The publication of cancer research papers in high impact journals

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Keywords

Literature, Research, Cancer, Journals

Abstract

Examines a set of over 27,000 UK papers in cancer research in order to identify the individual factors that influence the impact category of the journals in which they are published, using multiple regression analysis. The most important independent variables that have a positive effect are the numbers of authors and funding bodies, the research level (from clinical to basic), and the presence of certain universities, or of the USA, in the address field. Inter-lab co-operation was shown to have a negative effect on journal impact category, as was international co-authorship. It is because such partnerships usually involve more authors and funding for the research that they are perceived to lead to higher impact work. There is also a tendency for papers to be published in higher impact journals in later years, probably because of market forces, which means that such journals will tend to expand.

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Aslib Proceedings
Volume 55 · Number 5/6 · 2003 · pp. 379-387
 · ISSN 0001-253X
DOI 10.1108/00012530310498950

Introduction

Research evaluation is currently enjoying a favoured position in many countries as research budgets expand but there is also pressure from funders to ensure value for money (Balter, 2000; Hinde, 1997; Palmerini, 1999; Saegusa, 1999). In several European countries, for example, there is a move to more competitive funding both of laboratories and of individual research projects (Abbott, 1993; Allakhverdov, 1995; Goddard, 2000; Stone, 1996). The ultimate test of the utility of research is that it will give rise to new products and processes or, in the biomedical field, to better health for man and animals. However, the route to these tangible benefits is often lengthy, especially for basic research (Cerf, 1996; Martin and Salter, 1996; Patel *et al.*, 1999), so that proxy indicators are needed to show whether given expenditures have been worthwhile. The main proxy indicator is the esteem in which research is held by other researchers, which can be measured by the counting of citations. However, these suffer from some disadvantages:

- they are somewhat costly to determine – typically about US$1 per paper;
- it takes time for them to accumulate, so that fair comparisons can be made – perhaps five years; and
- comparisons between different fields and sub-fields are difficult because citation norms differ greatly.

An alternative proxy indicator of research quality is the prestige of the journal in which it has been published, which can conveniently be measured, at least in most areas of biomedicine, by citation counts. In effect, the judgements of editors and referees in selecting papers for publication can be used as a measure of quality (Lewison and van Rooyen, 1999). Correspondence between journals' mean citation scores and the actual numbers of citations received by papers (Lewison, 1998) would indicate that the two measures are in reasonable agreement and that a ranking on the basis of the former criterion would be useful as a means to evaluate different groups of research papers.

In some ways, the analysis of the factors that lead to high quality research is comparable with epidemiology. In this subject, the factors that lead to ill-health are analysed. The problem in both analyses is that

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Volume 55 · Number 5/6 · 2003 · 379-387

there may be missing factors, some of which are correlated with the ones used for analysis, and which can confound the apparent conclusions. For example, ill-health is positively associated with smoking, a poor diet, lack of exercise and a low-status job (Clarke *et al.*, 1998; Brunner *et al.*, 1999; Hemingway and Marmot, 1999; Marmot and Bobak, 2000). But each of these factors is strongly associated with the three others and indeed with yet more factors that can plausibly lead to ill-health, such as low income, low education level, poor housing and living in a polluted area. If public health measures are to be soundly based, it is essential that the individual effects of all these factors, and probably many more, are teased out, so that policies can be targeted on the most important ones.

Similarly, the factors that lead to high quality research may plausibly include:

- the subject area of the research;
- whether it is applied or basic (in biomedicine, clinical or basic);
- whether it is carried out in an industrial or academic setting (in biomedicine, in a hospital or a university);
- whether the team of authors is large and multi-disciplinary or small;
- whether there is inter-laboratory collaboration;
- whether there is international collaboration and, if so, with which country or countries;
- whether the research has been reviewed by a peer-review committee for funding and, if so, by how many;
- whether the research has been funded by a particular sector (government, private-non-profit, industry); and
- the city in which the research has been conducted.

