2 THE SCOPE OF GLOBAL BIOMEDICINE, 1989-2002

We live in an age of international biomedicine. But global biomedical research is vast and multi-faceted, encompassing a wide range of subjects from AIDS research to veterinary medicine. Contributions to the overall mass of research come from countries all around the globe.

So which country is the most research active and in which biomedical discipline does most research take place? How does commitment to different discipline vary from country to country? What trends are emerging over time?

To help us understand these questions within the international scope of biomedicine and the UK's position within it, this chapter provides a perspective based on numbers of research papers published and indexed in ISI's Science Citation Index and Social Sciences Citation Index (for the field of mental health).[1]

2.1 Expenditure

Gross expenditure on research and development

In order to put the data in this report on global research outputs into context, it is helpful to look first at one of the key inputs into the research system: the relative amounts of money ploughed into the research endeavour by the world's leading economies. The Organisation for Economic Cooperation and Development (OECD) publishes a statistical series[2] which makes it possible to compare national spending on R&D with ease. Of the leading (G7) economies in 2000, the USA spent most on R&D (£558 per caput) followed by Japan (£467), Germany (£363), France (£299), Canada (£275), the UK (£267) and Italy (£150). UK gross expenditure on research and development (GERD) can be broken down into support by the Government sector (49 per cent in 1999), business enterprises (28 per cent), private non-profit organizations and higher education (5

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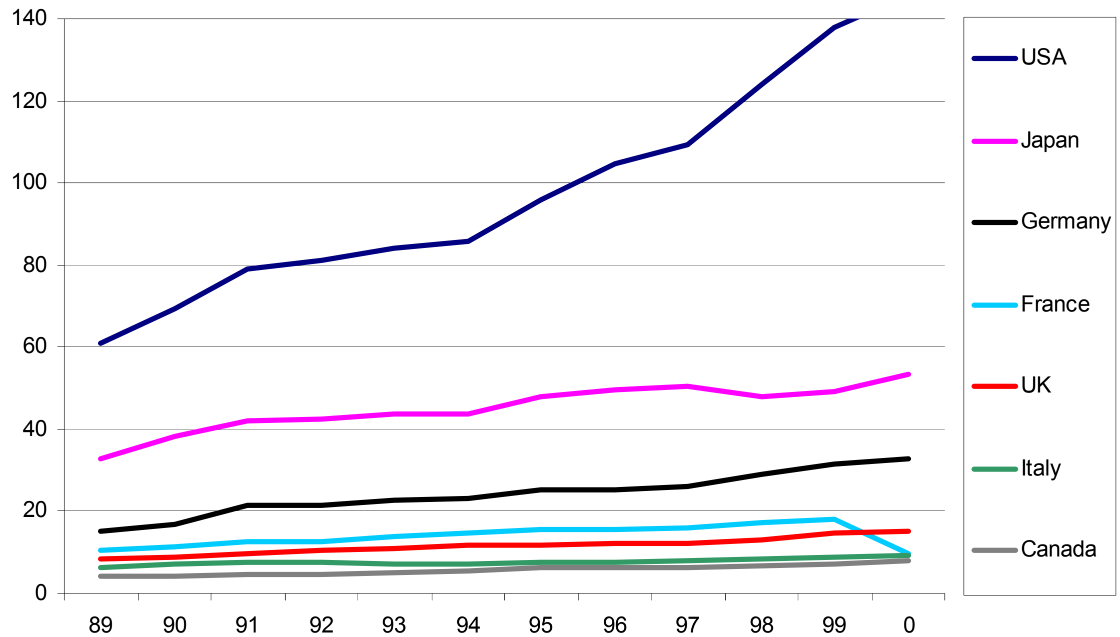
[1] For more information on the construction and contents of the SCI see the Annex.
[2] *Main Science and Technology Indicators,* Volume 2001/1, Directorate for Science, Technology and Industry, Paris, OECD, 2001.

per cent), the remaining 18 per cent being funding from abroad, notably by the European Union. In 1999, total GERD in the UK amounted to £15 900 million. Compared with other G7 countries, the UK has the smallest government contribution to its total GERD apart from Japan, and its share has declined from 33.3 per cent in 1995 to 27.9 per cent in 1999[3].

Defence naturally accounts for a significant proportion in most advanced economies and so gross expenditure figures may be misleading in the context of a report on biomedical research outputs. Trends in absolute gross expenditure on R&D with defence spending excluded (civil GERD), for the G7 countries for 1989-2000 are shown in Figure 2.1.1.



2.1.1 Gross expenditure on civil R&D for the G7 countries, 1989-2000 (£ billions ppp).

For most of the G7 countries, the pattern is one of steady upward growth, albeit at a fairly modest level given economic growth over that period. Over the period in question, UK spending on civil R&D increased by 182 per cent from £8.4 billion

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[3] *Science, Engineering and Technology (SET) Statistics,* Office for National Statistics, 2003.

in 1989 to £15.3 billion in 2000, a trend which is mirrored by many other advanced economies. In marked contrast is the commitment shown by the USA to increasing its spending on non-military R&D in both absolute and relative terms: rising by an impressive 239 per cent between 1989 (£61.0 billion) and 2000 (£146.0 billion). By 2000, the gap between US civil spending and that of the next largest player, Japan, had widened very considerably in absolute terms: with the US spending £18 billion more than the other G7 nations combined (see Table A2.1.1 in the Appendix).

