

# Research assessment and UK publication patterns

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The Research Assessment Exercise cycle in the UK makes extensive use of outputs to evaluate research performance. Gross analysis of these and related data shows improvements in the UK's research competitiveness. The RAE's outputs' database has a separate value as a rich and accessible data source of which a high proportion is information about serials. Because the database is created under stringent conditions it provides a sound way of exploring publication material identified by the researchers themselves as having specific significance. Each record can be tracked to an individual, an institution and a discipline. Analysis of this data allows us to explore the distribution of, for example, serial titles across disciplines and the degree of overlap between them. Analysts can track changing patterns of serial use within and between institutions and disciplines.



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## Introduction

This is a paper about the ways in which data on serial publications by UK university researchers can be used not only to evaluate their research performance but to build up a range of other pictures about the structure of the research base and the use of journals. The principal data source is the 'outputs database' of the cyclical UK Research Assessment Exercise (RAE). The examples given are from work carried out by Evidence Ltd.

Evidence carries out research performance consultancy and data analyses for government departments, for individual universities and research institutes and for the European Commission and various bodies outside the UK. We also have regular products, like our *UK Higher Education Yearbook*. One of the most important components in our analyses is research outputs and, particularly for journal articles, citations.

The Research Assessment Exercise is a critical UK university research evaluation cycle. It started in the 1980s as a response to dwindling resources for research, which needed to be distributed more selectively. There had to be a mechanism for identifying quality and then concentrating resources around that.<sup>1</sup> The RAE has evolved over

a series of cycles through 1986, 1989, 1992, 1996 and 2001. As for company work, one of the key RAE considerations is outputs.

The RAE has led to an increase in, for example, the UK's share of world citations.<sup>2</sup> If you take citations as a measure of research performance, as a lot of people do, then that means that UK research performance has effectively improved over the period from the mid eighties when the RAE was introduced through to the present day. This improvement occurs across a range of disciplines and, when we look at citations per paper, the UK has this year overtaken the USA in biology for the first time.<sup>3</sup> UK improvement has happened not only across disciplines but across quality grades as well. One outcome of the RAE is a grade that is awarded to a unit, and the grading has historically been on a one-to-five scale (actually a seven-point scale because the grade 3s are split into 3bs and 3as, and the 5s are split into 5/5\*), where 1 is low-ranked and 5 is high-ranked performance. Evidence looked at performance for the 4s, 3as and 3bs, and they have all improved throughout this period. It looks as if research assessment has been a powerful tool for the UK,

and certainly other countries have shown interest because they, too, believe that this correlation is also causation.<sup>4</sup>

### How Evidence uses the data

Our analyses are feasible because the RAE gives us a structured data source to draw on. The current RAE system allows four outputs per research-active member of staff submitted for assessment. The RAE peer review panels, spread across 68 discipline-based Units of Assessment (UoAs), also look at information on training, research funding from different sources, and strategic statements. But outputs – which are captured in the RA2 part of the RAE data – are acknowledged to be the most important piece of evidence that they review. Each output record identifies not only the full publication details but also the discipline and location of the author.

We draw on this data in our analyses because we can track journal articles back to individuals and to departments, collate the data and track articles over time. Publishing patterns are a central focus for managers, for researchers and for us, as analysts. Outputs are a key to research assessment. The four RAE items per researcher can be books, articles in journals, chapters in books, conference proceedings, or other works for visual and performing arts. Within this, journal articles – and the associated citation data – are excellent for evaluating outcomes as well as output.

We have analysed publications submitted both to RAE1996 and to RAE2001. Our data analyses draw on both of those cycles. In 1996, we used the RA2 data to carry out international benchmarking<sup>5</sup> and later we carried out a validation of the RAE2001 RA2 output database for the RAE manager. The reason for the benchmarking is that there is a problem with grades awarded by a panel within the UK. We have history with grades 1 to 5, biology with grades 1 to 5 and mechanical engineering with grades 1 to 5. But do we know whether a grade 4 in biology, mechanical engineering and history actually have any relationship to one another in terms of research standards? Data on serials is one means by which to establish whether there is any kind of international comparability.<sup>6</sup>