It is the aim of this paper to show how such an analysis can be undertaken for one relatively large subject area and group of papers (cancer research in the UK from 1988 to 1998). Although numerical results will be given, they are intended more as illustrative examples to show the general principles of the analysis and to show trends than as definitive values. The results will show in particular the dangers of making judgements on inadequate data and of making inappropriate comparisons. These cannot be too highly stressed. There are increasing numbers of cases where researchers have rejected the results of bibliometric or other quantitative studies, because they do not, in their view, reflect the reality of their situation (Collins, 1991; Williams, 1998). These rejections could prejudice the use of such quantitative studies where they can be useful as a supplement to the subjective views of peer-review committees (Lewison *et al.*, 1999).

The main analysis in the paper is of the potential impact category of the journals in which the papers are published, treated as a proxy indicator of research quality and an "output factor", and how it is influenced by a large number of independent parameters or "input factors". It is correlated with citation scores for groups of papers (Lewison, 1998), but there is inevitably much scatter and it is in effect almost an independent measure of impact. Subsequently the reasons for the changes in many of the parameters of UK oncology research with time (more authors, more collaboration, more funding etc.) are explored by a similar use of regression analysis. This reveals the main drivers behind the changes that have occurred and which ones have not been important.

Methodology

The study was based on a set of 27,189 papers extracted from the Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI) © The Institute for Scientific Information, CD-ROM version, for the years 1988-1998. Articles, notes and reviews were downloaded with an address in the UK and in the field of cancer research. This was defined (Lewison, 1999) by means of lists of specialist journals and title keywords, some in combination. This retrieval strategy or "filter" was developed in association with representatives of the Cancer Research Campaign, a leading UK cancer charity. The bibliographic data from the SCI and SSCI were supplemented by funding data obtained by looking up the papers in libraries. The papers were in fact a sub-set of the Research Outputs Database (ROD), which has been developed by the Wellcome Trust in order to track UK biomedical research and identify papers associated with particular funders (Dawson *et al.*, 1998).

The funding data included the identity of the funder(s), their category (e.g. government

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Volume 55 · Number 5/6 · 2003 · 379-387

agency, charity, foundation, pharmaceutical company), type of funding (e.g. intramural, extramural, personal) and country of the funder. In particular, funders were grouped into three main sectors – UK government, UK private-non-profit, and industrial. The UK addresses were all given their correct postcodes, if they were missing or incorrect in the SCI and SSCI. For the purposes of the current analysis, interest was focused on the first one or two letters of the postcode (e.g. B = Birmingham, CB = Cambridge, EC = London East Central) which designate the city. The setting of the research was characterised as clinical or academic according to whether certain key word contractions (HOSP, INFIRM, NHS for clinical; COLL, SCH, UNIV for academic) were present in the address field. Finally, the papers with foreign addresses were identified and the presence of 11 leading industrial countries was noted for each.

The papers were classified by research level using a system developed by CHI Research Inc. (Narin *et al.,* 1976). They assign a level (1 = clinical observation, 2 = clinical mix, 3 = clinical investigation, 4 = basic research) to almost all journals on the basis of expert opinion and journal-to-journal citation patterns – clinical journals cite ones more basic but not vice versa. The distribution of papers by research level varies greatly according to the sub-field of biomedicine: papers are mostly basic in genetics and mostly clinical in anaesthesiology. In cancer research, there is a good balance with 14 per cent basic research (RL = 4), 30 per cent clinical investigation (RL = 3), 37 per cent clinical mix (RL = 2) and 18 per cent clinical observation (RL = 1). Only 1.3 per cent of papers are unclassified.

The main output measure used was the potential impact category of the journals in which the papers were published, again with four levels. These were based on five-year mean citation scores (C_{0-4} values) for papers published in given years and were taken from the Journal Expected Citation Rates files (©The Institute for Scientific Information). Papers were grouped into levels according to these values, as shown in Table I. The examples given are the most-frequently used journals in each category; some are specialist cancer journals and some are general journals.

The appearance of *Brit. J. Cancer* in two categories is not a mistake: the journal changed category, as its citation score dipped below 11 in 1990 and then rose again to more than 15 in 1994. This illustrates the point that journals do vary in their citation impact with time, depending on the editor, the current importance of the subject and their publishing policy.