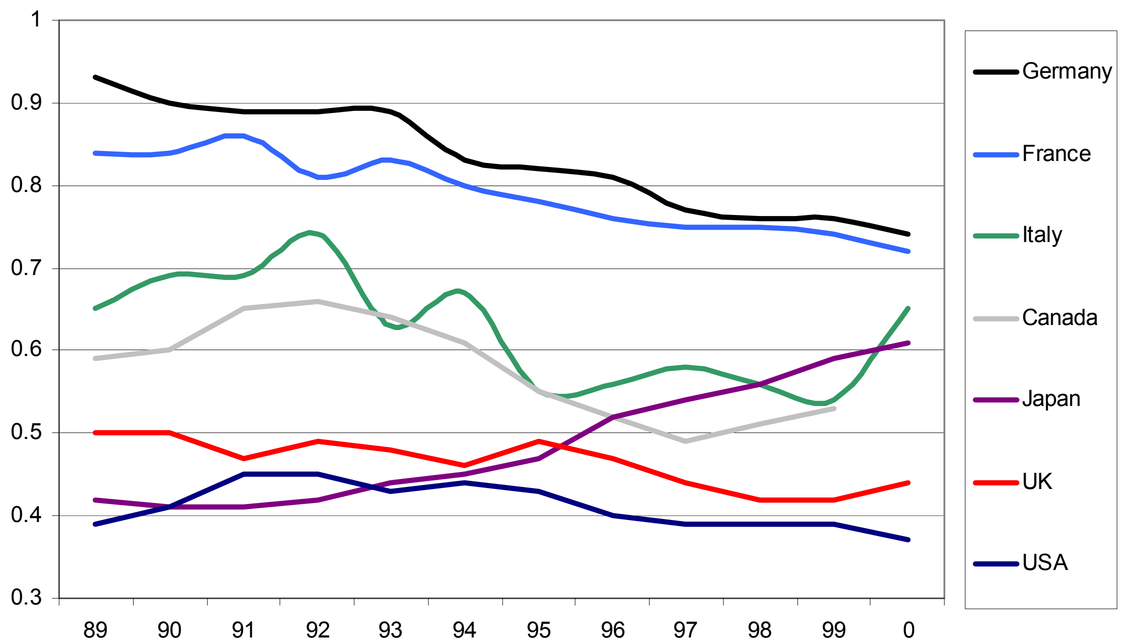

Fig. 2.1.2 Government funding of civil R&D for the G7 countries, 1989-2000 (percentages of national GDP).

Government spending on civil R&D as a percentage proportion of national wealth creation measured by GDP is another useful indicator. According to the OECD, this provides a useful measure of the relative priority accorded to investment in R&D among countries. Figure 2.1.2 illustrates a fairly consistent trend among all G7 countries, this time with the notable exception of Japan, for the government sector to become relatively less involved in funding non-defence R&D activities.

The sharpest decline over the period 1989-2000 is that of Germany (from 0.93 per cent in 1989 to 0.74 per cent in 2000), a trend which can only be partially explained by the unification of that country. The UK shows a consistent downward trend in relative government commitment to R&D, moderated by increases in the mid-1990s, its share falling from 0.5 percent in 1989 to 0.44 percent in 2000 to become the second lowest G7 nation in this respect after the USA. Only Japan shows a consistent upward trend over the period, rising from 6th to 4th place in the G7 rankings (see Table A2.1.2 in the Appendix).

UK spending on biomedical research

Figure 2.1.3 shows the estimated UK expenditure on biomedical science in 1999/2000 that would lead to publications (public domain biomedical research and development).

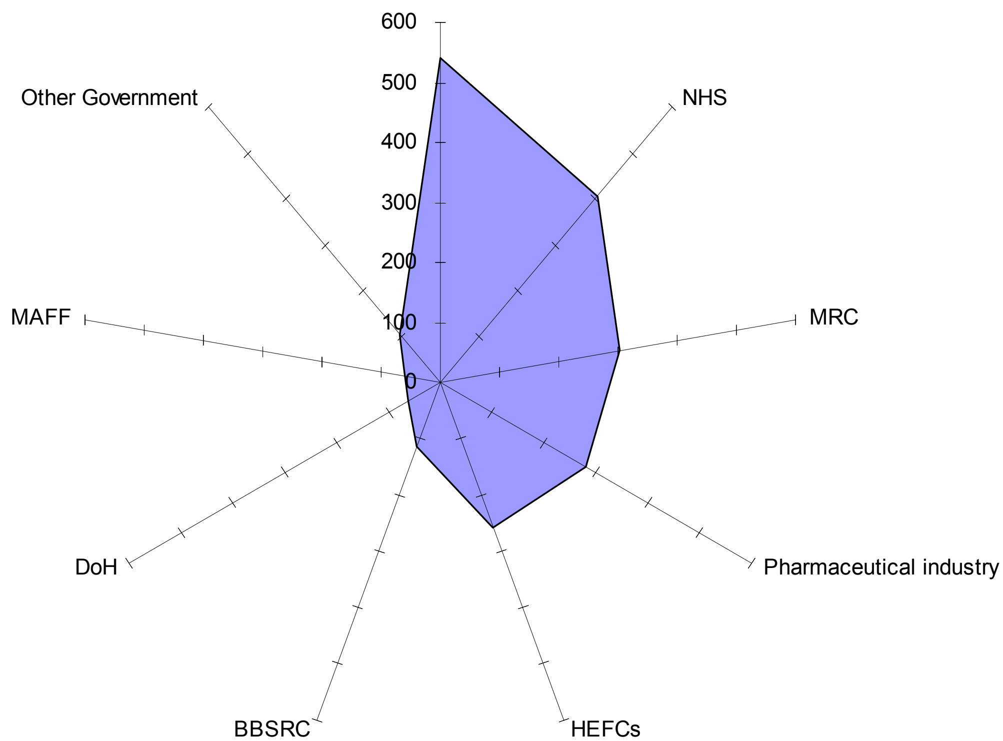

Figure 2.1.3 Sources of UK public domain biomedical research funding in 1999-2000.

This figure includes a nominal 10 per cent of the total expenditure on R&D by the pharmaceutical industry (see Figure 2.1.4); this is a very rough estimate of the proportion that is probably spent extramurally on research that finds its way into publications. A notable feature of the UK scene is that funding sources for UK public domain biomedical research are highly diverse (see Table A2.1.3 in the Appendix). They include not only explicit funding sources, like the Medical Research Council, but also the contributions of the Higher Education Funding Councils for academic salaries and infrastructure, and that of the National Health Service for clinical costs. The Department of Health makes a significant contribution to the overall landscape through its R&D budgets.

Total spending on biomedical R&D in 1999-2000 amounted to approximately £2 129 million.

In the previous edition of *Mapping the Landscape*, we estimated that £1 636 million was spent on UK public domain biomedical R&D in 1994-95. We can compare the two estimates more effectively by converting the earlier figure to constant 2000 prices using a GDP deflator (0.877). On that basis, we can see that UK expenditures have grown by £264 million in real terms, an increase of 14.2 per cent.

