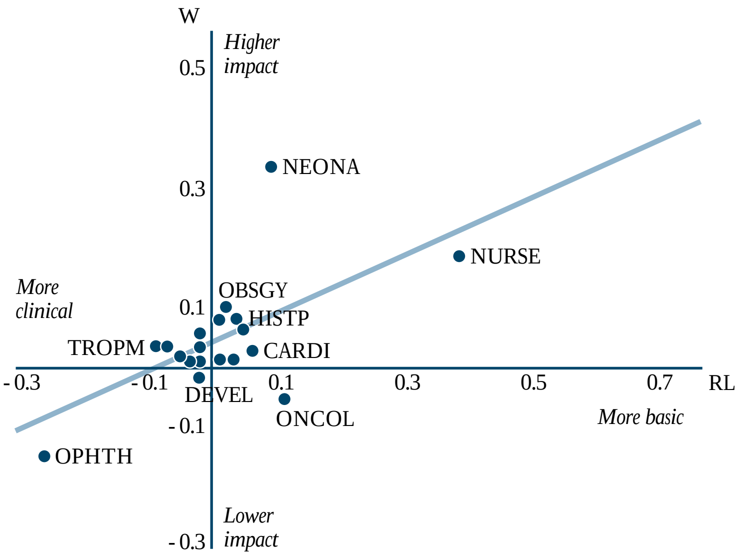

Figure 4.5 Pharmaceutical industry subfields – differences in average W/RLs from all funded papers.

Comparisons across the subfields are made in Tables A43–A51 in the Appendix and results for five subfields are presented, by way of examples, in Figures 4.6–4.10. Figure 4.6 shows cardiology, an area of research that deals with a major cause of mortality. Figure 4.7 shows multiple sclerosis research, a small subfield that is both highly specialist and basic in character. Figure 4.8 shows genetics; this is a rapidly expanding subfield, comprising largely basic research, with many funding acknowledgements. Figure 4.9 shows oncology. This subfield receives a high level of funding from the private-non-profit sector, particularly from the cancer charities. Finally, Figure 4.10 shows the situation in tropical medicine. This is a subfield of particular interest to the Wellcome Trust and is one of UK strength.

Overall, the results from Tables A43 and A45 show that the UK private-non-profit sector tends to fund higher impact research than the UK Government sector (which also includes Health Service laboratories and departments of state) in 15 out of 20 subfields. Tables A43 and A47 show that the Government sector in turn mostly funds higher impact research than does industry (in 14 out of 20 subfields). The pharmaceutical subsector (Table A48) tends to fund research of higher potential impact than the industrial sector as a whole. The figures and tables indicate that research carrying no acknowledgements (Table A51), situated at the bottom left of each of the plots, is characteristically clinical and of low impact. Overall, the Wellcome Trust funds research of the highest potential impact, that is it is ranked ‘top’ for W within a subfield most frequently. However, in multiple sclerosis and nursing research it is only ranked fourth. Where the Wellcome Trust is not ranked highest (in multiple sclerosis, ophthalmology, immunology and respiratory medicine research) it is bettered in terms of average potential impact by Research Council-funded research.

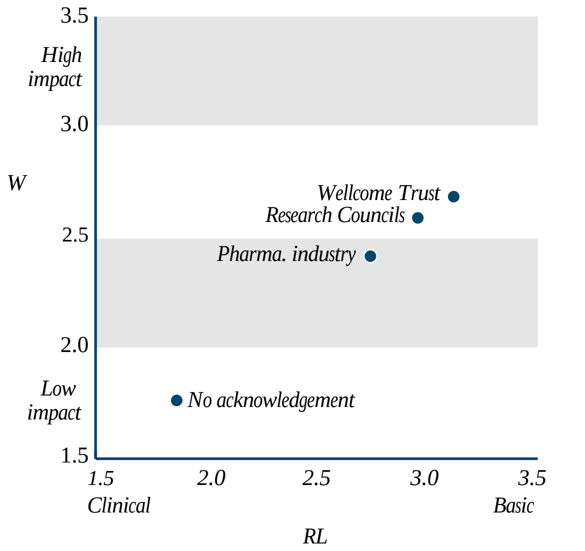

Figure 4.6 Scatterplot of mean W plotted against mean RL for cardiology for differently funded papers.

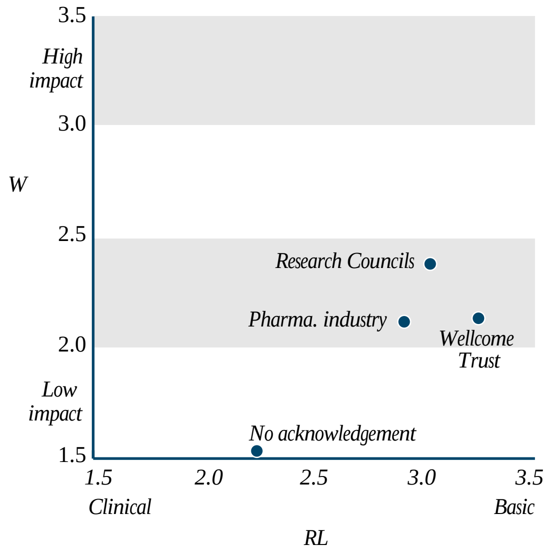

Figure 4.7 Scatterplot of mean W plotted against mean RL for multiple sclerosis research for differently funded papers.

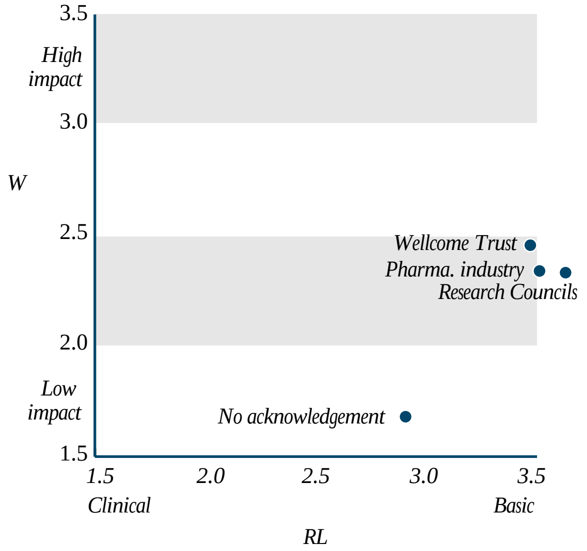

Figure 4.8 Scatterplot of mean W plotted against mean RL for genetics for differently funded papers.

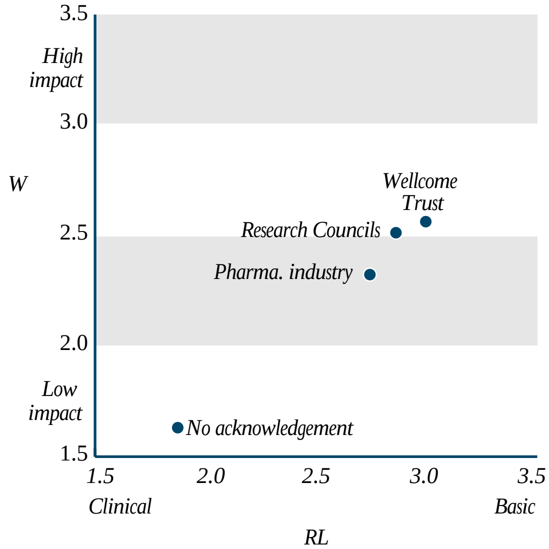

Figure 4.9 Scatterplot of mean W plotted against mean RL for oncology for differently funded papers.

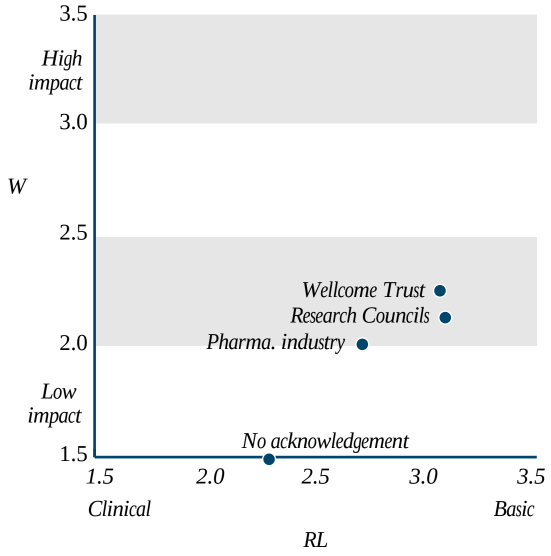

Figure 4.10 Scatterplot of mean W plotted against mean RL for tropical medicine for differently funded papers.

4.3 Citations on patents

As indicated in section 4.1, citations on patents are a potent measure of the relevance of research to wealth creation. TechTrac, an in-house database of the Wellcome Trust, was developed to link biomedical research publications to the US patents that cite these papers as ‘prior art’, that is, the research that has formed the basis for the development of a new and novel product. This may be, for example, a novel piece of medical monitoring equipment or a new pharmaceutical drug. The database links any UK-authored biomedical papers contained in the ROD with US patents filed from 1983 through to October 1996. Cited research papers may then be profiled in a similar fashion to other groups of papers, for example by research level (from clinical to basic), impact factor (citation scores from low to high), year, funding body and subfield. The citing patents may also be analysed by year, the patent owners (assignees) and their inventors (Seemungal and Ginns, 1998). In performing such a comprehensive analysis, we are able to define the impact that UK biomedical research has made on the US patent system, and within that context the impact that some of the major funding bodies, such as the Wellcome Trust, have had. This work is still at a preliminary stage, and only some early results are presented here.

Table 4.2 ROD papers 1988–94 referenced on US patents from 1988–96, ranked by percentage of UK inventors on the citing patents.

Subfield	Papers cited	% cited	Citing pats	With UK inv.	%UK invented
GASTR	180	1.39	224	35	15.6
NEONA	36	1.05	40	6	15.0
NEURO	322	1.49	371	54	14.6
ONCOL	295	1.74	327	36	11.0
ARTHR	110	1.92	129	12	9.3
ANEST	70	1.24	98	9	9.2
GENET	563	3.27	637	56	8.8
HAEMA	213	2.04	268	19	7.1
IMMUN	492	3.29	519	34	6.6
RESPI	127	1.48	131	8	6.1
CARDI	260	1.58	293	17	5.8
OBSGY	115	1.11	125	7	5.6
TROPM	69	1.85	55	3	5.5
GERON	36	1.12	43	2	4.7
HISTP	73	0.96	91	4	4.4
DEVEL	99	1.89	93	4	4.3
RENAL	27	0.65	33	1	3.0
OPHTH	41	0.89	39	0	0.0
MULSC	11	1.77	7	0	0.0
NURSE	1	0.05	1	0	0.0

The data in Table 4.2 confirm previous research (Narin *et al.*, 1997) that patents tend to cite basic rather than clinical papers. For example the subfields genetics and immunology are the most cited (3.3 per cent of papers are cited by US patents). Overall, not many patents have UK inventors (about 9 per cent) although there is a wide variance between subfields. The subfields with the highest numbers are genetics and neuroscience, while those with the highest percentage are gastroenterology, neonatology and neuroscience (about 15 per cent).

Conclusions

- Indicators based on journal impact factors, grouped for analysis into four categories, show that the five highest impact subfields are multiple sclerosis, genetics, developmental biology, oncology and haematology. These are also the most basic in terms of research level.
- The lowest impact subfields are respiratory medicine, neonatology, gerontology, anaesthetics and nursing research.
- Research Council-funded research is relatively basic in character and published in higher-impact journals than the average for UK-funded papers.
- Wellcome Trust-funded research is also rather basic and appears in high-impact journals, but the subfields of high and low relative impact are different from those supported by the Research Councils.
- Industry-funded research tends to have a more clinical profile. Most subfields have an impact similar to that of all UK-funded papers.
- Research without funding acknowledgements is relatively clinical and of low impact in all subfields.
- Citations to UK biomedical research papers from US patents reveal the subfields of greatest impact on technology. These patents tend to cite basic rather than clinical papers.
- Papers in the subfields genetics and immunology are most commonly cited on US patents.
- The subfields featuring the highest proportion of UK inventors on citing US patents are gastroenterology, neonatology and neuroscience.

5 Discussion and Policy Issues

5.1 Introduction

Biomedical science is now changing at an unprecedented rate, and it becomes increasingly complex and expensive as our depth of knowledge expands. To achieve deeper levels of understanding requires the development of new techniques or the design and fabrication of new pieces of equipment that have the capability of probing into the details of processes that were inaccessible to the previous generation of scientific researchers.

For more than a decade, however, the question of public spending distribution has dominated much political debate in developed countries. Scientific research, being intrinsically expensive and difficult to evaluate, has been especially vulnerable. A global consequence has been an emphasis on research of a more applied nature that appears more obviously connected to wealth creation. This has inevitably raised questions about the adequacy of support for fundamental science. In the UK, the Foresight Programme's attempts to divert funding towards more readily exploitable areas of science have been at the expense of curiosity-driven research. Despite this, for biomedical research in the UK, the overall situation is now more favourable to basic research and not less.

The pressure for more systematic criteria and procedures for deciding on budgetary priorities needs to be informed by analysis of the strengths, weaknesses, opportunities and threats of biomedical research. For the funding of biomedical science, *Mapping the Landscape* is a major step in this direction. Whilst this report is only the first of its kind, there is already a wealth of data to consider. Moreover, as the national research endeavour is relatively stable, the lessons from a period ending more than two years ago are still relevant to today's decision-makers.

The ROD has already proved invaluable in several specific policy-related studies both for the Wellcome Trust and for other ROD members (see Section 2.1 and Annex, Section 3.8). This report offers both a summary of the general situation and details of what can be concluded in particular areas. In short, it offers new insights into the outcomes of biomedical research funding. *Mapping the Landscape* is analogous to an aerial photograph. As the ROD is developed and refined, subsequent reports will move closer to the ground revealing finer detail and covering more subfields.

5.2 Policy implications

Several important policy questions arise from this report.

- The relative decline in UK Government funding has not had the adverse effect that might have been expected on biomedical research outputs because of the corresponding rise in private-non-profit funding and, to some extent, of industrial funding. However, this means that Government no longer has such a powerful grip on the overall research agenda. Will it be possible to coordinate the activities of the many different players satisfactorily?
- Despite fears that reduced funding will be concentrated on applied research and development to the detriment of basic or 'blue skies' research, this is not happening, at least in biomedicine in the UK. Instead, there has been a decline in the proportion of clinical work. But will clinical research in turn become neglected, particularly as it tends to be less influential, judged by conventional bibliometric indicators?
- The different subfields vary greatly in their characteristics and funding. Genetics is expanding rapidly and most papers in this subfield acknowledge funding. Nursing research is expanding even more rapidly but with little grant support, and is published in low impact journals. On the other hand,

gastroenterology is a subfield of declining UK world presence despite its papers underpinning a high percentage of UK-invented US patents. Will funding bodies change their priorities to take account of the specific needs of these different subfields? Should the amount of research in an area take account of the burden of disease?

- The geographical distribution of UK biomedical papers is very unequal, with a high proportion coming from south-east England (notably London, Oxford and Cambridge). If research spending is intended partly to enhance the capability to deliver high quality and advanced clinical care of patients in an institution, then a more equitable distribution, of clinical trials if not of basic research, that takes account of patient needs may be desirable. But will this still be compatible with the desire to support top-quality work in a small number of major centres?
- Collaboration between authors, laboratories and funding bodies (although the latter may be tacit) is increasingly common and leads to more influential research. More overt cooperation between different funding bodies may be helpful in order to reduce administrative costs to researchers chasing many small contributions. Should the criteria taken into account by peer-review funding committees include the range of funding sources already supporting an applicant as well as the amount?
- The drive to secure economic benefits from research needs to take account of the actual capability of UK industry (as shown, in part, by the presence of UK inventors on patents) to benefit from the work. Should this be an additional factor to determine the research priorities of funding bodies and the geographical location of research centres?

5.3 Future reports on UK biomedical research outputs

It is expected that the present report will be the first of a series. The intention is to make them authoritative and useful both to policy-makers and the research community. Feedback from readers would therefore be welcome, and in particular the Wellcome Trust would like to know:

- if more information should be given on the amount of funding?
- if the outputs of additional countries should be tabulated and if so which?
- which additional subfields should be covered?
- whether a mapping of research papers to disease groups (e.g. through the use of 'Read' codes) would be useful?
- whether more geographical analysis, for example of research of different levels, in different subfields, or funded in different ways, should be provided?
- what other subdivisions of the main funding sectors could or should be analysed?
- whether the four-fold categorization of journals by their impact on other researchers is a sufficiently fine discriminant of the potential impact of the papers?
- what additional information about the patents citing to UK biomedical papers would be useful?

Since the next report will encompass the 1996 and 1997 ROD data, it is expected to be prepared in 1999. Comments should therefore be sent to the Trust's Policy Research Department before the end of 1998.

Caveats, or health warnings

Bibliometrics is akin to epidemiology in that it attempts to draw conclusions on a statistical basis from samples, and to identify the factors important for the determination of outcomes. It is important to be aware of the limitations that apply to the present study, but also to a greater or less extent to other such studies.

- Some papers have not yet been examined and so their source of funding is unknown. These are actively being sought in line with the overall policy of continuous refinement of the ROD.
- The subfield coverage in this report is not exhaustive and subfield definition was by a small number of experts for specific studies (see Annex, Section 1.7). [The aim is to cover more subfields in subsequent reports and to improve filters if possible.]
- For a few subfields, either the precision or the recall was undesirably low (below 0.9) so the results may not be fully representative.
- Some of the subfields are rather small and therefore apparent differences in research level or journal impact category may not be significant.
- The recording process may lack precision. For example, where 'institutes' appear in addresses, it is not always clear what credits should be given.
- Some funding bodies are not identified, but the percentage of these is decreasing because of use of the Internet (see Annex, Section 3.4) and of 'generic codes' giving country and category.
- Research-funding bodies may have very different missions. For example, within the UK Government sector, the Medical Research Council and the Public Health Laboratory Service are so different that it is not appropriate to compare them directly.
- Some journals do not have an assigned research level. These are mainly those in the social sciences such as those publishing nursing research.
- Funding bodies, especially within the industry sector, often merge and change name making it difficult to determine which organization should be credited.