Table I Classification of journals by potential impact category (PIC) according to their five-year mean citation scores, C_{0-4}

PIC	C_{0-4} values	Examples
1	Below 6	*Brit. J. Urology, Brit. J. Radiology, Clin. Radiology*
2	Between 6 and 11	*Brit. J. Surgery, J. Clin. Pathol., Eur. J. Cancer, Brit. J. Cancer*
3	Between 11 and 20	*Brit. J. Cancer, Int. J. Cancer, Carcinogenesis*
4	Above 20	*Cancer Res., Oncogene, Lancet, Blood*

The "output" or dependent variable in the regression analysis was PIC, which could take the value 1, 2, 3 or 4. The "input" or independent variables used for the analysis were as follows:

- A = number of authors, obtained by counting hyphens in the author field;
- D = number of addresses, one more than the number of slashes in the address field;
- DF = number of non-UK addresses, obtained by subtracting the numbers of addresses in England, Wales, Sotland and Northern Ireland from D;
- F, F2 = number of funding bodies and its square, obtained by counting the number of entries in the funding field;
- YR = year of publication – 1987;
- RL, RL2 and RL3 = research level, its square and its cube (these three coefficients allow for PIC, the dependent variable, having an arbitrary relationship with RL);
- HOSP, ACAD = 1 or 0, depending on the presence of address key contractions;
- MRC, CRC, ICRF = 1 or 0, depending on the presence of three leading funders of cancer research (the Medical Research Council, the Cancer Research Campaign, and the Imperial Cancer Research Fund[1]);
- GOV, PNP, IND, NON = 1 or 0, depending on the presence of UK government, UK private-non-profit, industrial funding or no funding acknowledged;
- 20 postcode areas = 1 or 0, depending on whether they were represented in the postcode(s) for each paper;

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- 11 country codes = 1 or 0, depending on whether they were present in the address field.

The numbers of authors, addresses, foreign addresses and funding bodies were limited respectively to 9, 6, 3 and 5, because a few papers had very large values of these parameters and they would have distorted the analysis. Altogether, there were 49 independent variables used in the analysis.

Results

The main results of the analysis are presented in Tables II and III. Table II shows the analysis by the principal non-geographic parameters – authors, addresses, funding and year. The effect of research level is shown as the value of the unstandardised coefficient for each RL, including the constant term; although the coefficients in the cubic equation are all highly significant (< 0.1 per cent), it is not possible to show the statistical significance of each RL value. Overall, the contribution of the independent variables to the explanation of the variance of PIC was 31 per cent. In the Tables, only the statistically significant coefficients are shown.

The effect of research level on PIC should be seen more in terms of the overall distribution of papers than in terms of mean values, as PIC is a categorical variable, albeit one representing a continuum of values. Figure 1 shows that there are big differences between papers at the different research levels.

Table II SPSS analysis of effects of independent variables on PIC: authors (A), addresses (D and DF), funding (F) and individual funders

Parameter	*N* papers	Coefficient	Std error	Significance (%)
Authors, A		0.082	0.003	0.000
Addresses, D		–0.040	0.007	0.000
Foreign addr, DF	6,258	–0.031	0.011	0.613
RL = 1 (clinical)	4,821	0.793		
RL = 2	10,076	0.976		
RL = 3	8,130	1.270		
RL = 4 (basic)	3,817	1.702		
Year, YR		0.022	0.002	0.000
Setting, HOSP	19,064	–0.043	0.013	0.131
Setting, ACAD	16,755	0.070	0.012	0.000
Funding, F		0.093	0.020	0.000
Funding, GOV	5,429	–0.145	0.023	0.000
Funding, IND	3,311	–0.113	0.018	0.000
Funding, NON	9,364	–0.173	0.026	0.000
Funding, MRC	3,427	0.243	0.025	0.000
Funding, CRC	5,363	0.104	0.018	0.000
Funding, ICRF	2,835	0.209	0.021	0.000

Table III SPSS analysis of effects of geographical presence in the address field of UK oncology papers, 1988-1998, on PIC

Parameter	*N* papers	Coefficient	Std error	Significance (%)
London W	2,818	0.125	0.018	0.000
London WC	2,662	0.150	0.019	0.000
London SW	1,915	0.112	0.021	0.000
Oxford OX	1,726	0.131	0.022	0.000
Cambridge CB	1,588	0.144	0.024	0.000
London NW	835	0.156	0.031	0.000
Liverpool L	805	–0.122	0.031	0.009
Bristol BS	732	–0.090	0.033	0.579
USA	2,178	0.250	0.024	0.000

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The effect of the number of authors per paper, shown as a coefficient of +0.082 in Table II, is equally dramatic, as Figure 2 shows. It is the strong correlation (Figure 3) between numbers of addresses, D, and numbers of authors, A, and also with the numbers of funders, F, that led to the supposition that more addresses meant higher quality research in earlier work (Narin *et al.*, 1991; Glänzel, 2000). However, the negative coefficient for D in Table II shows clearly that this theory is erroneous. There is also a negative coefficient for DF, although from Table III it appears that collaboration with US researchers is very helpful in terms of publishing in high-impact journals.