As noted earlier, support for civil R&D by the government sector has been decreasing over time in most advanced economies in relative terms. Against this general context, however, the Medical Research Council increased its investment in biomedical R&D over the period 1989-2001 by 32.3 per cent in real terms, from £260m in 1989 (at 2001 prices) to £344m in 2001 (see Table A2.1.4 in the Appendix).

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 of Medical Research Charities (AMRC) have also increased substantially as may be seen in Figures 2.1.4 and 2.1.5.

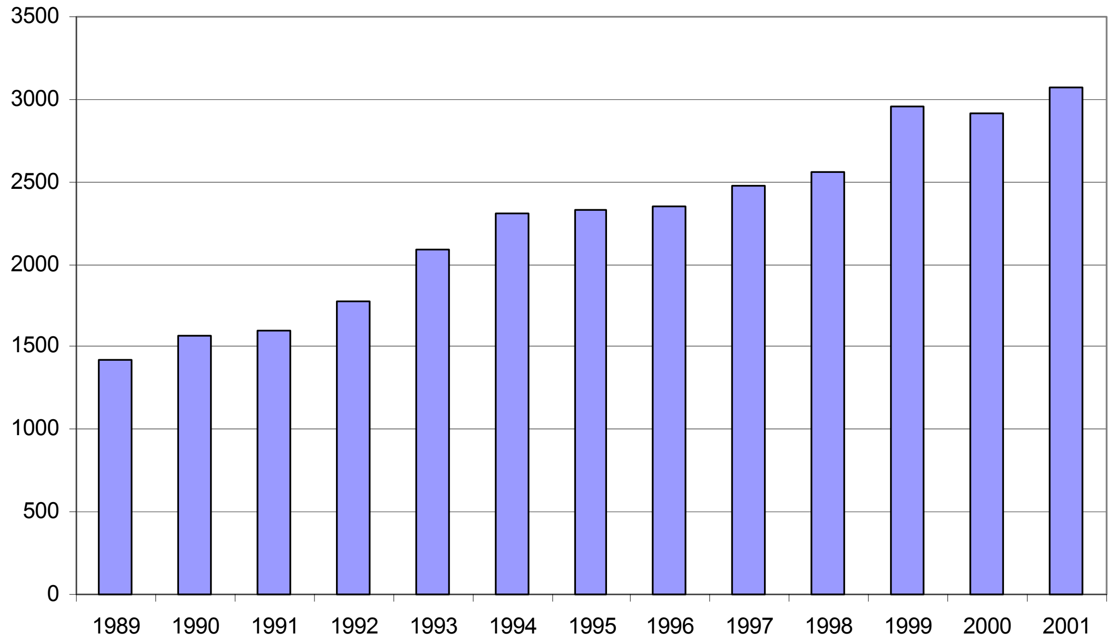

Figure 2.1.4 Annual research expenditures by members of the Association of British Pharmaceutical Industries, 1989-2001 (£ millions at constant 2001 prices).

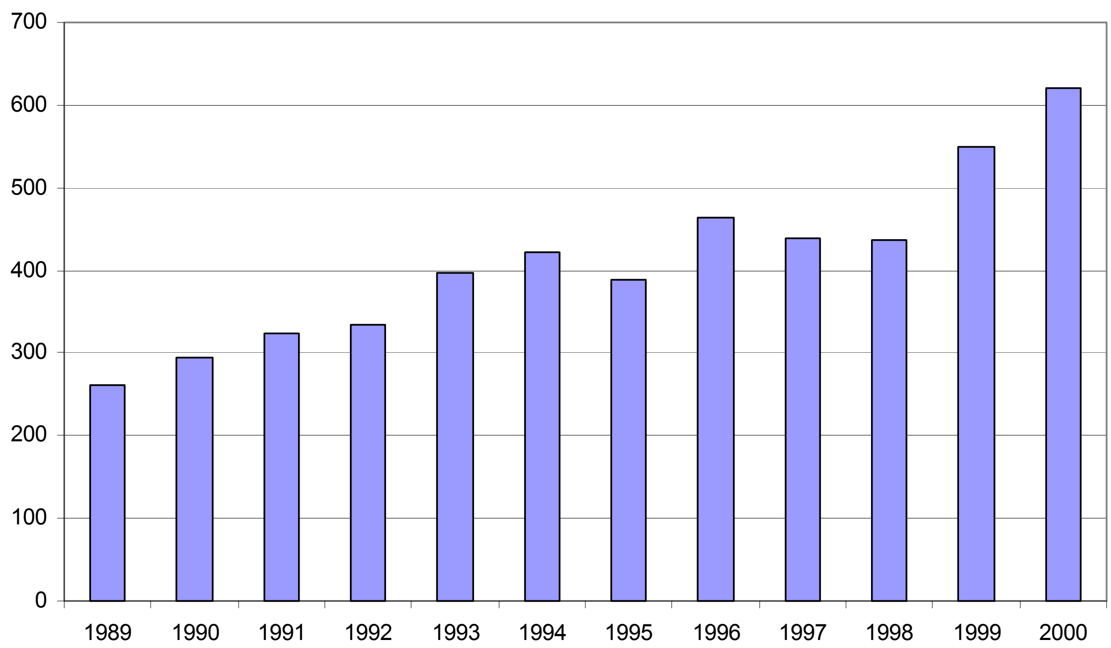

Figure 2.1.5 Annual research expenditure by members of the Association of Medical Research Charities, 1989-2000 (£ millions at constant 2000 prices).

In the case of the pharmaceutical industry, public domain R&D funding doubled in real terms over the period 1989-2001 (from £1 417m in 1989 to £3 070m in 2001) if our assumptions about the proportion of extramural funding are correct. A similar but even more striking growth in commitment can be seen in the charitable sector, with AMRC expenditures rising at constant 2000 prices from £261m in 1989 to £620m in 2000, an increase of 237.5 per cent (see Tables A2.1.5 and A2.1.6 in the Appendix).

2.2 Biomedicine's position in science

Biomedicine is one of the most heavily-researched areas of science. Nearly half of all papers listed in the Science Citation Index (SCI) between 1989 and 2002 came from within this field, compared to a 1999 figure of 15% from physics and 13% from chemistry[4]. In total, over three and a half million biomedical articles, notes and reviews[5] were published worldwide over this period. In the UK, 55% of all science publications are biomedical.