- The categorization of some funding bodies is problematic. The Royal Society and the British Council are two cases in point. The Royal Society is formally independent but receives most of its funding from Government; on the other hand the British Council is in effect a Government Agency (although formally a charity) but most of its funding is obtained from fees rather than from Government.
- No credit has been given for NHS or Higher Education Funding Council funding.
- Only seven out of eight acknowledgements that should be given actually are given, although there is no evidence that some funding bodies do better or worse than others.

Annex

A.1 Methodology

A.1.1 Research papers considered

The ROD contains two types of record (limited to articles, notes and reviews with a UK address):

- papers that have been checked for funding (status A);
- papers that have not yet been checked (status C).

Only status A papers are used for funding-related analyses whereas for global counts all status A and C papers are counted.

A.1.2 Research level

A research level (RL) value can be determined for each journal. It is a number from clinical observation = 1 to basic research = 4 which characterizes the majority of the papers in a journal by their research type, based on expert opinion and journal-to-journal citation patterns. Values for many journals have been determined by CHI Research Inc., and this categorization system is becoming an industry standard for the classification of research journals.

A.1.3 Potential impact of research (W)

For each paper a W value has been calculated to indicate the level of average citation impact of the journal in which it was published. For any given group of papers the W values were calculated as follows:

- first, all the journals in a group were listed in descending order of frequency of use;
- second, a 'core set' of journals was identified, which accounted for about 85 per cent of the total number of papers;
- third, the core set of journals was listed in descending order of five-year impact factor, determined as the mean number of citations from 1992–96 to papers published in 1992.
- fourth, the top 10 per cent of these journals were assigned a weighting, W, of 4; the next 20 per cent W = 3; the next 30 per cent W = 2 and the bottom 40 per cent W = 1.
- fifth, non-core journals were weighted by comparison of their impact factors with Table A42.

A.1.4 Authors, addresses and funding bodies

The numbers of authors may differ between a sole author and the hundreds that are found on papers describing international clinical trials. This variable was, therefore, collapsed into ten categories: 1–9, and 10 or more. The address variable was collapsed in a similar manner, whilst the funding bodies category was collapsed into ten categories: 0–8 and more than 8.

A.1.5 Citations on patents

TechTrac, an in-house database, was developed to link biomedical research publications to the US patents that cite these papers as 'prior art'. The database links any UK-authored biomedical papers contained in the ROD with US patents filed from 1983 onwards or to patents filed in the European Patent Office from 1978 onwards (as ROD only covered papers from 1988 onwards the early years are not relevant here). In this report only the US patents are considered.

A.1.6 Subfield definition

The first step is to identify papers with addresses containing relevant keywords (i.e. from specialist departments) which are likely to be mostly within the subfield and to derive from these a list of specialist journals. A sample of papers from all of these journals, and ones from the named departments, is then processed to list all the title words used and place them in descending order of frequency of use. These words are scanned by experts in the field and a proportion retained as being indicative of a paper relevant to that subfield. The performance of the filter is then checked by printing out sets of papers (titles and journal names) to check for their relevance to the subfield, and to provide data with which the filter may be calibrated. Two methods of calibration are used, one based on the relative numbers of papers in specialist and general journals, and another based on the relative numbers of papers retrieved and not retrieved from specialist departments. The two methods are independent and afford a check on the system. The filter calibration factor is an estimate of the number of papers actually present in a subfield compared with the number identified by the filter.

A.1.7 Subfields, developers and calibration factors

Code	Subfield	Defined by:	CF
ANEST	Anaesthetics	Prof. R Jones, St Mary's Hosp.	1.19
ARTHR	Arthritis and rheumatism	Dr M Devey, Arthritis Res. Campaign	1.11
CARDI	Cardiology	Dr M Phillips, Wellcome Trust	1.10
DEVEL	Developmental biology	Dr P Goodwin, Wellcome Trust	0.70
MULSC	Multiple sclerosis	Dr L Layward, MS Society	1.02
GASTR	Gastroenterology	Prof. D Thompson, BSG	0.95
GENET	Genetics	Dr B Skene, Wellcome Trust	1.04
GERON	Gerontology	Dr I Scott, Wellcome Trust	1.29
HAEMA	Haematology	Prof. D Lane, Charing Cross Hosp.	0.93
HISTP	Histopathology	Prof. N Wright, RPMS	1.63
IMMUN	Immunology	Dr P Chisholm, Wellcome Trust	1.12
NEONA	Neonatology	Prof. O Reynolds, UCL	1.02
NEURO	Neurosciences	Dr W Ewart, Wellcome Trust	0.78
NURSE	Nursing research (SSCI)	Dr A-M Rafferty, LSHTM	1.04
OBSGY	Obstetrics and gynaecology	Prof. P Steer, Charing Cross Hosp.	1.01
ONCOL	Oncology	Dr L Walker, Cancer Res. Campaign	1.24
OPHTH	Ophthalmology	Dr S Thomas, Wellcome Trust	1.00
RENAL	Renal medicine/nephrology	Prof. P Sever, St Mary's Hosp.	1.19
RESPI	Respiratory medicine	Prof. PJ Barnes, Nat. Heart & Lung Inst.	1.17
TROPM	Tropical medicine	Dr C Davies, Wellcome Trust	1.19

A.2 Methodological caveats

A.2.1 Filters

It was apparent during filter development that some were much better than others, that is they had both better recall and better precision. These were the filters for papers associated with particular parts of the human body, for example renal medicine, gastroenterology, respiratory medicine. None of the figures in this report (except those in Table 1.2) have been adjusted by the calibration factors but the true absolute number of biomedical publications in any given subfield may be estimated by multiplying by the calibration factor.

A.2.2 SCI/SSCI

The Research Outputs Database (ROD) is based on data available within ISI's Science and Social Sciences Citation Indexes (SCI/SSCI) with the addition of further post-code checks and funding information. This leaves ROD open to the same criticisms as these indices. This is not the case for subfield filters that are developed independently of ISI. One major concern is the journal coverage of the Science Citation Index (used as a generic term for both databases from now on). The database has been based on the CD-ROM version of the SCI until 1995 but has expanded in more recent years to cover more journals. This creates a moving target when attempting to indicate research trends and may impact on one subfield more than another. The only way to overcome this problem is always to consider changes in output in any given subfield at the national level as a proportion of world papers. In this way any changes are standardized for the changing base and should remain relatively comparable from one country to the next.

Another problem is the 'bias' towards international journals which precludes much research of any one country that may be in local national journals in the language of origin. The SCI has a tendency to cover journals of higher renown in the English language causing biases in any international comparisons, and this tendency is even more pronounced in the SSCI. As this report concentrates on national trends, albeit in an increasingly global climate, and research that is predominantly in the English language, these problems may be less important here but are still worth noting.

Within the UK, we may talk about increases or decreases in the output of a funding sector or in a given subfield but these must be considered in relation to overall movements from year to year in UK biomedicine as a whole. The biomedical filter used to develop the ROD is country specific, that is it uses UK address keywords in conjunction with specialist journal sets. It is not therefore fully appropriate to use for the identification of biomedical papers from other countries or from the SCI as a whole. Thus although we may have a figure of UK biomedicine increasing by 33 per cent from 1988 to 1995 it is not clear what has happened to the true level of world biomedical publications (as defined here) in that time although it appears to have increased steadily, by about 3 per cent per year, based on the application of the filter to the SCI alone.

A.3 The Research Outputs Database

A.3.1 Paper identification

The bibliographic records for inclusion in the ROD are selected from the Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI) CD-ROMs under a licence agreement with the Institute for Scientific Information (ISI) in Philadelphia. These databases are not only multidisciplinary and give coverage of all the scientific areas of interest, but they also contain all the authors' names and all the addresses in a standardized format. The ROD is intended to cover all UK papers in the scientific areas of interest to the Trust and the ROD members.

In order to select relevant papers from journals other than those classed as biomedical, and in particular important multidisciplinary journals such as *Nature* and *Science*, an additional keyword filter is used to search the address field of all UK papers. These words are of two types, specific (such as GLAXO or MRC) and generic (such as the contractions CANC – cancer, or BIOCHEM – biochemistry, used by the compilers of the SCI). The biomedical filter is checked and refined prior to the start of each campaign to ensure a comprehensive search of the CD-ROMs.

A.3.2 Database architecture

A relational data model was chosen for implementation of the database that provides data integrity and allows flexible data analysis through the mapping of relationships between parameters. The relational database management system Oracle 7 was selected, running on a Hewlett-Packard UNIX machine.

A.3.3 Recording funding information

Once the paper data are loaded into the database, the funding details are manually noted by inspection of the original sources. Recorders (history graduates) are supplied with workbooks each listing approximately 1000 papers and a thesaurus of funding bodies with three-letter (trigraph) codes, see below. The journals covered in the workbooks may be found in several libraries, and the workbooks list the journals and their shelf references for ease of location. The libraries mainly used are:

- the Science Reference Library (SRL), part of the British Library (in two parts);
- the library of the Royal Society of Medicine (RSM);
- the library of the British Medical Association (BMA);
- the libraries of University College London (UCL) and its constituent medical schools.

Six types of funding are recorded in the workbooks, as follows:

- intramural support (from the addresses on the paper);
- extramural;
- personal (e.g. fellowship or studentship);
- travel;
- equipment;
- in-kind (often a gift of a pharmaceutical drug).

A.3.4 Funding body thesaurus

The funding body thesaurus database, developed within the Wellcome Trust using MS Access, currently lists approximately 9500 different bodies funding biomedical research from many different countries, of which some 3640 are from the UK. Each is assigned a unique three-letter code in addition to its country code (two-digit ISO code) and organizational category. Currently the categories in use are as below.

BT	Biotechnology company
CH	Charity, collecting from the public
FO	Foundation, endowed or with a single source (e.g. a company)
GA	Government agency (not controlled by ministers)
GD	Government department
HT	Hospital trustees (funds associated with a particular hospital)
IN	Industry (non-pharmaceutical)
IP	Industry (pharmaceutical)
LA	Local or regional authority
NP	Not-for-profit (including some charities not primarily supporting research)
MI	Mixed (collecting charity and endowment; mainly academic own funds)
SN	Subsidiary industrial organization (non-pharmaceutical)
SP	Subsidiary industrial organization (pharmaceutical)
VP	Veterinary practice
XX	Unidentified

New or unrecognized funding bodies found by the recorders are temporarily assigned a numerical code and the details noted in the workbooks for investigation within the Trust. Some are found to have existing codes, some are assigned new codes and some are not sources of funding and therefore ignored.

New funding bodies are investigated using available information sources to determine their country and their category, and whether they are in fact the same as an organization previously listed. Some funding bodies are acknowledged with their names in English and some in other languages; some with their full names and some with only their initials. In the past books and other readily available directories were consulted but currently the Internet (using the AltaVista search engine) is proving to be an excellent source of new funding body information. It is particularly valuable for organizations identified only by their initials or acronyms. When they are found, the addresses of the relevant Web pages are recorded for future reference.

Inevitably, there are many organizations with only a single paper in the ROD acknowledging their support. This creates a very long tail of funding bodies, which occupies space in the thesaurus and makes it needlessly long. To simplify the problem, a system of 'generic' codes, which include numeric as well as alphabetic characters, has been adopted for the grouping of minor funding bodies in the larger countries (other than the UK). Thus 'X12' designates a US foundation and 'X4B' a Swedish biotech company.

A.3.5 Data entry process

Once the workbooks holding the indexed acknowledgements are returned to the Trust, all queries resolved and new funding body codes assigned, the funding acknowledgements are entered into the database. This is done separately by two different data entry clerks and procedurally cross-checked. Any inconsistencies are resolved and corrections are made.

A.3.6 Postcode correction and addition

All UK postcodes are checked for consistency and are corrected where necessary. If a postcode is missing from a paper and no address with the correct postcode exists on other papers in the ROD, then it is determined by reference to a postcode CD-ROM compiled by the Post Office, or other references such as *The Hospitals and Health Services Year Book*. If the address cannot be identified precisely by postcode (e.g. UNIV-OXFORD), a 'dummy' postcode is entered. The area code (the first one or two letters) is entered if it is obvious, followed by dummy values: this allows the paper to be assigned to the correct geographical area for mapping purposes (see Figure 2.6).

A.3.7 Quality assurance

A photocopy of the address and acknowledgement sections of every 100th paper is made by the recorders. The funding bodies recorded in the workbook are checked against the photocopies within the Trust and any errors are noted and fed back to the recorders to resolve any misunderstanding or lack of clarity in the guidelines.

A.3.8 ROD club membership

Access to detailed data in the ROD is through a club membership scheme. It is open to all organizations funding or carrying out research in the UK or Ireland. Membership is currently in four classes with annual subscriptions based on either biomedical research expenditure (for funding bodies) or external income (for research performers) in the UK and Ireland. It provides a variety of benefits, including:

- an annual cumulative list of papers supported or published by the organization;
- attendance at, or representation on, the ROD Club Members' Committee to influence the development of the database;
- invitations to seminars on research outputs (two have been held so far and a third is being planned);
- complimentary copies of research reports and publications;
- consultancy time to help with analysis and interpretation (with an initial free allowance);
- the opportunity to second staff members to work within the Trust on specific problems;
- a diskette containing spreadsheets with detailed data to allow members to analyse their own records.

A.3.9 Future developments

In order to improve ROD and the service provided to its membership a number of developments are currently being undertaken including:

- *Training sessions.* These sessions have contained a historical overview of the database, an explanation of the data collection process and ideas for uses of the data. An overview of analytical techniques helps members look at their data from a qualitative and quantitative perspective. Further sessions will be run in the future either for individual organizations or on a regional basis.
- *Increase in journal coverage.* Details of further papers in journals processed by ISI but not currently included in either the SCI or SSCI CD-ROMs have been purchased from ISI. The inclusion of additional papers from some 19 extra journals starting from 1988 in the current (1996) campaign will improve the database in terms of both data content and quality. The journals were selected following circulation of a list of journals to ROD members.

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Appendix contents

Note: The reference to a figure or table at the end of each heading shows where the data in the table are used in the report.

CHAPTER 1

Table A1 Civil Gross Expenditure on Research & Development for G7 countries from 1987-95, percentages of Gross Domestic Product (Figure 1.1)

	1987	1988	1989	1990	1991	1992	1993	1994	1995
UK	1.72	1.72	1.74	1.79	1.73	1.78	1.79	1.81	1.75
Canada	1.40	1.34	1.35	1.43	1.49	1.53	1.60	1.59	1.58
France	1.77	1.77	1.83	1.84	1.91	1.96	2.03	1.98	2.00
Germany	2.74	2.73	2.73	2.61	2.65	2.38	2.35	2.25	2.20
Italy	1.14	1.14	1.16	1.25	1.26	1.25	1.20	1.10	1.11
Japan	2.60	2.64	2.75	2.83	2.79	2.73	2.65	2.61	2.75
USA	1.97	1.96	1.98	2.08	2.14	2.10	1.98	1.96	2.04

Source: ONS/OST (1997) - Tables 7.1 & 7.7 - defence data subtracted

Table A2 UK Government funding of R&D for civil objectives as a percentage of GDP, 1983-95

	1983	1985	1987	1989	1991	1993	1995
%	0.68	0.63	0.57	0.51	0.49	0.50	0.51

Source: ONS/OST (1997) - Table 7.7

Table A3 Government funding of civil R&D as a percentage of total government expenditure for G7 countries, 1986-94 (Figure 1.2)

	1986	1987	1988	1989	1990	1991	1992	1993	1994
UK	2.45	2.38	2.37	2.23	2.11	1.95	1.99	2.00	1.94
Canada	2.43	2.22	2.20	2.25	2.19	2.24	2.21	2.27	2.30
France	3.85	3.70	3.64	3.73	3.73	3.79	3.45	3.40	3.33
Germany	4.01	3.94	3.84	3.99	3.97				
Italy	2.87	3.07	3.17	2.92	3.02	3.02	3.29	2.81	2.65
Japan	2.96	2.94	2.89	2.91	2.79	2.79	2.75	2.69	2.75
USA	1.86	1.91	1.93	2.08	2.17	2.30	2.40	2.36	

Source: ONS/OST 1996/97 - Tables 7.6/7.5 respectively

Table A4 Sources of UK public domain biomedical research funding in 1994-5 (Figure 1.3)

Group	Expenditure on R&D (£m)	% share
AMRC	361	22
NHS	326	20
MRC	267	16
HEFC/SHEFC/DENI/HEFCW	202	12
Pharmaceutical industry (1994)	192	12
BBSRC	94	6
MAFF	56	3
DH	59	4
Other departments	80	5
Total	1636	100

Source: Derived from ONS/OST (1997), Forward Look (1996), CMR Report (1996), AMRC

Notes for Table A4

MAFF (Ministry of Agriculture Fisheries and Food): Total taken from 'Animal health & welfare' (24.4m); 'Livestock science' (11.3m); and 'Food safety & applied nutrition' (20.1m) - Total 55.8m (Source: Forward Look 1996)

BBSRC (Biotechnology and Biological Sciences Research Council): Total taken from 'Animal sciences and psychology' (10.1m), 'Biochemistry and cell biology' (20.1m), 'Biomolecular sciences' (17.3m), 'Chemicals and pharmaceuticals directorate' (21.0m), 'Food directorate' (10.8m) and 'Genes and development biology' (15.0m) - Total 94.3m (Source: Forward Look 1996)

MRC (Medical Research Council): Total 266.7m (Source: ONS/OST - 1997)

DH (Department of Health) - 59m and NHS (National Health Service) - 326m. Total 385m (Source: ONS/OST - 1997 - p.15 note 6)

AMRC (Association of Medical Research Charities): - Total 360.8m (AMRC supplied data)

Medical Science for HEFC (Higher Education Funding Council) -164.6m, SHEFC (Scottish Higher Education Funding Council) - 23.4m, DENI (Department of Education for Northern Ireland) - 5.8m and HEFCW (Higher Education Funding Council for Wales) - 7.7m. Total 201.5m (Source: Forward Look 1996)

Pharmaceutical Industry R&D Expenditure in 1994 1918m (CMR Report) - taking 10% - Total 191.8m

Other departments: (Scottish Office Home and Health (10.1m), N. Ireland Department of Health & Social Services (1.5m), Welsh Department of Health and Social Care (2.1m), Department for International Development - formerly the ODA (13.3m), Health and Safety Commission and Executive (15.6m), Ministry of Defence). Estimated total 80m.