In view of the amount of labour involved in looking up every paper to determine its funding, it is reasonable to ask whether the relationships of PIC with the other independent variables shown in Tables II and III actually depend on the availability of funding data. The SPSS analysis was, therefore, repeated with the nine funding variables removed (F and F2; GOV, PNP, IND and NON; MRC, CRC and ICRF). The results for the independent variables are shown in Tables IV and V.

The absence of funding information makes little difference to the relationship between the estimated value of PIC and the non-geographic independent variables: there is naturally a larger coefficient for A but the coefficient of D is still negative and indeed almost unchanged. With regard to the geographical dependence (Table V compared with Table III), there are now several other cities (Manchester, Sutton & Cheam,

Figure 1 Distribution of papers by potential impact category (PIC; 1 = low, 4 = high) for UK oncology papers at four research levels (RL; 1 = clinical, 4 = basic), 1988-1998

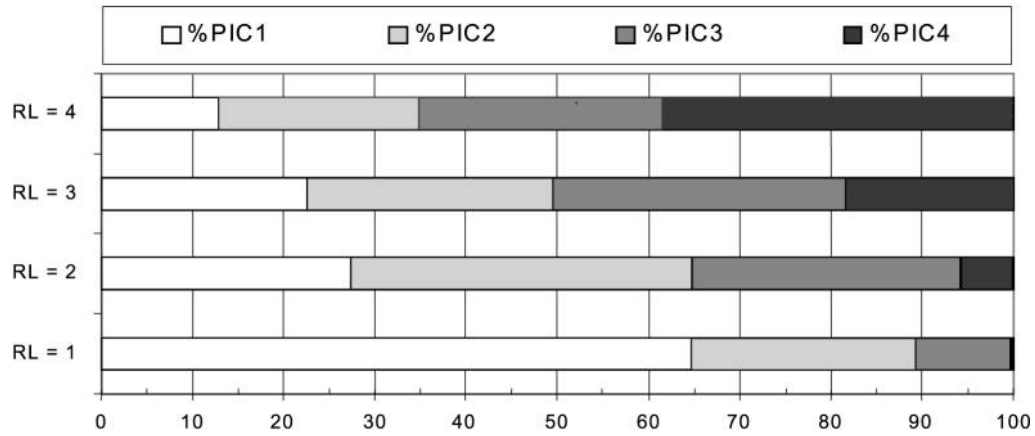

Figure 2 Distribution of papers by potential impact category (PIC; 1 = low, 4 = high) for UK oncology papers with different numbers of authors, A, 1988-1998