While the proportion of science papers made up by biomedicine has remained steady at around 48% of all papers produced every year for the past 14 years, its representation in the scientific output of individual countries has been less stable, as figure 2.2.1 shows.

The USA, the Netherlands, Canada and Germany have all increased their output of biomedical papers compared to other areas of science, while in Sweden, the UK and France publication of biomedical papers has relatively decreased.

These changes may have arisen for a number of reasons. In the US, the rise reflects a shift in the research environment, connected to funding. In the 1990s, the budgets of the National Institutes of Health and other foundations related to

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[4] See: *Science and engineering Indicators 2002* at: http://www.nsf.gov/sbe/srs/seind02/start.htm (ch. 5 table 5-41).

[5] Only articles, notes and reviews were analysed in this report. They are referred to, throughout the report, as papers, publications or outputs.

biomedicine went up.[6] At the same time, the US saw a decline in the budgets of agencies connected to the physical and engineering sciences.

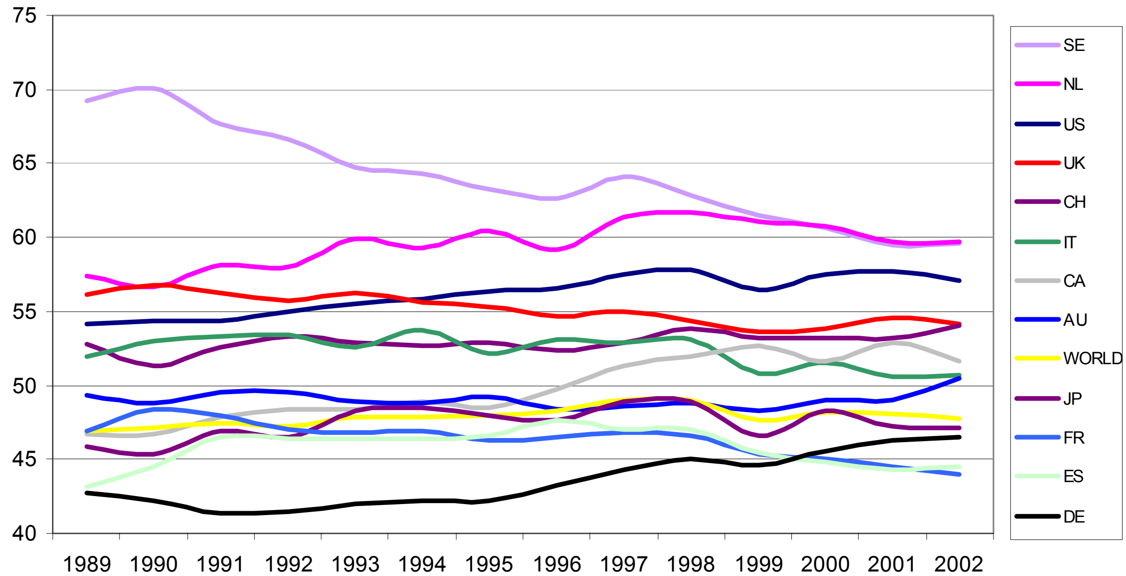

Fig. 2.2.1 BIOM outputs of 12 OECD countries as a percentage of all their SCI outputs, 1989-2002. The twelve countries are designated by their digraph codes, given in the Annex.

2.3 World leaders in the production of biomedical papers

The US was responsible for just under half (41% – 1,475,976 papers) of worldwide biomedical research over the past fourteen years and its output continues to rise. But year on year (as shown in Table 2.3.1), all of the 12 leading countries have been producing more papers. Spain's production of papers has shown the sharpest average annual growth rate of 7.1%, followed by Italy (4.8%) and Germany (4.6%).

Table 2.3.1. Biomedical outputs of 12 OECD countries, SCI data, 1989-2002 and average annual percentage growth (AAPG).

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[6] "Biomedical boom, forget the rest?" *Nature*, 22 February 2001, 409(6823), p. 965.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	AAPG
WLD	219829	224758	229171	241501	242088	254719	260804	265432	269798	281709	279615	285222	290876	284507	2.3
US	92917	95220	97520	101574	102515	105581	108684	107579	108144	110582	108680	111216	114878	110886	1.4
UK	21937	22750	23148	24541	24936	26559	26962	27577	27136	28215	28633	29290	29130	27956	2.1
JP	17567	18276	19464	21558	22244	24157	24527	25712	26545	29019	28372	29486	29917	28758	4.00
DE	14899	15021	15242	16515	16388	18022	18792	20068	21700	23930	23818	24608	25413	24831	4.60
FR	11984	12528	12974	14308	14396	15685	16194	16664	17253	18219	18042	17726	17948	17096	2.90
CA	10455	10732	11223	12129	12107	12646	12634	12999	12801	13010	13675	13330	13547	13330	1.80
IT	7374	7909	8460	9609	9474	10836	11192	12265	12283	13233	13095	13459	14049	14089	4.80
NL	6068	6256	6463	7124	7638	8042	8596	8482	9168	9336	9284	9342	9324	9328	3.40
SE	6331	6456	6318	6504	6507	6892	7118	7387	7595	7762	7792	7614	7866	7627	1.90
AU	5239	5228	5407	5783	6014	6413	6814	6973	7157	7638	7788	7859	8023	8338	3.90
ES	2961	3444	3886	4939	5228	5671	6186	6893	7273	7805	8118	8057	8464	8690	7.1
CH	3611	3807	4088	4610	4750	5134	5281	5350	5823	6090	6307	6344	6185	6199	4.10

One result of this is that the total global share produced by the US is falling – from 42% in 1989 to just under 39% in 2002 (Table 2.3.2.shows each country's biomedical output as a percentage of the worldwide total).

The UK has been the second most prolific producer over the whole period, responsible for around a tenth of global biomedical papers each year (or 368,770 papers over the 14-year period analysed here). But its commitment to biomedicine relative to other areas of science has fallen slightly, and since 2000, Japan has replaced the UK as the second most prolific producer of biomedical papers. In 2002, Japan was responsible for 10.1% of papers worldwide compared to the UK's 9.8%.