Table A5 Annual research expenditures by the Medical Research Council, 1995 prices, from 1988-95

	1988	1989	1990	1991	1992	1993	1994	1995
MRC (£m)	149	176	186	203	227	255	267	275
Deflator	72.71	77.78	83.99	89.37	93.14	95.83	97.53	100
Real terms	205	226	221	227	244	266	274	275

Source: ONS/OST - 1997, pp.15-16 (deflators from ONS/OST - 1997, p.8)

Table A6 Annual research expenditures by members of the Association of British Pharmaceutical Industries, 1995 prices, from 1988-95 (Figure 1.4)

	1988	1989	1990	1991	1992	1993	1994	1995
Expenditure (£m)	848	958	1140	1239	1420	1707	1918	1903
Deflator	72.71	77.78	83.99	89.37	93.14	95.83	97.53	100
Real terms	1166	1232	1357	1386	1525	1781	1967	1903

Source: CMR Report 1996 (deflators from ONS/OST - 1997, p.8)

Table A7 Annual research expenditures by members of the Association of Medical Research Charities, 1995 prices, from 1988-95 (Figure 1.5)

	1988	1989	1990	1991	1992	1993	1994	1995
Expenditure (£m)	149	177	216	251	269	318	361	340
Deflator	72.71	77.78	83.99	89.37	93.14	95.83	97.53	100
Real terms	205	228	257	281	289	331	370	340

Source: Association of Medical Research Charities (AMRC) supplied data (deflators from ONS/OST - 1997, p.8)

Table A8 Shares of world science publications for G7 countries, 1981-94 (from Australian data)

Country	Papers	% share of world papers
UK	671,944	8.0
Canada	376,588	4.5
France	434,218	5.2
Germany	593,503	7.0
Italy	228,901	2.7
Japan	613,114	7.3
USA	2,919,889	34.6
World	8,428,144	100.0

Source: Bureau of Industry Economics (1996) Table 2.1 Page 5

Table A9 Percentage shares of world science publications for G7 countries, 1985-93 (from European Commission report, using fractional counts) (Figure 1.6)

	1985	1989	1993
UK	9.0	8.3	8.7
Canada	4.4	4.4	4.5
France	4.3	4.7	5.1
Germany	6.5	6.3	6.3
Italy	2.4	2.7	3.0
Japan	7.2	7.7	8.2
USA	35.8	35.2	35.8

Source: European Report on Science and Technology indicators (1994) Table I.11.I

Table A10 Percentage shares of world science publications for G7 countries, 1985-97 (from SCI on CD-ROM, using integer counts) (Figure 1.7)

	1985	1987	1989	1991	1993	1995	1997
UK	8.71	8.77	8.34	8.52	8.77	8.96	8.95
Canada	4.61	4.88	4.78	4.85	4.94	4.79	4.53
France	5.06	5.25	5.46	5.59	6.08	6.43	6.68
Germany	7.47	7.44	7.44	7.62	7.71	8.19	8.89
Italy	2.60	2.71	3.03	3.28	3.56	3.95	4.21
Japan	7.40	7.58	8.17	8.59	9.10	9.40	9.86
USA	36.64	36.90	36.60	37.12	36.51	35.46	34.11

Source: SCI CD-ROMs 1985-1997

Table A11 Percentage shares of world biomedical publications for G7 countries, 1981-93 (from US National Science Foundation report, using fractional counts, and biomedicine = 2/3 clinical medicine + 1/3 biomedical research)

	1981	1985	1989	1993
UK	9.37	9.73	9.10	9.07
Canada	3.63	3.90	4.07	4.03
France	5.20	4.53	4.67	4.97
Germany	7.03	6.37	6.33	6.17
Italy	2.20	2.63	2.80	3.17
Japan	5.47	6.43	7.37	8.47
USA	40.70	39.47	38.77	38.73

Source: National Science Board, Appendix table 5-32

Table A12 Percentage shares of world biomedical publications for G7 countries, 1985-93 (from European Commission report, using fractional counts, and biomedicine = 2/3 clinical medicine + 1/3 biomedical research) (Figure 1.8)

	1985	1989	1993
UK	11.43	10.73	11.07
Canada	4.20	4.20	4.20
France	4.43	4.80	5.00
Germany	5.97	5.80	5.77
Italy	2.67	2.97	3.23
Japan	6.47	7.20	7.77
USA	39.00	38.37	38.53

Original source: European Report on Science and Technology indicators (1994) Table I.11.A/B.

Table A13 Percentage shares of world biomedical publications for G7 countries, 1985-97 (from SCI on CD-ROM, using integer counts, biomedicine defined by address keywords) (Figure 1.9)

	1985	1987	1989	1991	1993	1995	1997
UK	10.42	10.40	10.15	10.34	10.50	10.50	10.26
Canada	4.59	4.90	4.78	4.89	4.99	4.86	4.80
France	5.01	5.26	5.36	5.60	5.89	6.13	6.21
Germany	6.16	6.27	6.36	6.31	6.43	6.91	7.79
Italy	2.79	2.84	3.16	3.49	3.67	4.05	4.34
Japan	7.04	7.55	8.13	8.66	9.37	9.55	10.11
USA	44.00	43.77	43.35	43.48	43.15	42.46	41.09

Source: SCI CD-ROMs 1985-1997 (using ROD biomedical definition)

Table A14 Index of International Co-authorship in science and in biomedicine (m, %) among G7 countries (from SCI on CD-ROM), 1985-97 (Figure 1.10)

	1985	1987	1989	1991	1993	1995	1997
Science	4.22	4.86	5.32	6.07	7.05	8.00	9.18
Biomedicine	3.90	4.59	4.99	5.81	6.90	7.85	9.03

Source: SCI CD-ROMs 1985-1997

Note: The index (m, %) is calculated by adding the individual country totals (on an integer basis), subtracting the total for the G7 countries taken together and expressing this as a percentage of the latter total.

Table A15 UK biomedical papers co-authored with other EU member states and the USA, 1985-97 (Figure 1.11)

	1985	1987	1989	1991	1993	1995	1997
UK+EU	1071	1317	1492	1951	2481	3152	3881
UK+US	959	1095	1231	1420	1797	2315	2594

Source: SCI CD-ROMs 1985-1997

Table A16 Numbers of UK biomedical papers in the ROD, 1988-95 (Figure 2.1)

	1988	1989	1990	1991	1992	1993	1994	1995	1988-95
ROD, total	23354	24087	25228	25765	26916	28195	29772	31047	214364
ROD, inspected	23256	23998	25081	25599	26522	27631	28977	28694	209758
% inspected	99.6	99.6	99.4	99.4	98.5	98.0	97.3	92.4	97.9

Note: In general, when comparisons with national levels of biomedical outputs are made the 'ROD, total' figures should be used. However, in this report when considering degrees of funding by sector only those records so far inspected are used for comparison.

Table A17 List of 20 biomedical subfields ranked by UK outputs in ROD, 1995, with Average Annual Percentage Growth (Table 2.1)

	1988	1989	1990	1991	1992	1993	1994	1995	Total	AAPG
NEURO	2736	2850	3050	3117	3200	3316	3352	3619	25240	3.70
GENET	1849	1985	2229	2441	2688	2864	3161	3403	20620	9.26
ONCOL	1992	2273	2274	2441	2508	2625	2827	2714	19654	4.52
CARDI	1978	2174	2241	2355	2499	2514	2647	2676	19084	4.26
IMMUN	1984	2081	2065	2126	2217	2230	2230	2253	17186	1.82
GASTR	1758	1749	1924	1797	1838	1887	1995	1997	14945	1.82
OBSGY	1432	1418	1475	1464	1488	1472	1602	1718	12069	2.29
HAEMA	1342	1355	1457	1467	1499	1648	1685	1616	12069	3.37
RESPI	982	1140	1222	1241	1309	1302	1374	1399	9969	4.45
HISTP	958	973	1092	1154	1152	1212	1080	1061	8682	1.86
DEVEL	647	685	724	731	798	804	842	959	6190	5.12
ARTHR	699	628	750	832	931	951	945	936	6672	6.02
ANEST	750	757	769	839	833	857	821	800	6426	1.41
OPHTH	620	612	609	563	758	732	721	739	5354	3.51
TROPM	451	507	565	495	523	572	619	592	4324	3.62
NEONA	409	428	443	462	551	517	603	576	3989	5.82
RENAL	462	589	603	605	624	612	633	532	4660	1.70
GERON	366	423	431	488	469	470	558	523	3728	5.01
NURSE	198	206	263	276	307	346	472	515	2583	15.04
MULSC	83	84	74	98	89	94	101	102	725	3.61

For a key to the subfield abbreviations, see Table 1.1 in main text

Table A18 Number of papers in ROD with given numbers of authors, 1988-95 (Figure 2.2)

	1988	1989	1990	1991	1992	1993	1994	1995
1	3886	3792	3944	3906	3743	3714	4025	4012
2	5967	5934	5979	5882	5856	6040	6208	6294
3	5218	5302	5402	5491	5548	5853	5974	6267
4	3586	3783	3909	4018	4433	4624	4738	5050
5	2127	2317	2556	2742	2889	3163	3366	3488
6	1193	1377	1523	1610	1851	2029	2185	2366
7	603	744	806	932	996	1080	1188	1349
8	347	374	450	468	617	612	774	769
9	176	205	250	272	338	384	418	491
10+	251	259	409	444	645	696	896	961
Total	23354	24087	25228	25765	26916	28195	29772	31047
Mean:	3.20	3.29	3.38	3.44	3.60	3.64	3.71	3.76

Note: Where there are 10 or more authors the figure has been taken as 10 for calculation of the averages to avoid distortion from papers with very large authorship.

Table A19 Percentages of papers in ROD with given numbers of authors, 1988-95 (Figure 2.2)

	1988	1989	1990	1991	1992	1993	1994	1995
1	16.64	15.74	15.63	15.16	13.91	13.17	13.52	12.92
2	25.55	24.64	23.70	22.83	21.76	21.42	20.85	20.27
3	22.34	22.01	21.41	21.31	20.61	20.76	20.07	20.19
4	15.35	15.71	15.49	15.59	16.47	16.40	15.91	16.27
5	9.11	9.62	10.13	10.64	10.73	11.22	11.31	11.23
6	5.11	5.72	6.04	6.25	6.88	7.20	7.34	7.62
7	2.58	3.09	3.19	3.62	3.70	3.83	3.99	4.35
8	1.49	1.55	1.78	1.82	2.29	2.17	2.60	2.48
9	0.75	0.85	0.99	1.06	1.26	1.36	1.40	1.58
10+	1.07	1.08	1.62	1.72	2.40	2.47	3.01	3.10

Table A20 Numbers of papers in ROD with given numbers of addresses, 1988-95 (Figure 2.3)

Year	1988	1989	1990	1991	1992	1993	1994	1995
1	12560	12789	12980	12743	12801	13251	13645	13762
2	6840	7088	7617	7886	8229	8605	9169	9587
3	2557	2788	2911	3241	3585	3897	4052	4439
4	881	935	1044	1144	1322	1373	1597	1788
5	302	300	352	397	464	542	574	716
6	112	100	131	149	179	199	279	285
7	41	38	72	72	102	111	145	157
8	26	20	42	39	55	61	60	75
9	10	8	26	24	43	35	44	57
10+	25	21	53	70	136	121	207	181
Total	23354	24087	25228	25765	26916	28195	29772	31047
Mean	1.73	1.74	1.79	1.84	1.92	1.93	1.98	2.02

Note: Where there are 10 or more addresses the figure has been taken as 10 for calculation of the averages to avoid distortion from papers with many addresses.

Table A21 Percentages of papers in ROD with given numbers of addresses, 1988-95 (Figure 2.3)

	1988	1989	1990	1991	1992	1993	1994	1995
1	53.78	53.10	51.45	49.46	47.56	47.00	45.83	44.33
2	29.29	29.43	30.19	30.61	30.57	30.52	30.80	30.88
3	10.95	11.57	11.54	12.58	13.32	13.82	13.61	14.30
4	3.77	3.88	4.14	4.44	4.91	4.87	5.36	5.76
5	1.29	1.25	1.40	1.54	1.72	1.92	1.93	2.31
6	0.48	0.42	0.52	0.58	0.67	0.71	0.94	0.92
7	0.18	0.16	0.29	0.28	0.38	0.39	0.49	0.51
8	0.11	0.08	0.17	0.15	0.20	0.22	0.20	0.24
9	0.04	0.03	0.10	0.09	0.16	0.12	0.15	0.18
10+	0.11	0.09	0.21	0.27	0.51	0.43	0.70	0.58

Table A22 Numbers of papers in ROD at each Research Level (1=clinical, 4=basic), 1988-95

	1988	1989	1990	1991	1992	1993	1994	1995
RL1	4498	4587	4639	4807	4675	4954	5168	4820
RL2	6237	6280	6618	6466	6770	6637	6844	6884
RL3	5359	5545	5739	5967	6345	6608	6644	6707
RL4	6283	6676	7188	7333	7433	7879	8515	8903
n.a.	977	999	1044	1192	1693	2117	2601	3733
Total Papers	23354	24087	25228	25765	26916	28195	29772	31047

Table A23 Percentages of papers in ROD at each Research Level with n.a. ones removed (Figure 2.4)

	1988	1989	1990	1991	1992	1993	1994	1995
RL1	20.10	19.87	19.18	19.56	18.53	19.00	19.02	17.65
RL2	27.87	27.20	27.37	26.31	26.84	25.45	25.19	25.20
RL3	23.95	24.02	23.73	24.28	25.16	25.34	24.45	24.56
RL4	28.08	28.92	29.72	29.84	29.47	30.21	31.34	32.60

Table A24 Distribution of ROD papers in 20 selected subfields by Research Level (1=clinical, 4=basic), with mean value of RL (Figure 2.5)

	RL1	RL2	RL3	RL4	n.a.	Mean
GENET	471	3063	4341	11979	766	3.40
DEVEL	277	904	1156	3542	311	3.35
NEURO	2860	5102	5210	10709	1359	3.00
IMMUN	1063	4181	8692	2984	266	2.80
MULSC	65	252	173	227	8	2.78
TROPM	554	1612	761	1292	105	2.66
HISTP	950	2998	2721	1817	196	2.64
HAEMA	1427	3758	4813	1710	361	2.58
OPHTH	588	2600	660	1336	170	2.53
RENAL	892	1337	1902	474	55	2.43
NEONA	731	1590	802	735	131	2.40
ONCOL	3650	7386	5581	2510	527	2.36
OBSGY	2171	4887	2909	1625	477	2.34
CARDI	4996	5428	5543	2709	408	2.32
GASTR	3435	5821	3056	2297	336	2.29
ARTHR	1581	2729	1480	679	203	2.19
RESPI	3245	3176	2147	1228	173	2.14
GERON	1244	803	525	510	646	2.10
ANEST	2464	2228	1047	541	146	1.95
NURSE	724	469	103	15	1272	1.55

For a key to the subfield abbreviations, see Table 1.1 in main text

Table A25a Biomedical papers in UK Postcode Areas, 1988-95 (integer counts) (Figure 2.6, Table 2.3)

		1988	1989	1990	1991	1992	1993	1994	1995	AAPG
WC	London	2085	2183	2357	2366	2492	2633	2735	2812	4.38
W	London	1731	1784	1892	1927	1981	1945	2102	2243	3.32
CB	Cambridge	1490	1620	1699	1679	1826	2022	2106	2393	6.43
OX	Oxford	1423	1581	1673	1707	1849	1854	1980	2100	5.17
SE	London	1401	1438	1445	1609	1686	1723	1809	1827	4.35
SW	London	1238	1285	1432	1494	1583	1613	1681	1682	4.76
EH	Edinburgh	1112	1226	1264	1325	1421	1491	1589	1637	5.59
G	Glasgow	1241	1163	1242	1242	1335	1335	1429	1370	2.42
M	Manchester	1020	1118	1139	1156	1273	1365	1341	1487	5.12
NW	London	894	959	1041	1039	1086	1147	1185	1219	4.33
B	Birmingham	930	911	970	965	987	1080	1124	1166	3.61
BS	Bristol	711	675	744	772	853	838	928	1021	5.60
L	Liverpool	705	739	712	792	791	841	898	969	4.50
NE	Newcastle/T	603	609	659	687	747	833	807	816	5.26
CF	Cardiff	665	662	706	671	715	706	770	816	2.72
LS	Leeds	653	675	650	646	669	701	720	822	2.64
NG	Nottingham	563	591	608	638	648	716	801	822	5.73
EC	London	606	609	643	608	670	712	754	719	3.23
LE	Leicester	495	525	541	575	598	656	818	861	8.32
S	Sheffield	551	485	537	621	657	678	773	766	6.63
SO	Southampton	442	423	470	471	523	554	607	650	6.27
E	London	422	441	461	482	592	592	569	546	4.92
BT	Belfast	373	376	466	458	522	586	613	619	8.44
AB	Aberdeen	389	404	461	487	478	549	589	598	6.64
DD	Dundee	378	391	402	437	533	559	571	579	7.49
HA	Harrow	477	452	419	429	379	325	304	254	-8.30
RG	Reading	229	264	290	322	300	402	471	506	11.77
SM	Sutton	256	248	280	297	332	283	302	316	3.15
GU	Guildford	259	288	286	249	254	305	319	333	3.00
NR	Norwich	209	187	254	252	287	314	358	430	11.39
AL	St Albans	225	244	252	240	236	224	267	261	1.34
BN	Brighton	203	224	193	216	225	253	290	278	5.31
SK	Stockport	192	202	235	209	257	219	244	216	2.12
UB	Southall	131	137	192	195	205	244	286	263	11.74
BR	Bromley	159	196	204	209	188	213	197	244	3.70
BA	Bath	152	126	158	164	190	221	225	234	8.78
EN	Enfield	125	148	158	180	183	190	196	187	5.88
YO	York	122	115	101	130	155	187	196	226	11.32
CM	Chelmsford	102	122	126	104	152	172	207	223	11.88
CV	Coventry	117	125	119	132	155	180	159	198	7.78
UK	total	23354	24087	25228	25765	26916	28195	29772	31047	4.16