The RAE2001 RA2 database has 195,000 items submitted across the 68 UoAs. This is a rich source of data, accessible to anybody, which reveals how

the different submissions vary in terms of the balance of types and sources of published material. We reconciled about 90% of the material to real, catalogued items. Some items could not be traced in accessible catalogues and some were not identifiable. Validation was important because the material actually submitted for assessment was relatively 'dirty' in terms of data presentation. We had, for example, widely variant journal titles, gross mismatches between ISSNs and journal titles, incorrect pagination, and so on. Much of our analytical focus has been on those journals which are covered by Thomson Scientific databases, because that is where we can make the most ready matches. Recently, we have increased our analysis of books and publishing houses in some work for the Economic and Social Research Council (ESRC).

One assumption we make, validated by work we have done by talking to researchers in a variety of different disciplines, is that what people submit for assessment is material that represents their highest quality work. That should be fairly obvious but it needed to be tested.

There is a spread of output types across UoAs (see Figure 1 following). The UoAs are arranged in a spectrum from the clinical disciplines through the sciences, first of all with health-related, biology, physical sciences and then into engineering. Then we progress to the social sciences and the humanities and arts. There is a fairly clear pattern: in the sciences, the commonest outputs are journal articles; in engineering we have a relative increase in conference proceedings; when we track into the social sciences we have an increase in chapters in books; and in the arts we have other outputs such as videos, installations, compositions and recordings. So, one thing that comes out straightaway is that there are variations of output type, which is no surprise but is culturally important.

A huge number of journals appear in the RAE only as singletons. The following graph (see Figure 2) has histograms, which are a count of journals and, along the bottom, shows the number of UoAs in which the same journal occurred. The high bar on the left-hand side shows there were about 1,850 journals that occurred in only one UoA. Some journals were submitted to many UoAs: one journal was submitted to 34 UoAs (out of 68 in total in this cycle) and one to 37 UoAs. There is a high count of over 1,000 articles per journal for *Nature* and *Science*. If you published in *Nature* you were very likely to submit that to the RAE, even if