Table 2.3.2 Biomedical outputs of 12 OECD countries as a percentage of world biomedical outputs, 1989-2002.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
US	42.27	42.37	42.55	42.06	42.35	41.45	41.67	40.53	40.08	39.25	38.87	38.99	39.49	38.97
UK	9.98	10.12	10.10	10.16	10.30	10.43	10.34	10.39	10.06	10.02	10.24	10.27	10.01	9.83
JP	7.99	8.13	8.49	8.93	9.19	9.48	9.40	9.69	9.84	10.30	10.15	10.34	10.29	10.11
DE	6.78	6.68	6.65	6.84	6.77	7.08	7.21	7.56	8.04	8.49	8.52	8.63	8.74	8.73
FR	5.45	5.57	5.66	5.92	5.95	6.16	6.21	6.28	6.39	6.47	6.45	6.21	6.17	6.01
CA	4.76	4.77	4.90	5.02	5.00	4.96	4.84	4.90	4.74	4.62	4.89	4.67	4.66	4.69

IT	3.35	3.52	3.69	3.98	3.91	4.25	4.29	4.62	4.55	4.70	4.68	4.72	4.83	4.95
NL	2.76	2.78	2.82	2.95	3.16	3.16	3.30	3.20	3.40	3.31	3.32	3.28	3.21	3.28
SE	2.88	2.87	2.76	2.69	2.69	2.71	2.73	2.78	2.82	2.76	2.79	2.67	2.70	2.68
AU	2.38	2.33	2.36	2.39	2.48	2.52	2.61	2.63	2.65	2.71	2.79	2.76	2.76	2.93
ES	1.35	1.53	1.70	2.05	2.16	2.23	2.37	2.60	2.70	2.77	2.90	2.82	2.91	3.05
CH	1.64	1.69	1.78	1.91	1.96	2.02	2.02	2.02	2.16	2.16	2.26	2.22	2.13	2.18

There have also been significant changes in the biomedical productivity of nations outside the top 12 (figure 2.3.1). Russia (RU) almost halved its annual production over the period, with a resulting dramatic drop in its worldwide biomedical share (from over 6000 to around 2900 papers annually). This massive drop could be partly attributed to the dramatic decreases of research funding in Russia. Between 1990 and 1995 we notice the decline in the numbers of researchers, down from 1m in 1990 to 0.52 m in 1995, of whom half are thought to be working in other sectors of the economy with many of the best have gone abroad. The federal R&D budget has declined from US$10 billion to US$2.45 billion over the same period, and the number of science doctorates awarded has gone down from 29 000 in 1992 to 14 000 in 1995.[7] But in the Far East, South Korea (KR) saw a marked production increase, with its share of the world output rising from 0.1% in 1989, to 1.5% in 2002. China (CN) Taiwan (TW) and Brazil (BR) all more than doubled their share of biomedical papers. Table A2.3.1 in the Appendix shows annual production of 29 countries between 1989 and 2002 and their AAPG.

[7] "Russian research on the ropes" *Science*, 13 December 1996, 274 p. 1827-0.

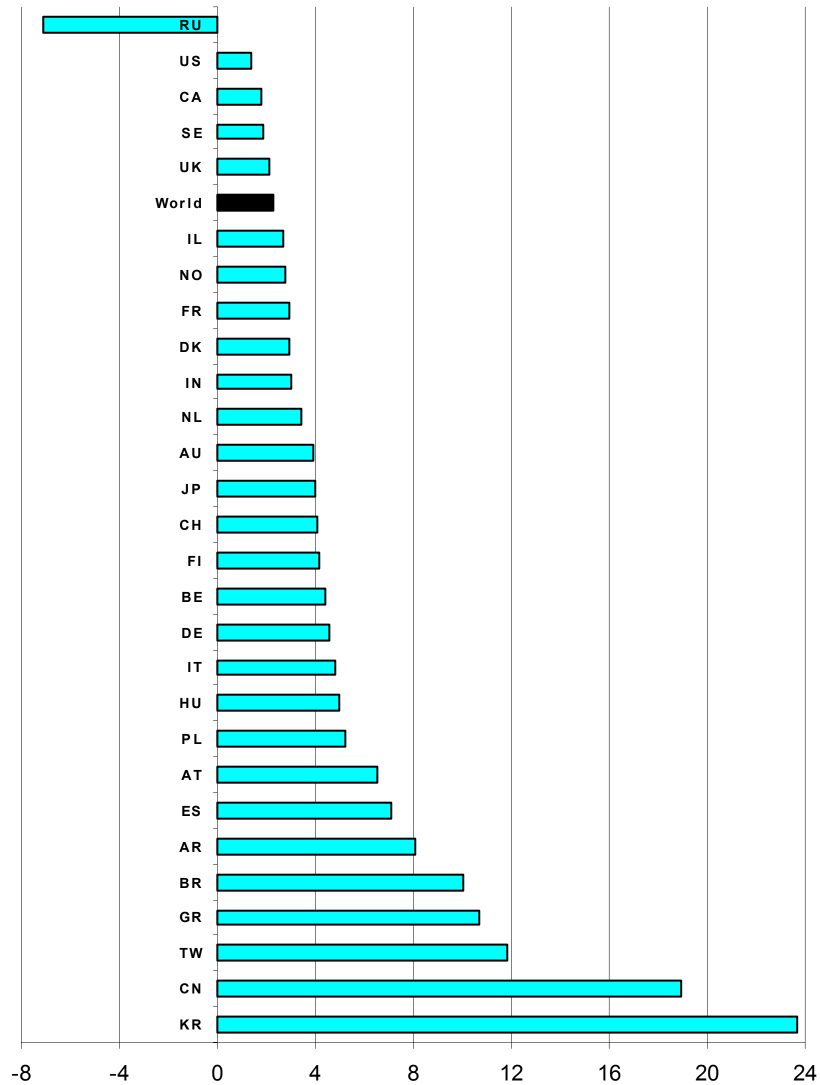

Fig. 2.3.1 Average annual percentage change of countries' and world production of BIOMED research papers, 1989-2002

It is difficult to know if these increases in paper production and participation in world biomedicine reflect actual increases in research output or if they simply reflect a shift in the practices of researchers from publishing in local journals – not covered by the SCI – to publishing in international journals.

There seems to be a correlation between a country's production of biomedical papers and its gross domestic product (GDP). Figure 2.3.2 shows a plot of mean numbers of biomedical papers produced by countries between 1998 and 2002 against their GDP (expressed in billions of $US) in the year 2000.[8] The correlation is statistically significant (r=0.961 at 0.01 level).