Table A25b Biomedical papers in UK Postcode Areas, 1988-95 (integer counts), continued (Figure 2.6, Table 2.3)

		1988	1989	1990	1991	1992	1993	1994	1995
KT	Kingston /Thames	141	148	163	141	120	162	154	137
CT	Canterbury	98	123	103	130	142	147	208	200
SL	Slough	95	105	133	158	153	164	159	151
KY	Kirkcaldy	107	119	122	115	136	147	149	153
ST	Stoke on Trent	82	102	105	111	124	155	142	192
EX	Exeter	109	82	110	107	119	145	164	174
SP	Swindon	97	107	124	137	145	141	111	118
MK	Milton Keynes	98	90	104	94	144	123	145	153
TW	Twickenham	103	132	117	102	113	98	132	147
SG	Stevenage	46	86	86	94	104	134	128	199
BD	Bradford	99	114	92	120	114	84	113	108
PO	Portsmouth	90	86	75	93	95	99	138	142
SA	Swansea	60	101	79	93	88	98	111	150
RH	Redhill	74	78	87	107	88	94	110	113
LL	Llandudno	71	65	72	104	83	94	108	123
PL	Plymouth	73	68	65	82	81	93	116	130
SY	Shrewsbury	77	71	78	80	69	84	110	113
N	London	78	81	94	81	72	102	77	96
HU	Hull	105	88	75	56	91	67	76	112
FK	Falkirk	57	47	64	82	78	93	89	114
HP	Hemel Hempstead	75	72	71	92	63	65	69	83
DH	Durham	56	73	57	76	71	84	63	102
KA	Kilmarnock	64	48	62	61	66	88	87	99
PE	Peterborough	64	76	80	84	69	82	69	47
LA	Lancaster	37	61	58	65	75	56	84	84
CO	Colchester	46	43	61	34	54	65	85	81
PR	Preston	35	35	47	42	54	48	65	75
TS	Cleveland	38	43	41	41	53	59	51	70
TN	Tonbridge	42	32	36	45	41	62	55	66
GL	Gloucester	35	42	38	38	45	41	54	76
ME	Medway	36	34	39	39	48	49	58	54
BH	Bournemouth	34	33	39	40	40	50	55	52
WA	Warrington	37	25	32	31	52	44	51	61
RM	Romford	33	24	22	32	48	41	44	36
NP	Newport	21	41	39	31	41	36	35	27
CH	Chester	19	28	30	34	46	34	32	37
SR	Sunderland	29	28	40	28	24	30	38	38
IP	Ipswich	24	19	34	26	20	37	41	44
DE	Derby	23	19	20	33	31	33	37	42
SN	Swindon	29	18	30	25	27	25	37	33
UK	total	23354	24087	25228	25765	26916	28195	29772	31047

Table A25c Biomedical papers in UK Postcode Areas, 1988-95 (integer counts), continued (Figure 2.6, Table 2.3)

		1988	1989	1990	1991	1992	1993	1994	1995
ML	Motherwell	23	24	27	24	29	19	39	28
N N	Northampton	15	20	25	22	27	22	33	40
PA	Paisley	28	24	16	20	27	28	27	31
WV	Wolverhampton	16	9	15	18	37	30	25	33
WD	Watford	23	21	30	17	22	8	35	26
HG	Harrogate	23	8	25	17	17	26	26	6
DY	Dudley	17	12	20	15	18	23	18	21
DA	Dartford	14	15	17	18	17	16	16	30
HD	Huddersfield	10	11	20	24	14	7	23	32
LU	Luton	12	12	19	14	17	20	25	21
TA	Taunton	17	13	12	11	11	22	16	32
IV	Inverness	9	15	16	13	29	6	11	24
WF	Wakefield	17	20	23	13	8	14	11	16
CR	Croydon	10	7	14	9	9	25	20	25
DL	Darlington	9	19	11	13	9	16	20	15
DN	Doncaster	5	8	9	17	20	20	18	15
WN	Wigan	15	13	10	13	13	20	12	13
BL	Bolton	12	14	9	5	13	16	12	26
SS	Southend on Sea	10	14	15	9	11	15	16	17
BB	Blackburn	6	9	10	15	16	15	15	20
CW	Crewe	8	15	17	13	10	8	14	16
CA	Carlisle	11	9	11	15	11	16	16	10
WR	Worcester	14	12	12	11	8	20	9	13
TR	Truro	16	8	11	12	16	14	15	5
DG	Dumfries	16	9	8	6	12	9	16	15
OL	Oldham	9	10	15	12	13	6	5	15
LN	Lincoln	11	7	8	10	8	15	13	11
TQ	Torquay	8	5	7	10	11	12	14	15
FY	Preston	7	9	10	7	7	4	9	10
PH	Perth	8	9	9	8	3	9	7	10
HR	Hereford	5	5	6	7	4	10	15	9
DT	Dorchester	8	8	3	4	5	4	7	21
WS	Walsall	7	7	7	7	3	2	15	10
IG	Ilford	8	3	5	4	4	5	7	5
TD	Galashiels	7	6	2	4	4	4	5	6
TF	Telford	3			5	4	2	3	6
LD	Llandrindod	1	3	1	3	4	3	1	2
HX	Halifax	3		2	1	3	2		1
KW	Kirkwall	2		1	2	2	2	1	
ZE	Shetland Isles	1		1	1		1	1	1
All PCs		28060	29051	30784	31615	33636	35330	37561	39393
UK total		23354	24087	25228	25765	26916	28195	29772	31047
m,%		20.15	20.61	22.02	22.71	24.97	25.31	26.16	26.88

Note: m is equivalent to the degree of collaboration i.e. the degree to which the totals for the 120 postcodes areas exceed the total papers in the UK.

Table A26 Postcode areas with greater than 1% (1988) of ROD papers, ranked by annual average percentage growth 1988-95, with percent increases between 1988 and 1995

	1988-95	% of UK	AAPG	% Incr. 1988-95		1988-95 (cont.)	% of UK	AAPG	% Incr. 1988-95
BT	4013	1.87	8.44	66	NE	5761	2.69	5.26	35
LE	5069	2.36	8.32	74	OX	14167	6.61	5.17	48
DD	3850	1.80	7.49	53	M	9899	4.62	5.12	46
AB	3955	1.84	6.64	54	SW	12008	5.60	4.76	36
S	5068	2.36	6.63	39	L	6447	3.01	4.50	37
CB	14835	6.92	6.43	61	WC	19663	9.17	4.38	35
SO	4140	1.93	6.27	47	NW	8570	4.00	4.33	36
NG	5387	2.51	5.73	46					
BS	6542	3.05	5.60	44					
EH	11065	5.16	5.59	47	UK total	214364	100.00	4.16	33

For postcode names see A25 above

Table A27 Percentages of ROD papers with foreign addresses, 1988-95 (Table 2.4)

		1988	1989	1990	1991	1992	1993	1994	1995
USA	US	5.078	5.347	5.312	5.997	6.810	6.696	7.363	7.820
Germany	DE	1.512	1.524	1.712	1.766	2.099	2.121	2.570	2.583
France	FR	1.186	1.200	1.586	1.525	1.802	2.068	2.328	2.416
Netherlands	NL	0.826	0.942	1.031	1.118	1.534	1.557	1.730	1.852
Italy	IT	0.895	0.992	1.153	1.417	1.601	1.405	1.814	1.836
Canada	CA	0.903	1.042	0.955	1.044	1.141	1.323	1.236	1.559
Australia	AU	0.792	0.785	0.920	1.126	1.048	1.188	1.270	1.366
Japan	JP	0.411	0.423	0.527	0.629	0.769	0.809	1.011	1.134
Switzerland	CH	0.617	0.664	0.821	0.811	0.851	0.954	1.068	1.134
Spain	ES	0.291	0.361	0.424	0.586	0.877	0.823	0.998	1.040
Belgium	BE	0.368	0.448	0.591	0.621	0.758	0.713	0.897	0.953
Sweden	SE	0.831	0.697	0.876	0.869	1.063	0.901	1.075	0.918
Denmark	DK	0.398	0.407	0.476	0.563	0.814	0.731	0.806	0.779
Ireland	IE	0.248	0.232	0.285	0.291	0.346	0.333	0.383	0.448
Finland	FI	0.188	0.208	0.270	0.287	0.375	0.316	0.363	0.415
New Zealand	NZ	0.231	0.241	0.210	0.256	0.312	0.234	0.265	0.361
Brazil	BR	0.137	0.170	0.274	0.310	0.316	0.305	0.369	0.354
Norway	NO	0.244	0.195	0.262	0.241	0.301	0.284	0.312	0.348
Greece	GR	0.150	0.220	0.155	0.252	0.282	0.238	0.286	0.264
India	IN	0.287	0.212	0.194	0.245	0.238	0.209	0.235	0.254
South Africa	ZA	0.141	0.208	0.178	0.159	0.186	0.177	0.232	0.238
Portugal	PT	0.030	0.083	0.115	0.093	0.126	0.181	0.151	0.225
Hong Kong	HK	0.120	0.079	0.091	0.093	0.175	0.209	0.212	0.213
Kenya	KE	0.141	0.149	0.099	0.147	0.163	0.206	0.171	0.206
Peoples Rep China	CN	0.090	0.087	0.119	0.132	0.152	0.202	0.148	0.190
Iraq	IQ	0.026	0.017	0.020	0.008	0.007	0.018	0.007	0.003
ROD total		23354	24087	25228	25765	26916	28195	29772	31047

Table A28 Numbers of ROD papers funded by the main sectors and combinations, 1988-95

	1988	1989	1990	1991	1992	1993	1994	1995
Government	7870	8078	8263	8450	8806	9349	9623	9697
Private-Non-P	5674	6270	6589	7092	7563	8546	9162	9128
Industry	3238	3496	3771	3994	4138	4733	4885	4980
Gov+PNP	2195	2427	2527	2745	2870	3175	3385	3370
Gov+Ind.	1041	1069	1238	1338	1394	1634	1634	1651
Ind.+PNP	787	901	898	1056	1070	1432	1523	1515
G+PNP+Ind.	337	390	412	471	441	585	638	617
ROD, inspected	23256	23998	25081	25599	26522	27631	28977	28694

Table A29 Numbers of ROD papers funded by the main sectors and combinations, 1988-95 (estimated, allowing for uninspected papers) (Figure 3.1)

Year:	1988	1989	1990	1991	1992	1993	1994	1995	Total
Government	7903	8108	8311	8505	8937	9540	9887	10492	71683
Private-Non-P	5698	6293	6628	7138	7675	8720	9413	9877	61442
Industry	3252	3509	3793	4020	4199	4830	5019	5388	34010
Gov-PNP	2204	2436	2542	2763	2913	3240	3478	3646	23222
Gov+Ind.	1045	1073	1245	1347	1415	1667	1679	1786	11258
Ind.+PNP	790	904	903	1063	1086	1461	1565	1639	9412
G+PNP+Ind.	338	391	414	474	448	597	656	668	3986
ROD	23354	24087	25228	25765	26916	28195	29772	31047	214364

Note: The papers have been adjusted up proportionally to compensate for papers not yet inspected, on the assumption that these papers have a similar profile to those already inspected. In the Venn diagram (Figure 3.1) figures for the total period (1988-95) have been divided by 8 to give the yearly balance of funding and co-funding.

Table A30 Percentages of ROD papers acknowledging UK Government and Research Councils in 20 subfields ranked by percent acknowledging Government support, 1988-95 (Tables 3.4, 3.5)

	Total	UK Gov.	% Total	UK RCs	% Total
GENET	20620	10730	52.04	9481	45.98
DEVEL	6190	2971	48.00	2614	42.23
TROPM	4324	1767	40.86	1316	30.43
IMMUN	17186	6810	39.63	5235	30.46
NEURO	25240	9565	37.90	8496	33.66
OBSGY	12069	3628	30.06	2573	21.32
NEONA	3989	1165	29.21	804	20.16
MULSC	725	206	28.41	186	25.66
HAEMA	12069	3402	28.19	2350	19.47
GERON	3728	998	26.77	673	18.05
OPHTH	5354	1359	25.38	1098	20.51
HISTP	8682	2190	25.22	1531	17.63
GASTR	14945	3759	25.15	2380	15.93
RESPI	9969	2303	23.10	1580	15.85
RENAL	4660	967	20.75	623	13.37
ONCOL	19654	3953	20.11	2778	14.13
ARTHR	6672	1335	20.01	955	14.31
CARDI	19084	3580	18.76	2615	13.70
NURSE	2583	475	18.39	128	4.96
ANEST	6426	956	14.88	636	9.90
ROD, inspected	209758	70136	33.4	52433	25.0

For a key to the subfield abbreviations see Table 1.1 in main text

Table A31 Private-non-profit acknowledgements by sub-sector, 1988-95

	1988	1989	1990	1991	1992	1993	1994	1995
Charities	3234	3586	3762	4067	4363	4605	4817	4816
CH%	13.9	14.9	15.0	15.9	16.5	16.7	16.6	16.8
Foundations	1980	2211	2352	2536	2784	3197	3541	3731
FO%	8.5	9.2	9.4	9.9	10.5	11.6	12.2	13.0
Hospital Trustees	567	591	606	643	728	1014	1074	705
HT%	2.4	2.5	2.4	2.5	2.7	3.7	3.7	2.5
Mixed (academic)	362	385	419	446	468	603	668	722
MI%	1.6	1.6	1.7	1.7	1.8	2.2	2.3	2.5
Other Non-Profit	634	720	779	904	1033	1309	1444	1262
NP%	2.7	3.0	3.1	3.5	3.9	4.7	5.0	4.4
Total P-N-P	5674	6270	6589	7092	7563	8546	9161	9128
P-N-P%	24.4	26.1	26.3	27.7	28.5	30.9	31.6	31.8
ROD, inspected	23256	23998	25081	25599	26522	27631	28977	28694

Table A32 Percentages of papers acknowledging the UK private-non-profit sector and the Wellcome Trust, in 20 subfields, ranked by percent acknowledging private-non-profit support, 1988-95 (Tables 3.6, 3.7)

	Total	P-N-P	% Total	WT	% Total
MULSC	725	443	61.10	116	16.00
ONCOL	19654	8995	45.77	568	2.89
GENET	20620	9174	44.49	2439	11.83
DEVEL	6190	2697	43.57	760	12.28
ARTHR	6672	2781	41.68	446	6.68
IMMUN	17186	7043	40.98	2164	12.59
NEONA	3989	1561	39.13	441	11.06
HISTP	8682	3285	37.84	668	7.69
TROPM	4324	1603	37.07	1128	26.09
HAEMA	12069	4448	36.85	837	6.94
NEURO	25240	8650	34.27	3845	15.23
CARDI	19084	6150	32.23	1413	7.40
OPHTH	5354	1724	32.20	628	11.73
OBSGY	12069	3826	31.70	772	6.40
RESPI	9969	2889	28.98	649	6.51
RENAL	4660	1282	27.51	345	7.40
GASTR	14945	3853	25.78	1048	7.01
GERON	3728	898	24.09	237	6.36
ANEST	6426	1044	16.25	334	5.20
NURSE	2583	357	13.82	21	0.81
ROD, inspected	209758	60024	28.6	16097	7.7

For a key to the subfield abbreviations see Table 1.1 in main text

Table A33 Percentages of papers acknowledging industrial funding, the pharmaceutical industry and UK biotech companies, in 20 subfields ranked by percent acknowledging industrial support, 1988-95 (Tables 3.10, 3.11, 3.12)

	Total	Industry	% Total	Pharm.	% Total	UK BT
TROPM	4324	1111	25.69	398	9.20	12
ANEST	6426	1291	20.09	988	15.38	7
CARDI	19084	3387	17.75	2710	14.20	90
NEURO	25240	4382	17.36	3518	13.94	72
RESPI	9969	1709	17.14	1243	12.47	16
IMMUN	17186	2886	16.79	1916	11.15	196
GASTR	14945	2238	14.97	1662	11.12	54
HAEMA	12069	1807	14.97	1263	10.46	65
ARTHR	6672	992	14.87	776	11.63	35
NEONA	3989	570	14.29	406	10.18	8
RENAL	4660	666	14.29	533	11.44	11
GERON	3728	503	13.49	376	10.09	18
GENET	20620	2593	12.58	1626	7.89	145
OBSGY	12069	1503	12.45	1009	8.36	22
ONCOL	19654	2179	11.09	1552	7.90	136
MULSC	725	74	10.21	41	5.66	2
DEVEL	6190	603	9.74	342	5.53	16
HISTP	8682	797	9.18	536	6.17	18
OPHTH	5354	445	8.31	240	4.48	8
NURSE	2583	121	4.68	91	3.52	3
ROD, inspected	209758	33235	15.8	22693	10.8	

Table A34 Distribution of Research Council-funded papers by Research Level (1=clinical,4=basic), 1988-95 (percentages exclude n.a. papers) (Figure 3.3)

	1988	1989	1990	1991	1992	1993	1994	1995	Total
RL1 n	309	318	337	307	296	330	298	275	2470
%	5.3	5.3	5.6	5.0	4.7	5.1	4.5	4.2	
RL2 n	873	872	855	852	782	837	835	788	6694
%	15.0	14.6	14.1	13.8	12.4	12.8	12.6	12.0	
RL3 n	1539	1509	1480	1485	1623	1682	1640	1555	12513
%	26.5	25.2	24.5	24.1	25.8	25.8	24.7	23.6	
RL4 n	3083	3293	3381	3528	3589	3668	3868	3962	28372
%	53.1	55.0	55.9	57.2	57.1	56.3	58.2	60.2	
n.a.	148	157	154	204	285	371	444	621	2384
Total	5952	6149	6207	6376	6575	6888	7085	7201	52433

Table A35 Distribution of Wellcome Trust-funded papers by Research Level, 1988-95 (percentages exclude n.a. papers) (Figure 3.5)

	1988	1989	1990	1991	1992	1993	1994	1995	Total
RL1 n	70	104	82	83	98	110	134	140	821
%	5.1	6.9	4.9	4.7	5.1	5.1	5.4	5.2	
RL2 n	314	260	288	289	308	320	335	317	2431
%	23.0	17.2	17.3	16.3	15.9	14.7	13.4	11.7	
RL3 n	413	432	491	485	550	613	672	698	4354
%	30.3	28.5	29.5	27.4	28.4	28.2	26.9	25.8	
RL4 n	568	718	805	915	982	1133	1356	1549	8026
%	41.6	47.4	48.3	51.6	50.7	52.1	54.3	57.3	
n.a.	14	22	16	20	34	59	101	199	465
Total	1379	1536	1682	1792	1972	2235	2598	2903	16097