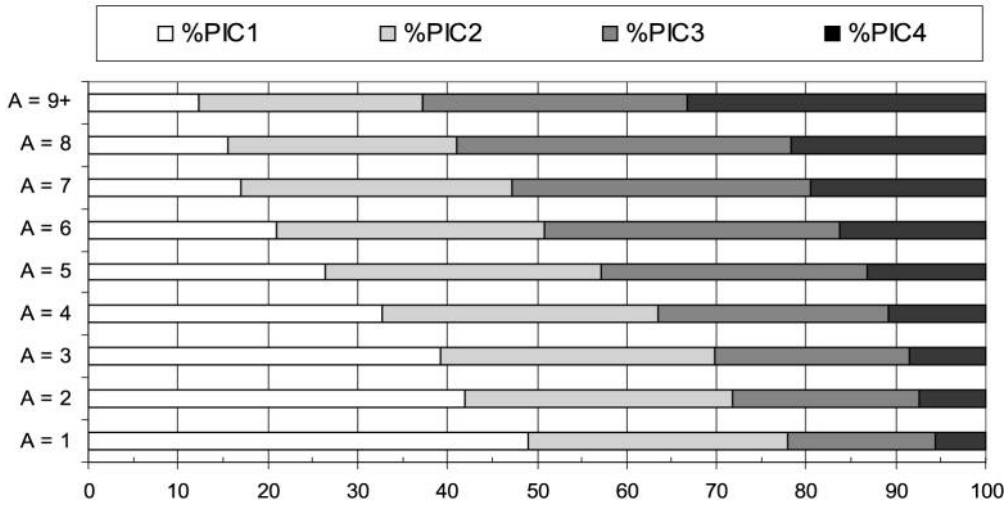

Figure 3 Relationship between numbers of addresses, D, and mean numbers of authors per paper, A, and numbers of funders per paper, F, for UK oncology papers, 1988-1998

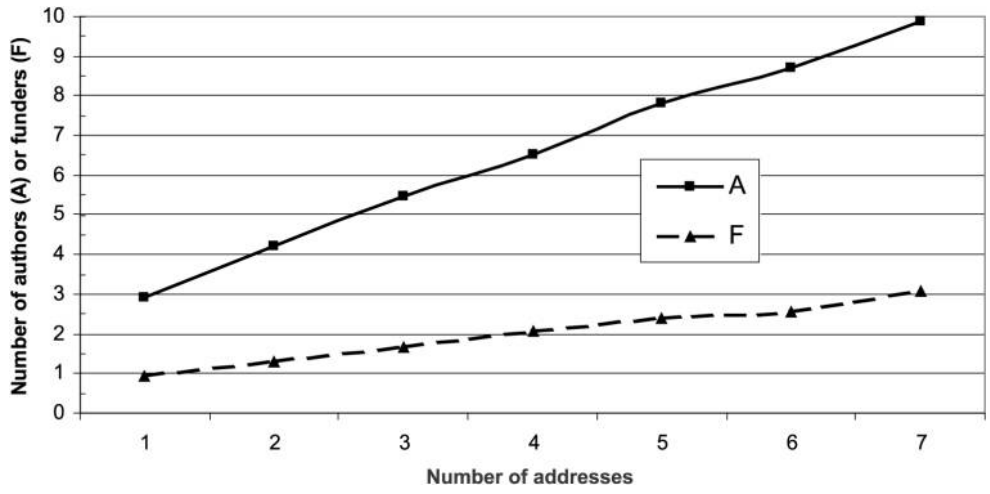

Table IV SPSS analysis of effects of independent variables on PIC: authors (A), addresses (D and DF), research level (RL), time and setting: without funding data

Parameter	*N* papers	Coefficient	Std error	Significance (%)
Authors, A		0.105	0.003	0.000
Addresses, D		–0.039	0.007	0.000
Foreign addr, DF	6,258	-0.012	0.011	n.s.
RL = 1 (clinical)	4,821	1.075		
RL = 2	10,076	1.483		
RL = 3	8,130	1.832		
RL = 4 (basic)	3,817	2.177		
Year, YR		0.020	0.002	0.000
Setting, HOSP	19,064	–0.098	0.013	0.000
Setting, ACAD	16,755	0.087	0.012	0.000

Table V SPSS analysis of effects of geographical presence in the address field of UK oncology papers, 1988-1998, on PIC: without funding data

Parameter	*N* papers	Coefficient	Std error	Significance (%)
London W	2,818	0.171	0.018	0.000
London WC	2,662	0.255	0.019	0.000
London SW	1,915	0.124	0.021	0.000
Manchester M	1,906	0.049	0.022	2.448
Sutton & Cheam SM	1,718	0.105	0.023	0.001
Oxford OX	1,726	0.264	0.022	0.000
Glasgow G	1,601	0.086	0.023	0.027
Cambridge CB	1,588	0.262	0.023	0.000
Edinburgh EH	1,415	0.098	0.025	0.007
Birmingham B	1,315	0.060	0.026	1.826
London NW	835	0.195	0.031	0.000
Liverpool L	805	–0.129	0.032	0.005
Bristol BS	732	–0.094	0.033	0.491
USA	2,178	0.286	0.024	0.000

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Glasgow, Edinburgh and Birmingham) that appear to have a positive influence on the PIC values of the oncology papers. This must be because they are successful in gaining external funding for their work and the positive effect on PIC that this brings is visible. However, the cities listed in Table III as having a positive coefficient do well, even when account is taken of their funding success. There are also two cities (Liverpool and Bristol) that appear to have a negative effect on PIC values by their presence in the address field, and this is so, whether or not account is taken of funding data. Again, only the USA appears to have a positive effect by its presence in the address field.