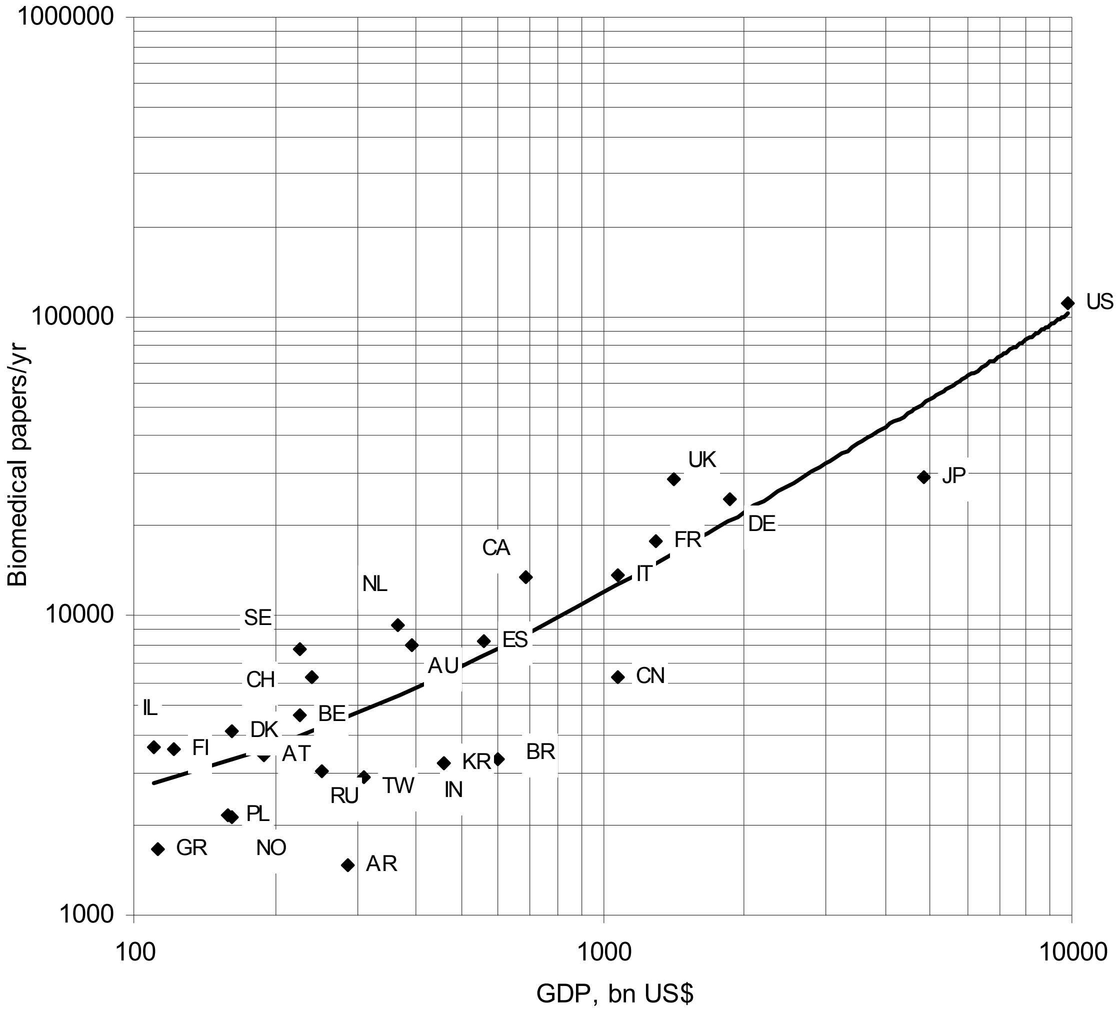

Figure 2.3.2 Correlation between countries' biomedical outputs and their GDP.

2.4 32 biomedical sub-fields worldwide and in 12 OECD countries

'Biomedicine' as an umbrella term covers a wide and diverse spread of research.[9] Some fields – genetics or endocrinology, for example – are far more

[8] GDP data after: *Pocket world in figures*. London: The Economist, 2003.

researched than others. And just as national rates of biomedical production shift with time, so too does the amount of papers published in each field. Every country – including the UK – has unique areas of relative commitment where the amount of papers produced is relatively higher than the average proportion of biomedical papers they produce as a whole.

It is important to note that the 32 sub-fields analysed here do not provide an exhaustive classification of the entire sphere of biomedicine. They are selected examples of research areas, which vary in size – from motor neurone disease with only 290 papers published annually, to infectious disease, with over 35,000 papers – and scope – from basic research to clinical reports.

Growth areas

Global biomedical research is an expanding area of science. In every sub-field, the number of papers produced has risen over the past 14 years. Table 2.4.1 shows numbers of papers published worldwide and in the UK in each sub-field in, their mean growth over the period and the UK share of world outputs.

We see that biomedical engineering, motor neurone disease, gerontology and multiple sclerosis are the areas showing the fastest worldwide growth. Globally, these fields grew on average by at least 5% every year.

At the other end of the scale, the sub-fields of obstetrics and gynaecology, haematology and veterinary medicine are expanding more slowly – with average annual growth rate of less than 1%.

In many fields, UK biomedical research has followed the global growth trends. In the UK – just as worldwide – the fields of biomedical engineering, motor neurone disease and gerontology have grown at an average annual rate of over 5%.

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[9] To isolate papers in different biomedical specialties a series of subject search strategies (called here filters) were constructed and run. Their scope definitions, names of experts responsible for their creation and precision and recall values are found in the Annex.

But there are some notable differences. Stroke research has a much faster average growth rate in the UK (over 7% annually) than it does worldwide (nearly 5%). While the average annual number of UK papers published in gastroenterology and renal medicine has gone down, it has increased at the world level.

Another noteworthy difference is UK's commitment to malaria and asthma research. UK outputs in these disciplines contribute over 17% each to world production. This is almost twice as much as UK's commitment to biomedical research overall (10% of world production).

Table 2.4.1 Total numbers of papers in the SCI for 32 biomedical sub-fields (and for mental health, also in the Social Sciences Citation Index) from the world and UK, average annual percentage growth, 1989-2002 and mean UK share of world research outputs.