Table A36 Distribution of pharmaceutical industry-funded papers by Research Level, 1988-95 (percentages exclude n.a. papers) (Figure 3.7)

	1988	1989	1990	1991	1992	1993	1994	1995	Total
RL1 n	208	211	189	195	184	239	191	191	1608
%	9.2	8.6	7.3	7.0	6.4	7.5	6.1	6.0	
RL2 n	571	623	618	627	592	593	583	576	4783
%	25.3	25.3	23.8	22.5	20.7	18.6	18.6	18.0	
RL3 n	849	892	965	1071	1085	1250	1145	1199	8456
%	37.6	36.3	37.2	38.4	37.9	39.2	36.5	37.5	
RL4 n	631	734	824	898	1005	1108	1214	1231	7645
%	27.9	29.8	31.7	32.2	35.1	34.7	38.7	38.5	
n.a.	13	12	11	16	50	73	110	186	471
Total	2272	2472	2607	2807	2916	3263	3243	3383	22963

Table A37 Distribution of papers with no funding acknowledgements by Research Level, 1988-95 (percentages exclude n.a. papers) (Figure 3.9)

	1988	1989	1990	1991	1992	1993	1994	1995	Total
RL1 n	3219	3200	3214	3355	3267	3158	3323	3054	25790
%	36.8	36.9	35.1	37.2	36.4	37.5	38.0	36.5	
RL2 n	2916	2893	3174	3003	3101	2893	2921	2852	23753
%	33.3	33.4	34.6	33.3	34.6	34.4	33.4	34.1	
RL3 n	1470	1532	1581	1580	1644	1447	1496	1426	12176
%	16.8	17.7	17.2	17.5	18.3	17.2	17.1	17	
RL4 n	1149	1046	1200	1082	954	916	1001	1033	8381
%	13.1	12.1	13.1	12.0	10.6	10.9	11.5	12.3	
n.a.	578	585	604	689	844	942	1124	1126	6492
Total	9332	9256	9773	9709	9810	9356	9865	9491	76592

Table A38 UK biotechnology companies with funding acknowledgements from ROD papers

Biotechnology Company Name	Trigraph
Agricultural Genetics Co Ltd (Babraham)	AGC
British Biotechnology Group plc	BBL
Biocompatibles plc	BCE
Biocure (UK) Ltd	BCK
Haemocell plc	BHO
Cambridge Antibody Technology Ltd (Babraham Hall)	CAT
Celltech Group plc	CEL
Chiroscience Group plc	CIZ
Cortecs (Diagnostics) Ltd	CTE
Cantab (Pharmaceuticals) Ltd	CTL
Drew Scientific Limited	DWF
Ethical Pharmaceuticals	EPY
Galen Research & Consultancy	GAN
Helix Biotechnology Ltd	HIX
Innovative Technologies Ltd	IVV
M L Laboratories plc	MLZ
Medeva plc	MVE
Neures Limited (British Biotech)	NUE
Oxford Glycosystems Ltd	OXG
Oxford Molecular Ltd	OXL
Phytopharm plc	PML
P P L Therapeutics plc	PPZ
Proteus Biotechnology/Molecular Design Ltd	PRO
Quadrant Research Foundation Ltd	QDR
Reynolds Medical Ltd	REM
Scotia Pharmaceuticals plc	SCP
Shire Pharmaceuticals Ltd	SHR
Shield Diagnostics Ltd	SJD
Therapeutic Antibodies Inc.	TAB
Therexsys Ltd	TSX
Univet Ltd	UVE
Vanguard Medica Ltd	VGM
Xenova Ltd	XEN
Capteur Sensors and Analysers Ltd	ZCA

Table A39 Papers in ROD acknowledging support from the European Union (EU) and United Nations (UN) organisations, 1988-95 (Figure 3.8)

	1988	1989	1990	1991	1992	1993	1994	1995
EU papers n	195	268	296	335	451	555	777	999
%	0.84	1.12	1.18	1.31	1.70	2.01	2.68	3.50
UN papers n	345	339	426	413	442	502	551	462
%	1.48	1.41	1.70	1.61	1.67	1.82	1.90	1.61
ROD, inspected	23256	23998	25081	25599	26522	27631	28977	28694

Table A40 Papers in ROD acknowledging support from sources in foreign countries, 1988-95 (Table 3.13)

		1988	1989	1990	1991	1992	1993	1994	1995
United States	US	8.20	8.27	8.16	8.45	8.65	9.47	9.66	10.04
Germany	DE	2.03	2.01	2.08	2.11	2.50	2.54	2.58	2.82
France	FR	1.49	1.52	1.65	1.64	1.91	1.99	2.24	2.32
Switzerland	CH	1.57	1.52	1.61	1.68	1.70	1.78	1.60	1.70
Australia	AU	0.51	0.49	0.49	0.61	0.57	0.83	0.91	1.27
Italy	IT	0.64	0.62	0.69	0.82	0.91	0.96	0.99	1.17
Japan	JP	0.28	0.31	0.39	0.46	0.64	0.78	0.85	1.12
Canada	CA	0.68	0.87	0.76	0.77	0.86	0.89	0.98	1.06
Netherlands	NL	0.40	0.53	0.56	0.58	0.78	0.86	0.84	1.04
Sweden	SE	0.97	0.94	1.07	1.13	1.13	1.07	1.11	1.01
Spain	ES	0.29	0.35	0.43	0.48	0.71	0.71	0.79	0.86
Denmark	DK	0.41	0.43	0.47	0.50	0.57	0.60	0.67	0.71
Belgium	BE	0.40	0.33	0.47	0.49	0.48	0.54	0.58	0.60
Brazil	BR	0.20	0.21	0.28	0.34	0.38	0.44	0.44	0.51
Finland	FI	0.12	0.18	0.18	0.21	0.22	0.24	0.21	0.28
Norway	NO	0.12	0.09	0.14	0.10	0.12	0.17	0.19	0.25
Portugal	PT	0.06	0.04	0.06	0.07	0.10	0.13	0.15	0.24
Greece	GR	0.12	0.10	0.12	0.11	0.10	0.13	0.10	0.17
Ireland	IE	0.09	0.10	0.10	0.14	0.13	0.14	0.19	0.17
New Zealand	NZ	0.17	0.15	0.10	0.13	0.16	0.15	0.14	0.17
Kenya	KE	0.06	0.06	0.07	0.09	0.10	0.18	0.15	0.16
South Africa	ZA	0.06	0.16	0.12	0.10	0.13	0.16	0.14	0.14
Hong Kong	HK	0.05	0.05	0.05	0.10	0.09	0.11	0.09	0.12
India	IN	0.11	0.06	0.06	0.07	0.07	0.08	0.08	0.11
People's Rep. China	CN	0.08	0.09	0.09	0.11	0.08	0.13	0.07	0.09
Iraq	IQ	0.08	0.08	0.07	0.03	0.03	0.03	0.00	0.01
Unknown	XX	1.72	1.69	1.78	1.95	2.58	3.00	3.09	0.78
ROD, inspected		23256	23998	25081	25599	26522	27631	28977	28694

Table A41 Percentage of papers in 20 subfields without funding acknowledgements and provenance of these from hospitals (HOSP, INFIRM or NHS in address) and universities (COLL, SCH or UNIV in address) (Table 3.14)

Subfield	Total	No ack.	% no ack.	Hosp	% H	Univ	% U
NURSE	2583	1725	66.8	897	52.0	1137	65.9
ANEST	6426	3701	57.6	3130	84.6	1658	44.8
RENAL	4660	2294	49.2	2001	87.2	1104	48.1
GERON	3728	1785	47.9	1295	72.5	1071	60.0
GASTR	14945	6873	46.0	5780	84.1	3798	55.3
CARDI	19084	8532	44.7	7047	82.6	4317	50.6
OPHTH	5354	2369	44.2	1775	74.9	1020	43.1
RESPI	9969	4407	44.2	3670	83.3	1891	42.9
HISTP	8682	3461	39.9	2473	71.5	2224	64.3
ARTHR	6672	2624	39.3	2182	83.2	1359	51.8
OBSGY	12069	4741	39.3	3658	77.2	2846	60.0
ONCOL	19654	7155	36.4	5930	82.9	3431	48.0
NEONA	3989	1402	35.1	1103	78.7	760	54.2
HAEMA	12069	4226	35.0	3439	81.4	2216	52.4
NEURO	25240	7706	30.5	4415	57.3	4920	63.8
IMMUN	17186	4207	24.5	2993	71.1	2661	63.3
MULSC	725	165	22.8	123	74.5	86	52.1
TROPM	4324	908	21.0	363	40.0	720	79.3
DEVEL	6190	1136	18.4	549	48.3	823	72.4
GENET	20620	2857	13.9	1391	48.7	2122	74.3

For a key to the subfield abbreviations see Table 1.1 in main text

Table A42 Distribution of five-year impact factors determining impact categories, W, for 20 subfields (Journal impact factors taken from Journal of Expected Citation Rates file © Institute of Scientific Information, for 1992 items cited 1992-96) (Figure 4.1)

	W2	W3	W4		W2	W3	W4
MULSC	9.55	17.20	45.06	HISTP	5.77	10.65	19.77
GENET	8.86	15.54	29.66	GASTR	5.94	9.89	18.64
DEVEL	6.89	12.61	23.64	CARDI	5.80	10.08	18.61
ONCOL	6.11	11.70	23.64	OBSGY	5.72	10.03	17.82
HAEMA	6.86	11.45	22.04	RENAL	6.03	10.70	17.52
TROPM	5.26	11.25	21.20	RESPI	5.35	10.57	17.52
OPHTH	6.15	11.56	21.03	NEONA	5.80	10.19	17.24
IMMUN	7.04	12.46	20.90	GERON	5.12	9.69	16.24
NEURO	6.66	11.04	20.83	ANEST	4.95	9.09	14.76
ARTHR	6.57	11.46	20.39	NURSE	3.24	6.84	10.46

Table A43 Mean W and RL values for papers in each of 20 subfields acknowledging UK Government support

	Total	% no RL	Govt	Mean W	Mean RL
ANEST	6426	2.27	924	2.62	2.57
ARTHR	6672	3.04	1302	2.27	2.61
CARDI	19084	2.14	3502	2.46	2.80
DEVEL	6190	5.02	2859	2.60	3.59
GASTR	14945	2.25	3670	2.37	2.86
GENET	20620	3.71	10370	2.26	3.59
GERON	3728	17.33	858	2.45	2.45
HAEMA	12069	2.99	3285	2.33	2.94
HISTP	8682	2.26	2150	2.30	3.08
IMMUN	17186	1.55	6721	2.34	2.98
MULSC	725	1.10	206	2.29	2.96
NEONA	3989	3.28	1119	2.27	2.67
NEURO	25240	5.38	9165	2.49	3.34
NURSE	2583	49.25	297	2.63	1.49
OBSGY	12069	3.95	3510	2.27	2.75
ONCOL	19654	2.68	3893	2.41	2.72
OPHTH	5354	3.18	1298	2.17	3.20
RENAL	4660	1.18	958	2.31	2.82
RESPI	9969	1.74	2269	2.26	2.62
TROPM	4324	2.43	1732	2.03	2.92

Note: ‘W’ values are not comparable across subfields but may be compared across sectors for the same subfield (i.e. across tables)

For a key to the subfield abbreviations see Table 1.1 in main text

Table A44 Mean W and RL values for papers in each of 20 subfields acknowledging Research Council support (Figure 4.3) - *W not comparable across subfields*

	Total	% no RL	RCs	Mean W	Mean RL
ANEST	6426	2.27	616	2.78	2.81
ARTHR	6672	3.04	935	2.38	2.76
CARDI	19084	2.14	2568	2.59	2.95
DEVEL	6190	5.02	2512	2.72	3.68
GASTR	14945	2.25	2331	2.50	3.06
GENET	20620	3.71	9149	2.34	3.64
GERON	3728	17.33	591	2.64	2.72
HAEMA	12069	2.99	2282	2.50	3.08
HISTP	8682	2.26	1501	2.45	3.22
IMMUN	17186	1.55	5177	2.48	3.07
MULSC	725	1.10	186	2.39	3.02
NEONA	3989	3.28	777	2.35	2.83
NEURO	25240	5.38	8149	2.56	3.41
NURSE	2583	49.25	91	2.80	1.77
OBSGY	12069	3.95	2495	2.38	2.92
ONCOL	19654	2.68	2744	2.52	2.87
OPHTH	5354	3.18	1049	2.34	3.37
RENAL	4660	1.18	615	2.45	2.97
RESPI	9969	1.74	1554	2.42	2.80
TROPM	4324	2.43	1302	2.13	3.06

Table A45 Mean W and RL values for papers in each of 20 subfields acknowledging UK private-non-profit sector support - *W not comparable across subfields*

	Total	% no RL	P-N-P	Mean W	Mean RL
ANEST	6426	2.27	1022	2.55	2.48
ARTHR	6672	3.04	2718	2.23	2.45
CARDI	19084	2.14	6054	2.48	2.71
DEVEL	6190	5.02	2627	2.67	3.47
GASTR	14945	2.25	3792	2.46	2.62
GENET	20620	3.71	8854	2.38	3.37
GERON	3728	17.33	787	2.43	2.50
HAEMA	12069	2.99	4344	2.38	2.79
HISTP	8682	2.26	3244	2.38	2.87
IMMUN	17186	1.55	6977	2.42	2.87
MULSC	725	1.10	441	2.06	2.91
NEONA	3989	3.28	1522	2.32	2.66
NEURO	25240	5.38	8411	2.51	3.20
NURSE	2583	49.25	210	2.69	1.62
OBSGY	12069	3.95	3717	2.30	2.59
ONCOL	19654	2.68	8869	2.42	2.63
OPHTH	5354	3.18	1693	1.96	2.81
RENAL	4660	1.18	1268	2.35	2.79
RESPI	9969	1.74	2854	2.28	2.48
TROPM	4324	2.43	1582	2.11	2.85

Table A46 Mean W and RL values for papers in each of 20 subfields acknowledging Wellcome Trust support (Figure 4.4) - *W not comparable across subfields*

	Total	% no RL	Wellcome Trust	Mean W	Mean RL
ANEST	6426	2.27	326	2.88	3.11
ARTHR	6672	3.04	435	2.47	2.74
CARDI	19084	2.14	1390	2.68	3.12
DEVEL	6190	5.02	746	2.84	3.72
GASTR	14945	2.25	1033	2.52	2.87
GENET	20620	3.71	2325	2.45	3.48
GERON	3728	17.33	207	2.77	2.89
HAEMA	12069	2.99	814	2.59	3.06
HISTP	8682	2.26	660	2.48	3.13
IMMUN	17186	1.55	2140	2.47	2.98
MULSC	725	1.10	115	2.14	3.23
NEONA	3989	3.28	435	2.63	3.13
NEURO	25240	5.38	3766	2.65	3.47
NURSE	2583	49.25	17	2.65	1.76
OBSGY	12069	3.95	754	2.40	2.92
ONCOL	19654	2.68	564	2.57	3.00
OPHTH	5354	3.18	614	2.27	3.25
RENAL	4660	1.18	340	2.55	3.00
RESPI	9969	1.74	639	2.41	2.90
TROPM	4324	2.43	1117	2.25	3.04

Table A47 Mean W and RL values for papers in each of 20 subfields acknowledging industry support (worldwide) - *W not comparable across subfields*

	Total	% no RL	Industry	Mean W	Mean RL
ANEST	6426	2.27	1277	2.50	2.32
ARTHR	6672	3.04	970	2.24	2.47
CARDI	19084	2.14	3346	2.37	2.68
DEVEL	6190	5.02	583	2.48	3.40
GASTR	14945	2.25	2187	2.35	2.61
GENET	20620	3.71	2531	2.29	3.49
GERON	3728	17.33	463	2.35	2.35
HAEMA	12069	2.99	1741	2.27	2.83
HISTP	8682	2.26	780	2.31	2.92
IMMUN	17186	1.55	2851	2.37	2.90
MULSC	725	1.10	74	2.15	2.91
NEONA	3989	3.28	567	2.50	2.66
NEURO	25240	5.38	4283	2.45	3.19
NURSE	2583	49.25	95	2.78	1.87
OBSGY	12069	3.95	1469	2.23	2.57
ONCOL	19654	2.68	2155	2.30	2.72
OPHTH	5354	3.18	435	1.71	2.61
RENAL	4660	1.18	659	2.27	2.69
RESPI	9969	1.74	1688	2.21	2.40
TROPM	4324	2.43	1098	2.04	2.78

Table A48 Mean W and RL values for papers in each of 20 subfields acknowledging pharmaceutical company support (Figure 4.5) - *W not comparable across subfields*

	Total	% no RL	Pharm.	Mean W	Mean RL
ANEST	6426	2.27	979	2.53	2.40
ARTHR	6672	3.04	765	2.20	2.45
CARDI	19084	2.14	2682	2.42	2.74
DEVEL	6190	5.02	330	2.55	3.47
GASTR	14945	2.25	1633	2.39	2.65
GENET	20620	3.71	1591	2.34	3.52
GERON	3728	17.33	352	2.38	2.36
HAEMA	12069	2.99	1216	2.30	2.85
HISTP	8682	2.26	524	2.37	2.93
IMMUN	17186	1.55	1899	2.40	2.91
MULSC	725	1.10	41	2.12	2.90
NEONA	3989	3.28	404	2.62	2.73
NEURO	25240	5.38	3455	2.49	3.21
NURSE	2583	49.25	76	2.78	1.93
OBSGY	12069	3.95	988	2.34	2.63
ONCOL	19654	2.68	1540	2.33	2.75
OPHTH	5354	3.18	234	1.80	2.63
RENAL	4660	1.18	528	2.32	2.68
RESPI	9969	1.74	1230	2.24	2.45
TROPM	4324	2.43	393	2.01	2.68

Table A49 Mean W and RL values for papers in each of 20 subfields acknowledging UK biotech company support - *W not comparable across subfields*