Discussion

The results presented above have provided several important findings:

- The negative effect of numbers of addresses on the impact category of journals in which research papers are published, which was found for gastroenterology, also applies to the larger field of cancer research.
- International collaboration (except with the USA) also has a negative impact on journal impact category, mainly because the apparently positive effect is actually attributable to the additional funding, which more than counters the negative effect of collaboration across frontiers.
- Clinicians tend to publish their papers in journals of much lower impact category than basic researchers in a field and this should be taken fully into account when comparisons between groups are being made. In particular, cancer research in hospitals is published in lower impact journals than ones from academia.
- The number of authors on a paper plays a major role in determining the impact category of the journal in which it is likely to be published.
- There is a small but positive drift in the impact category of journals in which cancer research is being published, probably because of the tendency for highly cited journals to increase in size and vice versa.
- It is possible to compare the outputs of research from different cities (read, universities) on a fair basis and to identify those whose work is of a superior standard and those whose work appears to be of lower potential impact. However, such distinctions depend to some extent on a university's success in gaining external funding, which could also be seen as an outcome measure.

Although the data set has been used to evaluate PIC as an output measure, we can also use it to investigate the causes behind the steady change in the character of UK oncology research with time seen in Table VI.

Evidently the research has become more multi-disciplinary, slightly more basic, with more papers specifically funded and much more foreign collaboration. Each of these variables can be considered as being the dependent variable, with all the others, as well as setting, year and number of addresses, being the independent variables. The results for authors, funding level, research level and foreign collaboration in turn are shown in Tables VII to X.

The main drivers behind the increase in team size have been the need to get funding (more F) and more collaboration, particularly in the UK (more D, but DF not important). Research level plays little part but clinical team sizes seem to have increased more than basic ones.

This shows that the primary drivers behind the apparent increase in funding are the larger research teams and increased foreign collaboration, and that funding has not inherently been more plentiful in recent years. Academics are more likely to be funded than clinicians in hospitals and there is a strong preference by funders for work at clinical investigation level, followed by basic research.

The effect of collaboration on research level is divided: foreign collaboration tends to make it more basic but domestic collaboration is more clinical. Not surprisingly, hospital settings lead to more clinical work and academic ones to more basic work. But the biggest driver has been funding: the receipt of specific funding seems to make the work much more basic.

The biggest influence on foreign collaboration has been the growing practice of domestic collaboration. The research level has had rather little influence, although basic research is more likely to lead to foreign collaboration, as is work in academia.

Table VI Variation with time of parameters associated with UK oncology research: authorship, A; funding, F; foreign collaboration, DF and research level, RL

Period	Papers	Mean A	Mean F	Mean DF	Mean RL
1988-1990	6,549	4.06	1.17	0.36	2.28
1991-1993	7,550	4.50	1.40	0.53	2.34
1994-1996	8,116	5.07	1.54	0.73	2.44
1997-1998	4,974	5.37	1.66	0.94	2.47

Table VII SPSS analysis of effects of independent variables on team size (authors per paper, A)

Parameter	Coefficient	Std error	Significance (%)
Year, YR	0.034	0.003	0.000
Addresses, D	0.997	0.010	0.000
Foreign addr, DF	–0.001	0.016	n.s.
Funding, F	0.476	0.019	0.000
Funding^2, F2	–0.046	0.004	0.000
Setting, HOSP	0.244	0.025	0.000
Setting, ACAD	–0.064	0.022	0.358
RL = 1 (clinical)	1.098		
RL = 2	1.320		
RL = 3	1.431		
RL = 4 (basic)	1.254		

Table VIII SPSS analysis of effects of independent variables on funding level (funders per paper, F)

Parameter	Coefficient	Std error	Significance (%)
Authors, A	0.148	0.004	0.000
Addresses, D	0.078	0.009	0.000
Foreign addr, DF	0.306	0.012	0.000
Year, YR	0.003	0.002	n.s.
Setting, HOSP	–0.423	0.018	0.000
Setting, ACAD	0.127	0.017	0.000
RL = 1 (clinical)	0.166		
RL = 2	0.663		
RL = 3	1.593		
RL = 4 (basic)	0.931		