Code	Subfield	World (N)	AAPG (world)	UK (N)	AAPG (UK)	UK %
MALAR	Malaria	15 372	1.9	2 705	4.5	17.6
ASTHM	Asthma	23 282	4.3	4 082	3.1	17.5
TROPM	Tropical medicine	65 236	1.5	9 561	2.6	14.7
MULSC	Multiple sclerosis	12 487	5.3	1 635	4.9	13.1
MONED	Motor neurone disease	3 924	5.9	513	5.5	13.1
DENTA	Dental research	59 234	2.4	7 641	1.9	12.9
ARTHR	Arthritis and rheumatism	96 878	2.6	12 454	1.6	12.9
RESPI	Respiratory medicine	186 219	2.2	21 242	1.6	11.4
CHILD	Neonatolgy & paediatrics	228 896	2.4	25 829	2.1	11.3
MENTH	Mental health	203 900	2.9	22 436	3.3	11.0
DERMA	Dermatology and venereology	129 660	1.3	13 968	0.5	10.8
OBSGY	Obstetrics & gynaecology	215 458	0.9	22 902	1.1	10.6
INFEC	Infectious diseases	518 923	2.1	55 109	1.7	10.6
OTORH	Otorhinolaryngology	75 556	2.8	8 004	1.0	10.6
OPTHT	Ophthalmology	97 579	2.0	10 304	2.1	10.6
VETER	Veterinary medicine	175 310	0.3	18 198	1.2	10.4
DIABE	Diabetes	67 162	2.4	6 891	1.5	10.3
GERON	Gerontology	123 077	5.0	12 468	5.0	10.1
IMMAL	Immunology and allergy	323 715	0.8	31 879	0.9	9.8
GENET	Genetics	489 607	3.8	47 966	4.1	9.8

HAEMA	Haematology	242 721	0.7	22 644	0.4	9.3
AIDSR	AIDS research	56 974	1.8	5 238	1.9	9.2
GASTR	Gastroenterology	287 906	1.7	26 387	**-0.6**	9.2
ENDOC	Endocrinology	476 719	1.1	43 033	0.5	9.0
NEUSC	Neuroscience	365 713	1.7	32 309	2.2	8.8
BIENG	Biomedical engineering	51 171	6.3	4 518	6.7	8.8
CARDI	Cardiology	415 837	1.3	36 475	1.7	8.8
ONCOL	Oncology	437 443	3.0	38 356	1.3	8.8
STROK	Stroke research	38 217	4.8	3 281	7.6	8.6
TROVE	Tropical veterinary med.	32 364	2.4	2 681	3.1	8.3
RENAL	Renal medicine	102 924	1.3	8 364	**-0.6**	8.1
SURGE	Surgery	222 783	3.0	16 784	0.5	7.5

Focus in different sub-fields

Infectious disease research papers make up the largest proportion (14%) of all the biomedical papers produced over the last 14 years.

But in the UK, the proportion of research into infectious disease is slightly higher at 15% of total biomedical paper output.

Figure 2.4.1 shows differences between the UK and the world in the proportion of papers produced in each sub-field.

Tropical medicine, infectious diseases, arthritis, neonatology & paediatrics, dentistry, obstetrics and malaria are notable areas in which the proportional output is significantly greater in the UK than the world, while in oncology, surgery and cardiology the opposite is the case.

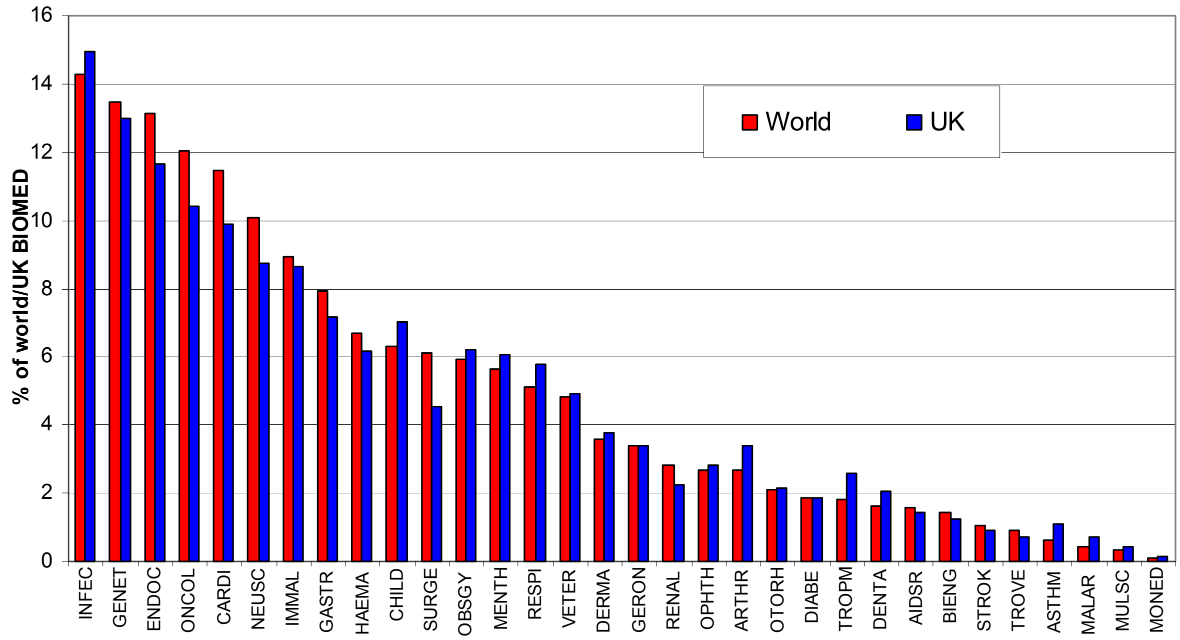

Figure 2.4.1 World and UK outputs in 32 subfields as a percentage of world and UK BIOM, 1989-2002.

Table 2.4.2 shows the proportion of biomedical papers produced per sub-field in different countries. Figures in red show the sub-fields where the proportion of papers produced by a country is significantly higher than that of the world, and correspondingly, figures in blue show subfields where the proportion of papers produced in a country was lower than that of the world.

Table 2.4.2 12 OECD countries' and world's mean commitment to 32 biomedical subfields, 1989-2002.