	Total	% no RL	Biotech.	Mean W	Mean RL
ANEST	6426	2.27	7	2.57	1.86
ARTHR	6672	3.04	35	2.46	2.66
CARDI	19084	2.14	88	2.58	3.03
DEVEL	6190	5.02	15	2.47	3.53
GASTR	14945	2.25	54	2.46	2.54
GENET	20620	3.71	143	2.36	3.71
GERON	3728	17.33	14	2.07	1.86
HAEMA	12069	2.99	62	2.58	3.16
HISTP	8682	2.26	18	2.67	3.17
IMMUN	17186	1.55	193	2.67	3.11
MULSC	725	1.10	2	2.00	3.50
NEONA	3989	3.28	8	3.50	2.75
NEURO	25240	5.38	68	2.46	2.87
NURSE	2583	49.25	1	2.00	1.00
OBSGY	12069	3.95	21	2.24	3.00
ONCOL	19654	2.68	133	2.65	2.76
OPHTH	5354	3.18	8	1.00	2.13
RENAL	4660	1.18	10	1.80	2.70
RESPI	9969	1.74	16	2.63	2.88
TROPM	4324	2.43	12	2.25	2.83

Table A50 Mean W and RL values for papers in each of 20 subfields acknowledging any funding support (Figures 4.3, 4.4, 4.5) - *W not comparable across subfields*

	Total	% no RL	Acknowledged	Mean W	Mean RL
ANEST	6426	2.27	2667	2.51	2.39
ARTHR	6672	3.04	3948	2.18	2.44
CARDI	19084	2.14	10364	2.39	2.68
DEVEL	6190	5.02	4879	2.56	3.49
GASTR	14945	2.25	7905	2.37	2.68
GENET	20620	3.71	17181	2.28	3.48
GERON	3728	17.33	1698	2.34	2.38
HAEMA	12069	2.99	7608	2.28	2.81
HISTP	8682	2.26	5134	2.29	2.90
IMMUN	17186	1.55	12831	2.32	2.91
MULSC	725	1.10	558	2.09	2.94
NEONA	3989	3.28	2507	2.28	2.63
NEURO	25240	5.38	16896	2.44	3.23
NURSE	2583	49.25	537	2.59	1.55
OBSGY	12069	3.95	7093	2.23	2.61
ONCOL	19654	2.68	12310	2.36	2.64
OPHTH	5354	3.18	2892	1.94	2.89
RENAL	4660	1.18	2343	2.28	2.75
RESPI	9969	1.74	5484	2.22	2.47
TROPM	4324	2.43	3350	1.98	2.77

Table A51 Mean W and RL values for papers in each of 20 subfields without funding acknowledgements - *W not comparable across subfields*

	Total	% no RL	Non Acknowledged	Mean W	Mean RL
ANEST	6426	2.27	3613	2.11	1.62
ARTHR	6672	3.04	2521	1.71	1.81
CARDI	19084	2.14	8312	1.76	1.87
DEVEL	6190	5.02	1000	1.74	2.70
GASTR	14945	2.25	6704	1.87	1.83
GENET	20620	3.71	2673	1.67	2.91
GERON	3728	17.33	1384	1.83	1.76
HAEMA	12069	2.99	4100	1.63	2.16
HISTP	8682	2.26	3352	1.80	2.24
IMMUN	17186	1.55	4089	1.78	2.48
MULSC	725	1.10	159	1.52	2.23
NEONA	3989	3.28	1351	1.74	1.97
NEURO	25240	5.38	6985	1.76	2.42
NURSE	2583	49.25	774	2.11	1.55
OBSGY	12069	3.95	4499	1.78	1.93
ONCOL	19654	2.68	6817	1.64	1.87
OPHTH	5354	3.18	2292	1.32	2.08
RENAL	4660	1.18	2262	1.68	2.09
RESPI	9969	1.74	4312	1.79	1.72
TROPM	4324	2.43	869	1.47	2.25

Table A52 ROD papers, 1988-94, in 20 subfields cited by US patents (1988-96), ranked by numbers cited on patents, with distribution by Research Level (Table 4.2)

	Total	RL1	RL2	RL3	RL4	n.a.	Cited	% cited
GENET	17217	3	45	82	426	7	563	3.27
IMMUN	14933	5	72	268	146	1	492	3.29
NEURO	21621	17	39	110	150	6	322	1.49
ONCOL	16940	10	79	116	87	3	295	1.74
CARDI	16408	27	59	114	59	1	260	1.58
HAEMA	10453	9	42	100	61	1	213	2.04
GASTR	12948	12	69	61	38		180	1.39
RESPI	8570	19	27	45	35	1	127	1.48
OBSGY	10351	16	35	43	21		115	1.11
ARTHR	5736	6	45	39	20		110	1.92
DEVEL	5231		14	21	64		99	1.89
HISTP	7621	7	19	26	21		73	0.96
ANEST	5626	21	15	25	9		70	1.24
TROPM	3732	2	10	26	31		69	1.85
OPHTH	4615	3	12	14	12		41	0.89
GERON	3205	6	8	4	17	1	36	1.12
NEONA	3413	3	11	12	9	1	36	1.05
RENAL	4128	4	2	15	6		27	0.65
MULSC	623		4	1	6		11	1.77
NURSE	2068	1					1	0.05

Source: Wellcome Trust, TechTrac

Table A53 US patents (1988-96) citing UK biomedical papers, 1988-94, in 20 subfields ranked by percentage of UK inventors (Table 4.2)

	Total	Papers cited	Citing patents	UK inv.	%
GASTR	12948	180	224	35	15.6
NEONA	3413	36	40	6	15.0
NEURO	21621	322	371	54	14.6
ONCOL	16940	295	327	36	11.0
ARTHR	5736	110	129	12	9.3
ANEST	5626	70	98	9	9.2
GENET	17217	563	637	56	8.8
HAEMA	10453	213	268	19	7.1
IMMUN	14933	492	519	34	6.6
RESPI	8570	127	131	8	6.1
CARDI	16408	260	293	17	5.8
OBSGY	10351	115	125	7	5.6
TROPM	3732	69	55	3	5.5
GERON	3205	36	43	2	4.7
HISTP	7621	73	91	4	4.4
DEVEL	5231	99	93	4	4.3
RENAL	4128	27	33	1	3.0
MULSC	623	11	7		0.0
NURSE	2068	1	1		0.0
OPHTH	4615	41	39		0.0

Source: Wellcome Trust, TechTrac

Anaesthetics research (ANEST)

Table A54a Papers in SCI, CD-ROM version, for 12 OECD countries in Anaesthetics research (ANEST), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	746	728	802	810	861	836	843	779	820
AU	156	183	199	215	210	224	227	242	219
CA	343	326	378	353	364	360	366	346	388
CH	95	89	95	94	91	102	137	116	110
DE	370	366	433	375	433	418	453	507	554
ES	56	73	75	87	113	102	107	125	162
FR	226	239	298	258	290	274	318	321	359
IT	174	188	215	203	248	192	206	217	212
JP	249	282	307	321	375	415	431	415	477
NL	108	100	109	139	127	116	136	149	170
SE	238	245	246	207	202	208	193	240	240
US	2176	2473	2390	2435	2304	2453	2458	2504	2362
Total	4937	5292	5547	5497	5618	5700	5875	5961	6073
World	5570	5999	6224	6111	6290	6328	6487	6698	6650
12 N	4749	5103	5328	5269	5376	5411	5567	5623	5679
m, %	4.0	3.7	4.1	4.3	4.5	5.3	5.5	6.0	6.9

Source: Science Citation Index, 1988-96

Table A54b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Anaesthetics research (ANEST), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	13.4	12.1	12.9	13.3	13.7	13.2	13.0	11.6	12.3
AU	2.8	3.1	3.2	3.5	3.3	3.5	3.5	3.6	3.3
CA	6.2	5.4	6.1	5.8	5.8	5.7	5.6	5.2	5.8
CH	1.7	1.5	1.5	1.5	1.4	1.6	2.1	1.7	1.7
DE	6.6	6.1	7.0	6.1	6.9	6.6	7.0	7.6	8.3
ES	1.0	1.2	1.2	1.4	1.8	1.6	1.6	1.9	2.4
FR	4.1	4.0	4.8	4.2	4.6	4.3	4.9	4.8	5.4
IT	3.1	3.1	3.5	3.3	3.9	3.0	3.2	3.2	3.2
JP	4.5	4.7	4.9	5.3	6.0	6.6	6.6	6.2	7.2
NL	1.9	1.7	1.8	2.3	2.0	1.8	2.1	2.2	2.6
SE	4.3	4.1	4.0	3.4	3.2	3.3	3.0	3.6	3.6
US	39.1	41.2	38.4	39.8	36.6	38.8	37.9	37.4	35.5

Source: Science Citation Index, 1988-96

Arthritis and Rheumatism research (ARTHR)

Table A55a Papers in SCI, CD-ROM version, for 12 OECD countries in Arthritis & Rheumatism research (ARTHR), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	717	633	758	829	932	943	967	924	941
AU	179	145	169	164	163	195	182	208	213
CA	293	261	277	284	322	330	364	383	384
CH	102	114	100	108	137	124	149	158	203
DE	246	271	311	305	370	364	399	422	490
ES	65	59	74	100	121	136	163	154	156
FR	351	365	410	416	420	472	458	495	469
IT	117	148	172	178	228	246	254	317	378
JP	271	312	348	414	467	522	568	589	674
NL	160	155	196	206	220	227	261	245	237
SE	153	172	162	170	164	180	189	197	229
US	2142	2256	2216	2256	2411	2396	2541	2696	2620
Total	4796	4891	5193	5430	5955	6135	6495	6788	6994
World	5364	5517	5754	5959	6397	6582	6936	7101	7137
12 N	4538	4688	4859	5016	5623	5634	5944	6242	6234
m, %	5.7	4.3	6.9	8.3	5.9	8.9	9.3	8.7	12.2

Source: Science Citation Index, 1988-96

Table A55b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Arthritis & Rheumatism research (ARTHR), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	13.4	11.5	13.2	13.9	14.6	14.3	13.9	13.0	13.2
AU	3.3	2.6	2.9	2.8	2.5	3.0	2.6	2.9	3.0
CA	5.5	4.7	4.8	4.8	5.0	5.0	5.2	5.4	5.4
CH	1.9	2.1	1.7	1.8	2.1	1.9	2.1	2.2	2.8
DE	4.6	4.9	5.4	5.1	5.8	5.5	5.8	5.9	6.9
ES	1.2	1.1	1.3	1.7	1.9	2.1	2.4	2.2	2.2
FR	6.5	6.6	7.1	7.0	6.6	7.2	6.6	7.0	6.6
IT	2.2	2.7	3.0	3.0	3.6	3.7	3.7	4.5	5.3
JP	5.1	5.7	6.0	6.9	7.3	7.9	8.2	8.3	9.4
NL	3.0	2.8	3.4	3.5	3.4	3.4	3.8	3.5	3.3
SE	2.9	3.1	2.8	2.9	2.6	2.7	2.7	2.8	3.2
US	39.9	40.9	38.5	37.9	37.7	36.4	36.6	38.0	36.7

Source: Science Citation Index, 1988-96

Cardiology research (CARDI)

Table A56a Papers in SCI, CD-ROM version, for 12 OECD countries in Cardiology research (CARDI), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	2014	2302	2288	2421	2652	2589	2823	2720	2667
AU	511	598	500	560	598	601	662	701	687
CA	1084	1230	1221	1330	1376	1306	1389	1389	1383
CH	415	462	417	476	499	513	503	597	553
DE	1928	1885	1913	2054	2241	2073	2308	2426	2367
ES	216	261	302	324	445	422	454	522	553
FR	1368	1442	1505	1523	1726	1554	1710	1815	1850
IT	871	1035	1056	1148	1316	1195	1390	1426	1482
JP	1953	2310	2296	2661	2954	2941	3202	3245	3330
NL	631	725	681	752	818	876	909	975	1046
SE	667	723	701	742	759	713	751	715	790
US	10192	11077	10849	11544	11480	11169	11553	11939	11439
Total	21850	24050	23729	25535	26864	25952	27654	28470	28147
World	24721	26889	26463	28417	29120	27735	29973	30230	29833
12 N	20891	22919	22562	24154	25221	24323	25741	26346	26017
m, %	4.6	4.9	5.2	5.7	6.5	6.7	7.4	8.1	8.2

Source: Science Citation Index, 1988-96

Table A56b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Cardiology research (CARDI), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	8.1	8.6	8.6	8.5	9.1	9.3	9.4	9.0	8.9
AU	2.1	2.2	1.9	2.0	2.1	2.2	2.2	2.3	2.3
CA	4.4	4.6	4.6	4.7	4.7	4.7	4.6	4.6	4.6
CH	1.7	1.7	1.6	1.7	1.7	1.8	1.7	2.0	1.9
DE	7.8	7.0	7.2	7.2	7.7	7.5	7.7	8.0	7.9
ES	0.9	1.0	1.1	1.1	1.5	1.5	1.5	1.7	1.9
FR	5.5	5.4	5.7	5.4	5.9	5.6	5.7	6.0	6.2
IT	3.5	3.8	4.0	4.0	4.5	4.3	4.6	4.7	5.0
JP	7.9	8.6	8.7	9.4	10.1	10.6	10.7	10.7	11.2
NL	2.6	2.7	2.6	2.6	2.8	3.2	3.0	3.2	3.5
SE	2.7	2.7	2.6	2.6	2.6	2.6	2.5	2.4	2.6
US	41.2	41.2	41.0	40.6	39.4	40.3	38.5	39.5	38.3

Source: Science Citation Index, 1988-96

Developmental Biology research (DEVEL)

Table A57a Papers in SCI, CD-ROM version, for 12 OECD countries in Developmental Biology research (DEVEL), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	740	784	827	802	894	887	951	1058	1054
AU	220	227	243	218	266	279	321	324	305
CA	497	540	507	560	623	598	634	652	680
CH	154	138	157	179	167	182	189	216	232
DE	609	637	707	725	730	742	790	889	967
ES	106	132	130	160	182	208	209	262	293
FR	524	577	580	630	675	705	738	787	829
IT	228	258	288	276	345	359	389	458	471
JP	789	851	870	930	1021	1161	1200	1202	1228
NL	195	217	222	270	255	284	285	316	311
SE	127	133	146	131	159	160	154	180	227
US	3555	3831	3913	4030	4277	4453	4614	4903	4959
Total	7744	8325	8590	8911	9594	10018	10474	11247	11556
World	8356	8881	9080	9310	9927	10230	10749	11353	11562
12 N	7208	7750	7951	8167	8764	9115	9507	10096	10301
m, %	7.4	7.4	8.0	9.1	9.5	9.9	10.2	11.4	12.2

Source: Science Citation Index, 1988-96

Table A57b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Developmental Biology research (DEVEL), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	8.9	8.8	9.1	8.6	9.0	8.7	8.8	9.3	9.1
AU	2.6	2.6	2.7	2.3	2.7	2.7	3.0	2.9	2.6
CA	5.9	6.1	5.6	6.0	6.3	5.8	5.9	5.7	5.9
CH	1.8	1.6	1.7	1.9	1.7	1.8	1.8	1.9	2.0
DE	7.3	7.2	7.8	7.8	7.4	7.3	7.3	7.8	8.4
ES	1.3	1.5	1.4	1.7	1.8	2.0	1.9	2.3	2.5
FR	6.3	6.5	6.4	6.8	6.8	6.9	6.9	6.9	7.2
IT	2.7	2.9	3.2	3.0	3.5	3.5	3.6	4.0	4.1
JP	9.4	9.6	9.6	10.0	10.3	11.3	11.2	10.6	10.6
NL	2.3	2.4	2.4	2.9	2.6	2.8	2.7	2.8	2.7
SE	1.5	1.5	1.6	1.4	1.6	1.6	1.4	1.6	2.0
US	42.5	43.1	43.1	43.3	43.1	43.5	42.9	43.2	42.9

Source: Science Citation Index, 1988-96

Gastroenterology research (GASTR)

Table A58a Papers in SCI, CD-ROM version, for 12 OECD countries in Gastroenterology research (GASTR), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	1781	1839	1906	1873	1921	1966	2056	2034	1839
AU	345	361	417	432	459	501	508	589	632
CA	768	763	745	742	841	813	793	868	860
CH	236	250	268	256	332	352	396	366	363
DE	1239	1333	1357	1326	1469	1416	1425	1563	1596
ES	321	337	338	399	477	513	525	625	622
FR	957	1037	1089	1048	1197	1213	1315	1343	1324
IT	699	746	846	879	1001	984	1130	1141	1256
JP	1547	1797	1762	1895	2279	2413	2745	2842	3014
NL	370	506	502	452	471	599	584	627	607
SE	647	653	631	591	586	561	599	619	644
US	6019	6382	6260	6416	6590	6780	6911	6939	6840
Total	14929	16004	16121	16309	17623	18111	18987	19556	19597
World	17064	18216	18145	18285	19362	19644	20432	21006	21201
12 N	14114	15114	15141	15289	16410	16762	17536	18035	17994
m, %	5.8	5.9	6.5	6.7	7.4	8.0	8.3	8.4	8.9

Source: Science Citation Index, 1988-96

Table A58b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Gastroenterology research (GASTR), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	10.4	10.1	10.5	10.2	9.9	10.0	10.1	9.7	8.7
AU	2.0	2.0	2.3	2.4	2.4	2.6	2.5	2.8	3.0
CA	4.5	4.2	4.1	4.1	4.3	4.1	3.9	4.1	4.1
CH	1.4	1.4	1.5	1.4	1.7	1.8	1.9	1.7	1.7
DE	7.3	7.3	7.5	7.3	7.6	7.2	7.0	7.4	7.5
ES	1.9	1.9	1.9	2.2	2.5	2.6	2.6	3.0	2.9
FR	5.6	5.7	6.0	5.7	6.2	6.2	6.4	6.4	6.2
IT	4.1	4.1	4.7	4.8	5.2	5.0	5.5	5.4	5.9
JP	9.1	9.9	9.7	10.4	11.8	12.3	13.4	13.5	14.2
NL	2.2	2.8	2.8	2.5	2.4	3.0	2.9	3.0	2.9
SE	3.8	3.6	3.5	3.2	3.0	2.9	2.9	2.9	3.0
US	35.3	35.0	34.5	35.1	34.0	34.5	33.8	33.0	32.3