Table IX SPSS analysis of effects of independent variables on research level (RL)

Parameter	Coefficient	Std error	Significance (%)
Authors, A	0.021	0.003	0.000
Addresses, D	–0.078	0.006	0.000
Foreign addr, DF	0.094	0.008	0.000
Year, YR	0.010	0.002	0.000
Funding, F	0.412	0.010	0.000
Funding^2, F2	–0.050	0.002	0.000
Setting, HOSP	–0.498	0.012	0.000
Setting, ACAD	0.107	0.011	0.000

Table X SPSS analysis of effects of independent variables on foreign collaboration (foreign addresses per paper, DF)

Parameter	Coefficient	Std error	Significance (%)
Authors, A	0.000	0.002	n.s.
Addresses, D	0.395	0.004	0.000
Year, YR	0.005	0.001	0.035
Funding, F	–0.059	0.007	0.000
Funding^2, F2	0.030	0.001	0.000
RL = 1 (clinical)	–0.534		
RL = 2	–0.503		
RL = 3	–0.402		
RL = 4 (basic)	–0.373		
Setting, HOSP	–0.187	0.010	0.000
Setting, ACAD	0.082	0.009	0.000

It is worth noting that nearly all the coefficients in the Tables are highly statistically significant, because the data set is so large. It is likely that similar associations would be found for smaller data sets, e.g. in more specialist sub-fields or with papers from smaller countries. It is recommended that more analyses of research output should be conducted on a multi-factorial basis in order to elucidate the important underlying factors; this can probably be done satisfactorily provided that the data set contains at least several thousand papers.

Note

1 The Cancer Research Campaign and the Imperial Cancer Research Fund have now merged to form Cancer Research UK.

References

Abbott, A. (1993), "Czechs revise policy on research funding, aim for a more western approach. Prague institute leads the way", *Nature*, Vol. 361 No. 6408, pp. 104-5.

Allakhverdov, A. (1995), "Russian science: president's council lambastes ministry", *Science*, Vol. 268 No. 5216, p. 1426.

Balter, M. (2000), "New chief promises renewal and openness", *Science*, Vol. 287 No. 5453, p. 567.

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Brunner, E., Shipley, M.J., Blane, D., Smith, G.D. and Marmot, M.G. (1999), "When does cardiovascular risk start? Past and present socio-economic circumstances and risk-factors in adulthood", *Journal of Epidemiology and Community Health*, Vol. 53, pp. 757-64.

Cerf, V.G. (1996), "Research pays off", *Science*, Vol. 271 No. 5243, 8 March, p. 1343.

Clarke, R., Breeze, E., Sherliker, P., Shipley, M., Youngman, L., Fletcher, A., Fuhrer, R., Leion, D., Parish, S., Collins, R. and Marmot, M. (1998), "Design, objectives, and lessons from a pilot 25-year follow-up re-survey of survivors in the Whitehall study of London Civil Servants", *Journal of Epidemiology and Community Health*, Vol. 52 No. 6, pp. 364-9.

Collins, P.M.D. (1991), *Quantitative Assessment of Departmental Research: A Survey of Academics' Views*, SEPSU Policy Study No. 5, the Royal Society/ Fellowship of Engineering, London.

Dawson, G., Lucocq, B., Cottrell, R. and Lewison, G. (1998), *Mapping the Landscape: National Biomedical Research Outputs 1988-1995*, Policy Report No. 9, The Wellcome Trust, London.

Glänzel, W. (2000), "Science in Scandinavia: a bibliometric approach", *Scientometrics*, Vol. 48, June, pp. 121-50.

Goddard, A. (2000), "Research faces big overhaul", *THES*, 1 September, p. 4.

Hemingway, H. and Marmot, M. (1999), "Evidence-based cardiology – psychosocial factors in the aetiology and prognosis of coronary heart disease – systematic review of prospective cohort studies", *British Medical Journal*, Vol. 318, p. 1460.

Hinde, J. (1997), "Institutes' research pays", *THES*, 4 July, p. 7.

Lewison, G. (1998), "Gastroenterology research in the United Kingdom: funding sources and impact", *Gut*, Vol. 43, August, pp. 288-93.