	AU	CA	CH	DE	ES	FR	IT	JP	NL	SE	UK	US	WORLD
INFEC	1.12	0.86	1.05	0.99	1.15	1.15	0.75	0.83	0.99	0.86	1.05	0.95	14.3
GENET	1.08	1.05	0.99	1.08	0.95	1.20	0.86	1.17	0.95	0.85	0.96	1.10	13.4
ENDOC	1.06	1.07	0.88	0.90	1.02	1.06	1.18	1.09	0.96	1.24	0.89	0.95	13.2
ONCOL	0.75	0.80	0.87	1.06	0.75	1.02	1.42	1.27	1.07	0.92	0.87	0.99	12.0
CARDI	0.86	0.97	0.92	1.11	0.73	0.95	1.11	1.14	1.02	0.93	0.86	0.95	11.5
NEUSC	0.94	1.29	0.98	1.05	1.02	0.99	1.09	1.12	0.74	1.13	0.87	1.06	10.1
IMMAL	1.14	0.83	1.39	1.12	0.89	1.13	1.18	1.12	1.20	1.12	0.97	0.99	9.0
GASTR	1.01	0.81	0.87	1.03	1.18	1.03	1.28	1.40	0.90	1.09	0.91	0.80	7.9

HAEMA	0.92	0.86	1.00	1.13	0.89	1.15	1.50	1.06	1.19	0.96	0.92	0.93	6.7
CHILD	1.27	1.12	0.80	0.76	0.67	0.91	0.95	0.56	1.02	1.04	1.11	1.01	6.3
SURGE	0.71	0.82	0.73	0.81	0.49	0.52	0.62	0.99	0.75	1.08	0.75	1.15	6.1
OBSGY	1.25	1.03	0.68	0.84	0.74	0.77	0.94	0.79	0.97	1.03	1.04	0.99	6.0
MENTH	1.32	1.30	0.71	0.83	0.69	0.50	0.66	0.40	0.77	0.90	1.08	1.20	5.6
RESPI	1.05	1.20	0.92	0.81	1.02	0.94	0.89	0.85	1.01	1.02	1.13	0.98	5.1
VETER	1.88	1.65	0.87	0.93	1.15	0.75	0.35	0.72	0.95	0.68	1.02	0.88	4.9
DERMA	0.87	0.66	1.07	1.22	0.98	1.04	1.07	0.92	0.99	0.90	1.06	0.93	3.6
GERON	1.01	1.02	0.76	0.76	0.84	0.75	1.28	0.75	1.05	1.20	1.00	1.12	3.4
RENAL	0.90	0.83	0.98	1.21	1.22	0.93	1.14	1.05	1.04	1.02	0.81	0.88	2.8
OPTHT	1.29	0.87	1.13	1.31	0.67	0.53	0.75	0.96	0.88	0.66	1.04	1.06	2.7
ARTHR	1.16	1.07	1.15	0.88	0.91	1.11	0.96	0.95	1.17	1.15	1.27	0.91	2.7
OTORH	0.88	0.72	0.71	0.79	0.68	0.71	0.87	0.95	0.93	1.11	1.05	1.02	2.1
DIABE	1.02	0.99	0.90	0.84	0.98	0.96	1.40	1.09	0.74	1.72	1.01	0.88	1.8
TROPM	1.38	0.48	1.55	0.61	0.69	1.14	0.39	0.35	1.01	0.69	1.44	0.72	1.8
DENTA	0.72	0.80	0.76	0.56	0.44	0.36	0.57	1.01	1.07	1.92	1.27	0.93	1.6
AIDSR	0.81	0.70	1.18	0.70	1.10	1.50	1.38	0.39	0.87	0.71	0.90	1.32	1.6
BIENG	0.82	1.07	0.99	0.90	0.58	0.75	0.92	1.10	1.36	1.20	0.87	1.01	1.4
STROK	0.68	0.94	0.90	1.17	0.58	0.81	1.00	1.51	0.85	1.17	0.84	0.93	1.0
TROVE	1.77	0.58	0.62	0.51	0.95	0.68	0.26	0.41	0.61	0.34	0.81	0.52	0.9
ASTHM	1.85	1.41	1.00	0.64	0.99	0.76	1.18	0.78	1.55	2.09	1.73	0.70	0.6
MALAR	2.47	0.46	2.20	0.67	0.31	1.49	0.52	0.37	1.30	0.89	1.71	0.85	0.4
MULSC	0.77	1.28	1.37	1.16	0.83	1.03	1.57	0.61	1.25	1.40	1.29	1.03	0.34
MONED	0.63	1.56	0.99	0.97	0.64	1.18	1.35	1.48	0.80	1.09	1.29	0.98	0.11

Over the period, the proportion of research papers which focused on biomedical engineering, genetics, stroke, gerontology, mental health and motor neurone disease rose in all 12 countries and the proportional amount of publication outputs in cardiology, endocrinology, haematology, immunology and renal medicine fell. Table A2.4.1 in the Appendix shows annual outputs of 12 OECD countries in all analysed subfields.

Methodology

Numbers of biomedical papers in the SCI were determined using a biomedical filter (see the Annex). This filter allowed for the extraction of all papers by authors working in institutions with biomedical key words in their addresses. The construction of subfield filters is also explained in the Annex.

For this chapter, as the data come directly from the ISI disks, CD-ROM year rather than publication year was used as the unit of analysis.

The outputs of counties were determined using integer counting of their SCI publications.

Between 1989 and 2002, the CD-ROM version of SCI listed 3,630,029 biomedical articles, notes and reviews published worldwide.

Key Findings

- Biomedical papers constitute about 55% of all science publications in the UK.

- UK produces around 10% of all biomedical papers worldwide but in 2000 Japan overtook as the second most prolific annual producer.

- UK share of biomedical papers has been decreasing. USA, Canada and Sweden's shares have also decreased.

- Among smaller (scientifically) countries the biggest increases in the share of biomedical papers have been observed for South Korea (24% AAPR), China (19%), Taiwan (12%), Greece (10%) and Brazil (9%).

- UK has a well-balanced biomedical portfolio. The only noticeably weaker sub-field is surgery at 7.5% of global surgery outputs.

- Worldwide, biomedical engineering, motor neurone disease, multiple sclerosis, gerontology and stroke research have been growing the most dynamically.

- In the UK, the biggest growth areas have been stroke research, biomedical engineering, motor neurone disease and gerontology.