Source: Science Citation Index, 1988-96

Genetics research (GENET)

Table A59a Papers in SCI, CD-ROM version, for 12 OECD countries in Genetics research (GENET), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	1939	2130	2355	2570	2923	3099	3514	3750	3634
AU	572	609	654	739	784	874	933	1038	1043
CA	1099	1243	1316	1385	1606	1709	1809	1912	1970
CH	433	417	475	535	520	610	712	754	749
DE	1516	1714	1906	2091	2167	2387	2755	2899	3206
ES	261	299	383	464	495	638	693	746	873
FR	1312	1552	1686	1839	2068	2405	2539	2763	2888
IT	523	622	719	904	953	1042	1252	1378	1461
JP	1744	2010	2297	2514	2938	3186	3739	3983	4266
NL	542	655	709	794	895	943	983	1204	1093
SE	429	481	532	576	691	733	797	878	891
US	10154	11297	12247	13172	14284	15209	16235	16958	16798
Total	20524	23029	25279	27583	30324	32835	35961	38263	38872
World	21328	23670	25656	27523	30155	32202	34838	36878	37247
12 N	18768	20913	22794	24667	26984	29047	31410	33160	33584
m, %	9.4	10.1	10.9	11.8	12.4	13.0	14.5	15.4	15.8

Source: Science Citation Index, 1988-96

Table A59b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Genetics research (GENET), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	9.1	9.0	9.2	9.3	9.7	9.6	10.1	10.2	9.8
AU	2.7	2.6	2.5	2.7	2.6	2.7	2.7	2.8	2.8
CA	5.2	5.3	5.1	5.0	5.3	5.3	5.2	5.2	5.3
CH	2.0	1.8	1.9	1.9	1.7	1.9	2.0	2.0	2.0
DE	7.1	7.2	7.4	7.6	7.2	7.4	7.9	7.9	8.6
ES	1.2	1.3	1.5	1.7	1.6	2.0	2.0	2.0	2.3
FR	6.2	6.6	6.6	6.7	6.9	7.5	7.3	7.5	7.8
IT	2.5	2.6	2.8	3.3	3.2	3.2	3.6	3.7	3.9
JP	8.2	8.5	9.0	9.1	9.7	9.9	10.7	10.8	11.5
NL	2.5	2.8	2.8	2.9	3.0	2.9	2.8	3.3	2.9
SE	2.0	2.0	2.1	2.1	2.3	2.3	2.3	2.4	2.4
US	47.6	47.7	47.7	47.9	47.4	47.2	46.6	46.0	45.1

Source: Science Citation Index, 1988-96

Gerontology research (GERON)

Table A60a Papers in SCI, CD-ROM version, for 12 OECD countries in Gerontology research (GERON), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	320	397	389	420	402	382	492	439	504
AU	52	70	67	86	98	91	145	138	141
CA	140	176	152	184	189	230	242	210	237
CH	38	41	48	44	55	53	74	66	65
DE	120	141	159	166	193	177	224	233	246
ES	20	28	31	53	70	86	92	102	109
FR	122	149	140	155	183	197	173	219	216
IT	121	170	190	322	257	210	271	276	389
JP	166	207	227	291	279	296	321	349	369
NL	78	67	114	119	129	127	141	153	162
SE	79	93	113	110	142	117	148	152	200
US	1507	1760	1728	1874	2010	1972	2176	2186	2215
Total	2763	3299	3358	3824	4007	3938	4499	4523	4853
World	3071	3590	3653	4058	4254	4118	4742	4662	5008
12 N	2634	3150	3175	3541	3742	3635	4164	4139	4387
m, %	4.9	4.7	5.8	8.0	7.1	8.3	8.1	9.3	10.6

Source: Science Citation Index, 1988-96

Table A60b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Gerontology research (GERON), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	10.4	11.1	10.6	10.3	9.4	9.3	10.4	9.4	10.1
AU	1.7	1.9	1.8	2.1	2.3	2.2	3.1	3.0	2.8
CA	4.6	4.9	4.2	4.5	4.4	5.6	5.1	4.5	4.7
CH	1.2	1.1	1.3	1.1	1.3	1.3	1.6	1.4	1.3
DE	3.9	3.9	4.4	4.1	4.5	4.3	4.7	5.0	4.9
ES	0.7	0.8	0.8	1.3	1.6	2.1	1.9	2.2	2.2
FR	4.0	4.2	3.8	3.8	4.3	4.8	3.6	4.7	4.3
IT	3.9	4.7	5.2	7.9	6.0	5.1	5.7	5.9	7.8
JP	5.4	5.8	6.2	7.2	6.6	7.2	6.8	7.5	7.4
NL	2.5	1.9	3.1	2.9	3.0	3.1	3.0	3.3	3.2
SE	2.6	2.6	3.1	2.7	3.3	2.8	3.1	3.3	4.0
US	49.1	49.0	47.3	46.2	47.2	47.9	45.9	46.9	44.2

Source: Science Citation Index, 1988-96

Haematology research (HAEMA)

Table A61a Papers in SCI, CD-ROM version, for 12 OECD countries in Haematology research (HAEMA), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	1448	1515	1574	1513	1531	1681	1755	1664	1601
AU	362	377	333	356	398	372	459	428	400
CA	606	631	665	681	727	659	737	696	716
CH	294	287	270	319	326	340	357	337	364
DE	1131	1158	1187	1205	1318	1252	1465	1523	1548
ES	177	213	215	225	288	278	331	362	408
FR	1004	1005	1070	1044	1163	1293	1279	1289	1314
IT	803	873	919	957	1003	1023	1128	1136	1288
JP	1305	1431	1540	1453	1619	1604	1783	1781	1845
NL	538	579	526	523	601	630	718	664	722
SE	443	426	436	401	414	440	472	446	512
US	6359	6698	6742	6374	6686	6218	6906	6709	6923
Total	14470	15193	15477	15051	16074	15790	17390	17035	17641
World	15700	16379	16724	16015	16799	16298	18067	17561	17973
12 N	13479	14169	14396	13864	14643	14253	15725	15258	15701
m, %	7.4	7.2	7.5	8.6	9.8	10.8	10.6	11.6	12.4

Source: Science Citation Index, 1988-96

Table A61b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Haematology research (HAEMA), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	9.2	9.2	9.4	9.4	9.1	10.3	9.7	9.5	8.9
AU	2.3	2.3	2.0	2.2	2.4	2.3	2.5	2.4	2.2
CA	3.9	3.9	4.0	4.3	4.3	4.0	4.1	4.0	4.0
CH	1.9	1.8	1.6	2.0	1.9	2.1	2.0	1.9	2.0
DE	7.2	7.1	7.1	7.5	7.8	7.7	8.1	8.7	8.6
ES	1.1	1.3	1.3	1.4	1.7	1.7	1.8	2.1	2.3
FR	6.4	6.1	6.4	6.5	6.9	7.9	7.1	7.3	7.3
IT	5.1	5.3	5.5	6.0	6.0	6.3	6.2	6.5	7.2
JP	8.3	8.7	9.2	9.1	9.6	9.8	9.9	10.1	10.3
NL	3.4	3.5	3.1	3.3	3.6	3.9	4.0	3.8	4.0
SE	2.8	2.6	2.6	2.5	2.5	2.7	2.6	2.5	2.8
US	40.5	40.9	40.3	39.8	39.8	38.2	38.2	38.2	38.5

Source: Science Citation Index, 1988-96

Histopathology research (HISTP)

Table A62a World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Histopathology research (HISTP), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	1101	1194	1209	1316	1381	1404	1260	1265	1272
AU	224	293	238	240	280	307	310	329	334
CA	586	607	588	579	616	624	550	616	614
CH	186	189	191	206	193	244	237	261	249
DE	850	923	939	940	963	953	940	1011	980
ES	221	207	237	249	278	313	297	330	346
FR	827	878	812	787	832	857	875	876	868
IT	411	474	536	554	587	587	646	682	793
JP	1142	1229	1268	1260	1473	1485	1504	1562	1657
NL	361	374	355	344	397	425	393	408	384
SE	340	367	296	308	277	274	302	300	326
US	4111	4219	4361	4290	4547	4677	4639	4726	4645
Total	10360	10954	11030	11073	11824	12150	11953	12366	12468
World	11250	11873	11777	11848	12508	12714	12390	12836	12848
12 N	9640	10159	10160	10166	10821	11044	10797	11048	11125
m, %	7.5	7.8	8.6	8.9	9.3	10.0	10.7	11.9	12.1

Source: Science Citation Index, 1988-96

Table A62b Papers in SCI, CD-ROM version, for 12 OECD countries in Histopathology research (HISTP), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	9.8	10.1	10.3	11.1	11.0	11.0	10.2	9.9	9.9
AU	2.0	2.5	2.0	2.0	2.2	2.4	2.5	2.6	2.6
CA	5.2	5.1	5.0	4.9	4.9	4.9	4.4	4.8	4.8
CH	1.7	1.6	1.6	1.7	1.5	1.9	1.9	2.0	1.9
DE	7.6	7.8	8.0	7.9	7.7	7.5	7.6	7.9	7.6
ES	2.0	1.7	2.0	2.1	2.2	2.5	2.4	2.6	2.7
FR	7.4	7.4	6.9	6.6	6.7	6.7	7.1	6.8	6.8
IT	3.7	4.0	4.6	4.7	4.7	4.6	5.2	5.3	6.2
JP	10.2	10.4	10.8	10.6	11.8	11.7	12.1	12.2	12.9
NL	3.2	3.2	3.0	2.9	3.2	3.3	3.2	3.2	3.0
SE	3.0	3.1	2.5	2.6	2.2	2.2	2.4	2.3	2.5
US	36.5	35.5	37.0	36.2	36.4	36.8	37.4	36.8	36.2

Source: Science Citation Index, 1988-96

Immunology research (IMMUN)

Table A63a Papers in SCI, CD-ROM version, for 12 OECD countries in Immunology research (IMMUN), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	1913	2057	2057	2088	2139	2181	2193	2211	2205
AU	558	683	643	645	749	686	694	735	638
CA	846	858	868	893	948	921	984	957	1051
CH	510	467	494	552	571	578	603	644	631
DE	1307	1391	1468	1580	1607	1700	1833	1987	1980
ES	237	255	273	343	487	438	473	602	581
FR	1342	1315	1456	1458	1587	1654	1705	1733	1709
IT	710	751	752	894	993	962	1057	1119	1175
JP	1701	2024	1972	2028	2392	2366	2552	2493	2817
NL	607	749	719	720	775	813	834	866	852
SE	657	735	717	693	694	658	707	720	803
US	8644	8938	8733	9314	9425	9623	9561	9702	9898
Total	19032	20223	20152	21208	22367	22580	23196	23769	24340
World	20517	21743	21668	22169	23299	22974	23519	24091	24535
12 N	17433	18613	18412	19236	20228	20281	20680	21101	21343
m, %	9.2	8.7	9.5	10.3	10.6	11.3	12.2	12.6	14.0

Source: Science Citation Index, 1988-96

Table A63b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Immunology research (IMMUN), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	9.3	9.5	9.5	9.4	9.2	9.5	9.3	9.2	9.0
AU	2.7	3.1	3.0	2.9	3.2	3.0	3.0	3.1	2.6
CA	4.1	3.9	4.0	4.0	4.1	4.0	4.2	4.0	4.3
CH	2.5	2.1	2.3	2.5	2.5	2.5	2.6	2.7	2.6
DE	6.4	6.4	6.8	7.1	6.9	7.4	7.8	8.2	8.1
ES	1.2	1.2	1.3	1.5	2.1	1.9	2.0	2.5	2.4
FR	6.5	6.0	6.7	6.6	6.8	7.2	7.2	7.2	7.0
IT	3.5	3.5	3.5	4.0	4.3	4.2	4.5	4.6	4.8
JP	8.3	9.3	9.1	9.1	10.3	10.3	10.9	10.3	11.5
NL	3.0	3.4	3.3	3.2	3.3	3.5	3.5	3.6	3.5
SE	3.2	3.4	3.3	3.1	3.0	2.9	3.0	3.0	3.3
US	42.1	41.1	40.3	42.0	40.5	41.9	40.7	40.3	40.3

Source: Science Citation Index, 1988-96

Multiple Sclerosis research (MULSC)

Table A64a Papers in SCI, CD-ROM version, for 12 OECD countries in Multiple Sclerosis research (MULSC), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	78	89	79	86	104	90	93	107	112
AU	18	14	21	9	9	18	11	16	15
CA	55	38	44	54	48	56	60	47	61
CH	24	24	15	18	27	21	20	27	22
DE	56	52	41	28	61	71	67	75	72
ES	7	4	6	12	6	15	10	12	14
FR	37	45	26	37	34	51	53	44	44
IT	12	17	24	32	25	35	36	49	64
JP	32	31	28	43	30	41	38	44	45
NL	20	12	20	17	36	28	25	38	27
SE	9	29	23	28	16	25	43	30	38
US	317	282	277	319	303	317	339	362	425
Total	665	637	604	683	699	768	795	851	939
World	690	656	635	682	685	729	774	828	900
12 N	612	596	564	625	631	678	711	747	824
m, %	8.7	6.9	7.1	9.3	10.8	13.3	11.8	13.9	14.0

Source: Science Citation Index, 1988-96

Table A64b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Multiple Sclerosis research (MULSC), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	11.3	13.6	12.4	12.6	15.2	12.3	12.0	12.9	12.4
AU	2.6	2.1	3.3	1.3	1.3	2.5	1.4	1.9	1.7
CA	8.0	5.8	6.9	7.9	7.0	7.7	7.8	5.7	6.8
CH	3.5	3.7	2.4	2.6	3.9	2.9	2.6	3.3	2.4
DE	8.1	7.9	6.5	4.1	8.9	9.7	8.7	9.1	8.0
ES	1.0	0.6	0.9	1.8	0.9	2.1	1.3	1.4	1.6
FR	5.4	6.9	4.1	5.4	5.0	7.0	6.8	5.3	4.9
IT	1.7	2.6	3.8	4.7	3.6	4.8	4.7	5.9	7.1
JP	4.6	4.7	4.4	6.3	4.4	5.6	4.9	5.3	5.0
NL	2.9	1.8	3.1	2.5	5.3	3.8	3.2	4.6	3.0
SE	1.3	4.4	3.6	4.1	2.3	3.4	5.6	3.6	4.2
US	45.9	43.0	43.6	46.8	44.2	43.5	43.8	43.7	47.2

Source: Science Citation Index, 1988-96

Neonatology research (NEONA)

Table A65a Papers in SCI, CD-ROM version, for 12 OECD countries in Neonatology research (NEONA), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	318	288	323	298	374	329	391	388	383
AU	86	86	82	88	107	99	121	135	121
CA	208	211	224	172	236	244	220	257	192
CH	59	46	48	61	51	62	64	68	55
DE	179	162	187	170	255	223	243	192	213
ES	56	44	60	53	68	77	80	86	80
FR	166	187	177	173	221	156	187	194	216
IT	77	71	102	77	115	91	173	106	120
JP	153	156	166	182	193	194	211	186	220
NL	79	99	106	87	130	154	145	145	107
SE	105	90	116	107	138	119	90	105	112
US	1382	1633	1537	1478	1577	1676	1520	1573	1477
Total	2868	3073	3128	2946	3465	3424	3445	3435	3296
World	3234	3387	3438	3234	3753	3663	3664	3670	3532
12 N	2750	2928	2966	2815	3252	3206	3195	3196	3044
m, %	4.3	5.0	5.5	4.7	6.5	6.8	7.8	7.5	8.3

Source: Science Citation Index, 1988-96

Table A65b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Neonatology research (NEONA), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	9.8	8.5	9.4	9.2	10.0	9.0	10.7	10.6	10.8
AU	2.7	2.5	2.4	2.7	2.9	2.7	3.3	3.7	3.4
CA	6.4	6.2	6.5	5.3	6.3	6.7	6.0	7.0	5.4
CH	1.8	1.4	1.4	1.9	1.4	1.7	1.7	1.9	1.6
DE	5.5	4.8	5.4	5.3	6.8	6.1	6.6	5.2	6.0
ES	1.7	1.3	1.7	1.6	1.8	2.1	2.2	2.3	2.3
FR	5.1	5.5	5.1	5.3	5.9	4.3	5.1	5.3	6.1
IT	2.4	2.1	3.0	2.4	3.1	2.5	4.7	2.9	3.4
JP	4.7	4.6	4.8	5.6	5.1	5.3	5.8	5.1	6.2
NL	2.4	2.9	3.1	2.7	3.5	4.2	4.0	4.0	3.0
SE	3.2	2.7	3.4	3.3	3.7	3.2	2.5	2.9	3.2
US	42.7	48.2	44.7	45.7	42.0	45.8	41.5	42.9	41.8

Source: Science Citation Index, 1988-96

Neuroscience research (NEURO)

Table A66a Papers in SCI, CD-ROM version, for 12 OECD countries in Neuroscience research (NEURO), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	2705	2788	3032	2988	3257	3212	3286	3450	3675
AU	609	722	705	709	759	720	777	899	941
CA	1791	1781	1832	1943	2157	2127	2163	2070	2243
CH	503	531	545	584	709	626	708	746	781
DE	1895	2137	2201	2198	2563	2573	2753	3018	3149
ES	399	468	527	577	721	772	771	806	823
FR	1672	1754	1804	1890	2158	2024	2222	2210	2325
IT	1109	1210	1355	1365	1633	1530	1647	1727	1895
JP	2404	2605	2813	2997	3302	3556	3771	3731	4007
NL	630	691	758	748	876	871	900	935	936
SE	873	1007	975	1036	1031	1049	1111	1111	1068
US	13301	14076	14397	14699	15937	15252	15876	16391	16618
Total	27891	29770	30944	31734	35103	34312	35985	37094	38461
World	29912	31974	32852	33279	36299	35367	37336	38645	38963
12 N	26194	27848	28801	29376	32214	31345	32800	33672	34574
m, %	6.5	6.9	7.4	8.0	9.0	9.5	9.7	10.2	11.2