Lewison, G. (1999), "The definition and calibration of biomedical subfields", *Scientometrics*, Vol. 46 No. 3, pp. 529-37.

Lewison, G. and van Rooyen, S. (1999), "Reviewers' and editors' perceptions of submitted manuscripts with different numbers of authors, addresses and funding sources", *Journal of Information Science*, Vol. 25 No. 6, pp. 509-11.

Lewison, G., Cottrell, R. and Dixon, D. (1999), "Bibliometric indicators to assist the peer review process in grant decisions", *Research Evaluation*, Vol. 8 No. 1, pp. 47-52.

Marmot, M. and Bobak, M. (2000), "International comparators and poverty and health in Europe", *British Medical Journal*, Vol. 321, pp. 1124-8.

Martin, B. and Salter, A. (1996), *The Relationship between Publicly Funded Basic Research and Economic Performance*, report for HM Treasury, Science Policy Research Unit, University of Sussex.

Narin, F., Pinski, G. and Gee, H.H. (1976), "Structure of the biomedical literature", *Journal of the American Society of Information Science*, Vol. 27, pp. 25-45.

Narin, F., Stevens, K. and Whitlow, E.S. (1991), "Scientific co-operation in Europe and the citation of multinationally authored papers", *Scientometrics*, Vol. 21 No. 3, pp. 313-24.

Palmerini, C. (1999), "Italy: university funding to be tied to performance", *Science*, Vol. 284 No. 5415, 30 April, pp. 725-6.

Patel, K., Thomson, A., Tysome, T., Utley, A. and Wojtas, O. (1999), "Nurturing the creative", *THES*, 3 December, p. 6.

Saegusa, A. (1999), "Japanese labs balk at bid to boost external evaluation", *Nature*, Vol. 397 No. 6718, 4 February, p. 378.

Stone, R. (1996), "Estonian researchers lead the way in science reform", *Science*, Vol. 273 No. 5284, 4 October, pp. 29-30.

Williams, G. (1998), "Misleading, unscientific and unjust: the United Kingdom's research assessment exercise", *British Medical Journal*, Vol. 316, pp. 1079-82.

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1. Sameer Kumar Asia-Europe Institute, University of Malaya, Kuala Lumpur, Malaysia Jariah Mohd. Jan Faculty of Languages and Linguistics, University of Malaya Kuala Lumpur, Malaysia . 2015. The assortativity of scholars at a research-intensive university in Malaysia. *The Electronic Library* **33**:2, 162-180. [Abstract] [Full Text] [PDF]
2. Grant Lewison, Richard Sullivan. 2015. Conflicts of interest statements on biomedical papers. *Scientometrics* **102**:3, 2151-2159. [CrossRef]
3. Sameer Kumar Asia-Europe Institute, University of Malaya, Kuala Lumpur, Malaysia Jariah Mohd. Jan Department of English Language, University of Malaya, Kuala Lumpur, Malaysia . 2014. Relationship between authors' structural position in the collaboration network and research productivity. *Program* **48**:4, 355-369. [Abstract] [Full Text] [PDF]
4. Faruk Tas. 2014. An analysis of the most-cited research papers on oncology: which journals have they been published in?. *Tumor Biology* **35**:5, 4645-4649. [CrossRef]
5. Grant Lewison, Philip Roe. 2012. The evaluation of Indian cancer research, 1990–2010. *Scientometrics* **93**:1, 167-181. [CrossRef]
6. Grant Lewison, Valentina Markusova. 2011. Female researchers in Russia: have they become more visible?. *Scientometrics* **89**:1, 139-152. [CrossRef]
7. Carmen López-Illescas, Ed C.M. Noyons, Martijn S. Visser, Félix De Moya-Anegón, Henk F. Moed. 2009. Expansion of scientific journal categories using reference analysis: How can it be done and does it make a difference?. *Scientometrics* **79**:3, 473-490. [CrossRef]
8. G Lewison, S Tootell, P Roe, R Sullivan. 2008. How do the media report cancer research? A study of the UK's BBC website. *British Journal of Cancer* **99**:4, 569-576. [CrossRef]
9. Carmen López-Illescas, Félix de Moya-Anegón, Henk F. Moed. 2008. The actual citation impact of European oncological research. *European Journal of Cancer* **44**:2, 228-236. [CrossRef]