Source: Science Citation Index, 1988-96

Table A66b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Neuroscience research (NEURO), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	9.0	8.7	9.2	9.0	9.0	9.1	8.8	8.9	9.4
AU	2.0	2.3	2.1	2.1	2.1	2.0	2.1	2.3	2.4
CA	6.0	5.6	5.6	5.8	5.9	6.0	5.8	5.4	5.8
CH	1.7	1.7	1.7	1.8	2.0	1.8	1.9	1.9	2.0
DE	6.3	6.7	6.7	6.6	7.1	7.3	7.4	7.8	8.1
ES	1.3	1.5	1.6	1.7	2.0	2.2	2.1	2.1	2.1
FR	5.6	5.5	5.5	5.7	5.9	5.7	6.0	5.7	6.0
IT	3.7	3.8	4.1	4.1	4.5	4.3	4.4	4.5	4.9
JP	8.0	8.1	8.6	9.0	9.1	10.1	10.1	9.7	10.3
NL	2.1	2.2	2.3	2.2	2.4	2.5	2.4	2.4	2.4
SE	2.9	3.1	3.0	3.1	2.8	3.0	3.0	2.9	2.7
US	44.5	44.0	43.8	44.2	43.9	43.1	42.5	42.4	42.7

Source: Science Citation Index, 1988-96

Nursing research (NURSE)

Table A67a Papers in SSCI, CD-ROM version, for 12 OECD countries in Nursing research (NURSE), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	123	144	194	192	219	253	354	364	600
AU	23	29	41	41	41	72	60	101	153
CA	81	107	116	119	118	136	181	160	239
CH	7	6	6	15	9	14	10	11	15
DE	12	11	22	18	18	24	42	29	42
ES	0	1	1	3	5	3	10	6	9
FR	2	2	5	5	4	8	10	8	26
IT	4	3	5	13	4	6	13	17	21
JP	1	1	5	7	3	11	12	15	3
NL	9	21	15	23	23	33	46	28	76
SE	11	26	21	30	16	44	73	81	98
US	1014	1106	1153	1178	1159	1392	1458	1582	1826
Total	1287	1457	1584	1644	1619	1996	2269	2402	3108
World	1439	1607	1769	1793	1770	2160	2439	2599	3291
12 N	1273	1437	1551	1602	1590	1947	2194	2346	2985
m, %	1.1	1.4	2.1	2.6	1.8	2.5	3.4	2.4	4.1

Source: Social Sciences Citation Index, 1988-96

Table A67b World percentage shares in SSCI, CD-ROM version, for 12 OECD countries in Nursing research (NURSE), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	8.5	9.0	11.0	10.7	12.4	11.7	14.5	14.0	18.2
AU	1.6	1.8	2.3	2.3	2.3	3.3	2.5	3.9	4.6
CA	5.6	6.7	6.6	6.6	6.7	6.3	7.4	6.2	7.3
CH	0.5	0.4	0.3	0.8	0.5	0.6	0.4	0.4	0.5
DE	0.8	0.7	1.2	1.0	1.0	1.1	1.7	1.1	1.3
ES	0.0	0.1	0.1	0.2	0.3	0.1	0.4	0.2	0.3
FR	0.1	0.1	0.3	0.3	0.2	0.4	0.4	0.3	0.8
IT	0.3	0.2	0.3	0.7	0.2	0.3	0.5	0.7	0.6
JP	0.1	0.1	0.3	0.4	0.2	0.5	0.5	0.6	0.1
NL	0.6	1.3	0.8	1.3	1.3	1.5	1.9	1.1	2.3
SE	0.8	1.6	1.2	1.7	0.9	2.0	3.0	3.1	3.0
US	70.5	68.8	65.2	65.7	65.5	64.4	59.8	60.9	55.5

Source: Social Sciences Citation Index, 1988-96

Note: There is a particularly strong English-language bias in the SSCI

Obstetrics/Gynaecology research (OBSGY)

Table A68a Papers in SCI, CD-ROM version, for 12 OECD countries in Obstetrics & Gynaecology research (OBSGY), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	1408	1433	1531	1463	1564	1578	1707	1725	1776
AU	413	428	415	434	433	513	497	569	529
CA	711	780	725	705	767	805	765	800	767
CH	149	190	166	178	221	204	203	232	238
DE	739	834	813	750	1262	827	1484	910	885
ES	140	127	178	157	216	274	274	299	307
FR	599	625	629	606	625	684	672	738	752
IT	354	433	442	484	539	527	620	658	714
JP	723	839	867	908	932	1031	1110	1151	1141
NL	357	358	421	399	454	473	469	502	436
SE	346	431	445	331	399	393	350	440	473
US	5585	6099	6266	5993	6077	6558	6133	6765	6232
Total	11524	12577	12898	12408	13489	13867	14284	14789	14250
World	13394	14258	14577	13740	15028	15285	15654	16207	15532
12 N	10954	11949	12205	11674	12627	12943	13255	13608	13024
m, %	5.2	5.3	5.7	6.3	6.8	7.1	7.8	8.7	9.4

Source: Science Citation Index, 1988-96

Table A68b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Obstetrics & Gynaecology research (OBSGY), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	10.5	10.1	10.5	10.6	10.4	10.3	10.9	10.6	11.4
AU	3.1	3.0	2.8	3.2	2.9	3.4	3.2	3.5	3.4
CA	5.3	5.5	5.0	5.1	5.1	5.3	4.9	4.9	4.9
CH	1.1	1.3	1.1	1.3	1.5	1.3	1.3	1.4	1.5
DE	5.5	5.8	5.6	5.5	8.4	5.4	9.5	5.6	5.7
ES	1.0	0.9	1.2	1.1	1.4	1.8	1.8	1.8	2.0
FR	4.5	4.4	4.3	4.4	4.2	4.5	4.3	4.6	4.8
IT	2.6	3.0	3.0	3.5	3.6	3.4	4.0	4.1	4.6
JP	5.4	5.9	5.9	6.6	6.2	6.7	7.1	7.1	7.3
NL	2.7	2.5	2.9	2.9	3.0	3.1	3.0	3.1	2.8
SE	2.6	3.0	3.1	2.4	2.7	2.6	2.2	2.7	3.0
US	41.7	42.8	43.0	43.6	40.4	42.9	39.2	41.7	40.1

Source: Science Citation Index, 1988-96

Oncology research (ONCOL)

Table A69a Papers in SCI, CD-ROM version, for 12 OECD countries in Oncology research (ONCOL), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	1989	2353	2272	2431	2643	2602	2836	2804	2813
AU	393	414	407	408	534	514	531	637	607
CA	822	929	902	969	1050	1106	1185	1240	1281
CH	328	334	379	434	517	540	549	581	572
DE	1452	1647	1715	1719	2104	1956	2388	2404	2610
ES	175	247	288	331	381	418	472	542	648
FR	1233	1380	1462	1503	1718	1817	2002	2030	1961
IT	1062	1130	1276	1459	1509	1565	1837	1912	2229
JP	2107	2358	2458	2650	3082	3254	3480	3549	3865
NL	635	728	745	806	918	972	1061	1145	1093
SE	582	661	643	629	645	666	746	844	818
US	9468	10182	10519	10481	11408	11797	12461	12643	12654
Total	20246	22363	23066	23820	26509	27207	29548	30331	31151
World	22072	24179	24639	25076	27517	27997	30257	31204	31700
12 N	18969	20909	21453	21930	24200	24676	26630	27293	27813
m, %	6.7	7.0	7.5	8.6	9.5	10.3	11.0	11.1	12.0

Source: Science Citation Index, 1988-96

Table A69b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Oncology research (ONCOL), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	9.0	9.7	9.2	9.7	9.6	9.3	9.4	9.0	8.9
AU	1.8	1.7	1.7	1.6	1.9	1.8	1.8	2.0	1.9
CA	3.7	3.8	3.7	3.9	3.8	4.0	3.9	4.0	4.0
CH	1.5	1.4	1.5	1.7	1.9	1.9	1.8	1.9	1.8
DE	6.6	6.8	7.0	6.9	7.6	7.0	7.9	7.7	8.2
ES	0.8	1.0	1.2	1.3	1.4	1.5	1.6	1.7	2.0
FR	5.6	5.7	5.9	6.0	6.2	6.5	6.6	6.5	6.2
IT	4.8	4.7	5.2	5.8	5.5	5.6	6.1	6.1	7.0
JP	9.5	9.8	10.0	10.6	11.2	11.6	11.5	11.4	12.2
NL	2.9	3.0	3.0	3.2	3.3	3.5	3.5	3.7	3.4
SE	2.6	2.7	2.6	2.5	2.3	2.4	2.5	2.7	2.6
US	42.9	42.1	42.7	41.8	41.5	42.1	41.2	40.5	39.9

Source: Science Citation Index, 1988-96

Ophthalmology research (OPHTH)

Table A70a Papers in SCI, CD-ROM version, for 12 OECD countries in Ophthalmology research (OPHTH), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	596	611	659	587	720	765	716	726	762
AU	163	178	187	175	189	192	200	219	244
CA	281	257	278	255	291	308	282	269	303
CH	158	90	133	123	188	133	148	172	160
DE	465	536	533	540	570	552	566	568	691
ES	45	50	64	65	62	102	96	119	118
FR	155	178	164	189	219	179	232	215	220
IT	110	147	161	147	191	172	187	217	229
JP	421	376	449	489	520	541	590	593	641
NL	181	177	216	180	212	199	212	190	177
SE	111	127	115	95	110	123	132	118	117
US	2777	2880	2975	2998	3113	2814	2784	2975	3049
Total	5463	5607	5934	5843	6385	6080	6145	6381	6711
World	5990	6221	6404	6366	6817	6443	6428	6541	6826
12 N	5154	5257	5562	5441	5932	5591	5622	5794	6045
m, %	6.0	6.7	6.7	7.4	7.6	8.7	9.3	10.1	11.0

Source: Science Citation Index, 1988-96

Table A70b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Ophthalmology research (OPHTH), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	9.9	9.8	10.3	9.2	10.6	11.9	11.1	11.1	11.2
AU	2.7	2.9	2.9	2.7	2.8	3.0	3.1	3.3	3.6
CA	4.7	4.1	4.3	4.0	4.3	4.8	4.4	4.1	4.4
CH	2.6	1.4	2.1	1.9	2.8	2.1	2.3	2.6	2.3
DE	7.8	8.6	8.3	8.5	8.4	8.6	8.8	8.7	10.1
ES	0.8	0.8	1.0	1.0	0.9	1.6	1.5	1.8	1.7
FR	2.6	2.9	2.6	3.0	3.2	2.8	3.6	3.3	3.2
IT	1.8	2.4	2.5	2.3	2.8	2.7	2.9	3.3	3.4
JP	7.0	6.0	7.0	7.7	7.6	8.4	9.2	9.1	9.4
NL	3.0	2.8	3.4	2.8	3.1	3.1	3.3	2.9	2.6
SE	1.9	2.0	1.8	1.5	1.6	1.9	2.1	1.8	1.7
US	46.4	46.3	46.5	47.1	45.7	43.7	43.3	45.5	44.7

Source: Science Citation Index, 1988-96

Renal Medicine research (RENAL)

Table A71a Papers in SCI, CD-ROM version, for 12 OECD countries in Renal Medicine research (RENAL), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	482	585	595	610	630	629	653	553	575
AU	148	178	150	140	177	183	169	175	155
CA	266	296	263	262	311	272	291	278	317
CH	124	147	132	122	142	137	144	179	158
DE	562	512	565	531	594	607	591	670	719
ES	113	118	128	147	186	170	189	221	221
FR	371	353	364	349	374	417	429	490	460
IT	262	249	287	284	390	351	338	363	370
JP	494	600	534	609	671	628	736	670	784
NL	201	227	184	182	189	217	264	276	273
SE	216	199	239	190	238	221	199	192	216
US	2584	2603	2500	2712	2556	2633	2614	2651	2674
Total	5823	6067	5941	6138	6458	6465	6617	6718	6922
World	6588	6747	6688	6882	7196	6977	7229	7238	7558
12 N	5565	5789	5627	5844	6012	6050	6102	6146	6329
m, %	4.6	4.8	5.6	5.0	7.4	6.9	8.4	9.3	9.4

Source: Science Citation Index, 1988-96

Table A71b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Renal Medicine research (RENAL), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	7.3	8.7	8.9	8.9	8.8	9.0	9.0	7.6	7.6
AU	2.2	2.6	2.2	2.0	2.5	2.6	2.3	2.4	2.1
CA	4.0	4.4	3.9	3.8	4.3	3.9	4.0	3.8	4.2
CH	1.9	2.2	2.0	1.8	2.0	2.0	2.0	2.5	2.1
DE	8.5	7.6	8.4	7.7	8.3	8.7	8.2	9.3	9.5
ES	1.7	1.7	1.9	2.1	2.6	2.4	2.6	3.1	2.9
FR	5.6	5.2	5.4	5.1	5.2	6.0	5.9	6.8	6.1
IT	4.0	3.7	4.3	4.1	5.4	5.0	4.7	5.0	4.9
JP	7.5	8.9	8.0	8.8	9.3	9.0	10.2	9.3	10.4
NL	3.1	3.4	2.8	2.6	2.6	3.1	3.7	3.8	3.6
SE	3.3	2.9	3.6	2.8	3.3	3.2	2.8	2.7	2.9
US	39.2	38.6	37.4	39.4	35.5	37.7	36.2	36.6	35.4

Source: Science Citation Index, 1988-96

Respiratory Medicine research (RESPI)

Table A72a Papers in SCI, CD-ROM version, for 12 OECD countries in Respiratory Medicine research (RESPI), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	1007	1191	1230	1257	1316	1315	1386	1447	1429
AU	207	218	233	250	256	271	308	353	331
CA	606	641	666	679	744	760	782	791	741
CH	129	148	153	174	190	198	221	252	235
DE	519	620	595	585	576	595	655	710	736
ES	81	123	145	169	227	229	260	283	368
FR	436	492	517	545	650	620	729	729	814
IT	273	313	328	308	396	378	505	495	543
JP	518	537	602	644	831	822	940	938	1062
NL	229	283	283	284	334	362	380	437	434
SE	277	280	306	308	284	282	335	312	350
US	4062	4179	4408	4348	4707	4572	4741	5178	4956
Total	8344	9025	9466	9551	10511	10404	11242	11925	11999
World	9342	9983	10576	10569	11229	11097	11941	12517	12559
12 N	7947	8553	8975	9021	9766	9693	10405	10976	11000
m, %	5.0	5.5	5.5	5.9	7.6	7.3	8.0	8.6	9.1

Source: Science Citation Index, 1988-96

Table A72b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Respiratory Medicine research (RESPI), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	10.8	11.9	11.6	11.9	11.7	11.9	11.6	11.6	11.4
AU	2.2	2.2	2.2	2.4	2.3	2.4	2.6	2.8	2.6
CA	6.5	6.4	6.3	6.4	6.6	6.8	6.5	6.3	5.9
CH	1.4	1.5	1.4	1.6	1.7	1.8	1.9	2.0	1.9
DE	5.6	6.2	5.6	5.5	5.1	5.4	5.5	5.7	5.9
ES	0.9	1.2	1.4	1.6	2.0	2.1	2.2	2.3	2.9
FR	4.7	4.9	4.9	5.2	5.8	5.6	6.1	5.8	6.5
IT	2.9	3.1	3.1	2.9	3.5	3.4	4.2	4.0	4.3
JP	5.5	5.4	5.7	6.1	7.4	7.4	7.9	7.5	8.5
NL	2.5	2.8	2.7	2.7	3.0	3.3	3.2	3.5	3.5
SE	3.0	2.8	2.9	2.9	2.5	2.5	2.8	2.5	2.8
US	43.5	41.9	41.7	41.1	41.9	41.2	39.7	41.4	39.5

Source: Science Citation Index, 1988-96

Tropical Medicine research (TROPM)

Table A73a Papers in SCI, CD-ROM version, for 12 OECD countries in Tropical Medicine research (TROPM), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	521	576	611	579	565	665	697	666	664
AU	135	120	145	135	147	148	178	160	162
CA	76	98	96	95	99	102	110	120	109
CH	89	99	123	137	139	139	120	144	115
DE	159	164	170	174	171	171	199	209	210
ES	38	26	38	42	45	59	81	80	90
FR	252	226	246	283	279	324	321	326	336
IT	45	52	63	59	57	67	66	71	88
JP	111	115	116	109	144	154	133	139	144
NL	71	107	117	132	117	158	157	172	144
SE	56	54	97	86	80	98	90	81	91
US	1193	1222	1255	1303	1310	1375	1337	1268	1379
Total	2746	2859	3077	3134	3153	3460	3489	3436	3532
World	3962	4078	4290	4352	4489	4652	4517	4453	4578
12 N	2539	2638	2762	2822	2839	3085	3116	2996	3109
m, %	8.2	8.4	11.4	11.1	11.1	12.2	12.0	14.7	13.6

Source: Science Citation Index, 1988-96

Table A73b World percentage shares in SCI, CD-ROM version, for 12 OECD countries in Tropical Medicine research (TROPM), 1988-96

	1988	1989	1990	1991	1992	1993	1994	1995	1996
UK	13.1	14.1	14.2	13.3	12.6	14.3	15.4	15.0	14.5
AU	3.4	2.9	3.4	3.1	3.3	3.2	3.9	3.6	3.5
CA	1.9	2.4	2.2	2.2	2.2	2.2	2.4	2.7	2.4
CH	2.2	2.4	2.9	3.1	3.1	3.0	2.7	3.2	2.5
DE	4.0	4.0	4.0	4.0	3.8	3.7	4.4	4.7	4.6
ES	1.0	0.6	0.9	1.0	1.0	1.3	1.8	1.8	2.0
FR	6.4	5.5	5.7	6.5	6.2	7.0	7.1	7.3	7.3
IT	1.1	1.3	1.5	1.4	1.3	1.4	1.5	1.6	1.9
JP	2.8	2.8	2.7	2.5	3.2	3.3	2.9	3.1	3.1
NL	1.8	2.6	2.7	3.0	2.6	3.4	3.5	3.9	3.1
SE	1.4	1.3	2.3	2.0	1.8	2.1	2.0	1.8	2.0
US	30.1	30.0	29.3	29.9	29.2	29.6	29.6	28.5	30.1

Source: Science Citation Index, 1988-96

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