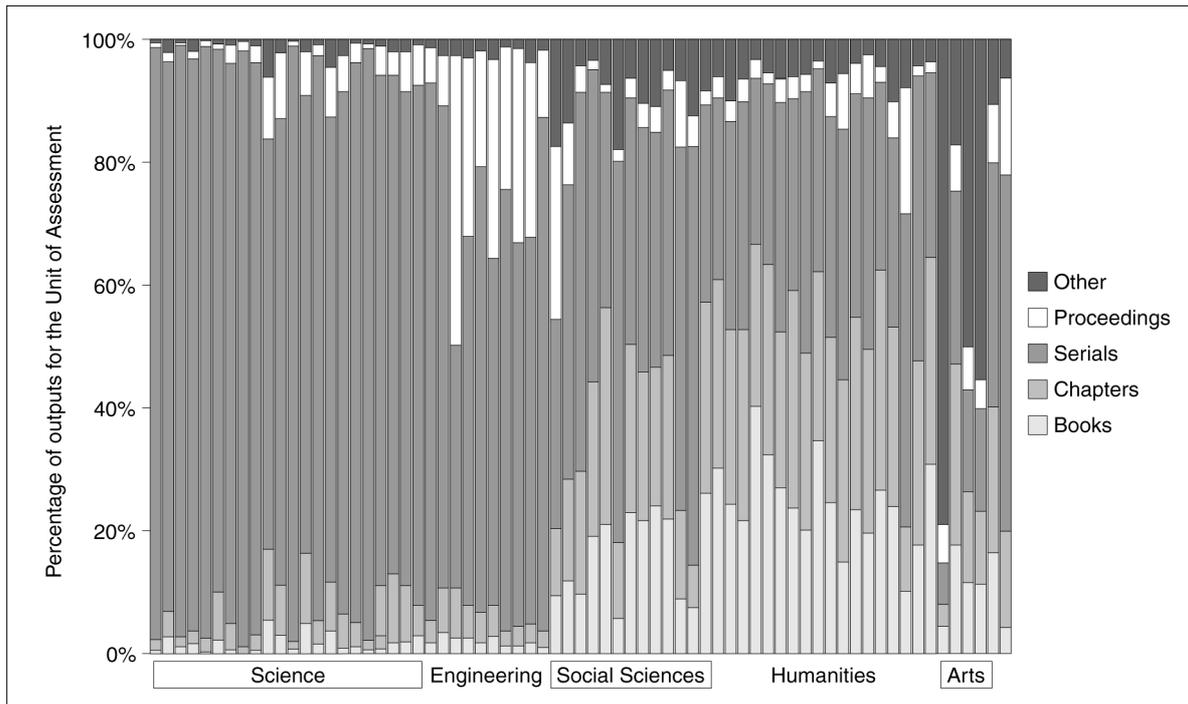


Figure 1. Output type by Units of Assessment

The commonest type of output submitted by university researchers to the UK Research Assessment Exercise varies by Unit of Assessment (UoA). Each researcher submits four items. These are more likely to be serial articles in sciences, and monographs in the social sciences and humanities.

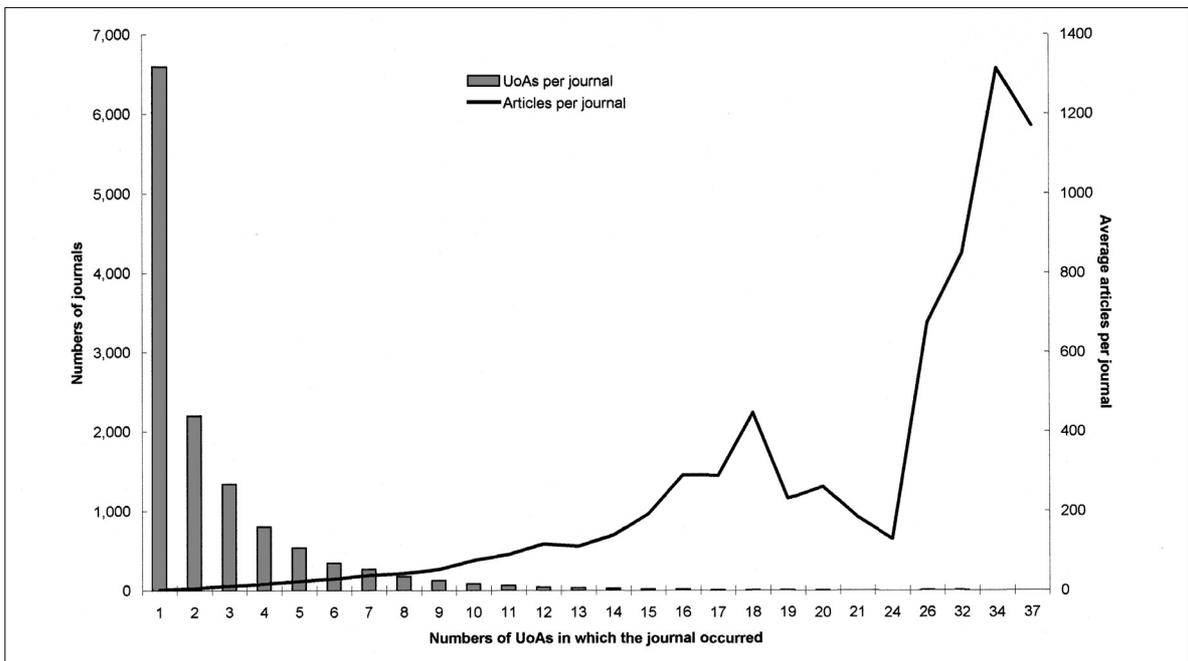


Figure 2. Serials spread, by Units of Assessment

Many serials are submitted to only one UoA but articles from a few are found across many UoAs. The more widely distributed serials are also represented by a much greater number of articles.

you worked in UoA68 education, which one of those articles is from. *Nature* is not an education journal, but if somebody from a School of Education has an article in *Nature* then there is a

good chance that they are going to submit it. That confirms our assumptions about people submitting their best work.

UoA	Biological sciences	Physics	Mechanical engineering	Law	Sociology
UoA code	14	19	30	36	42
<b>RAE1996</b>					
Submitted outputs	9,063	6,675	4,909	5,142	3,792
Journal articles	8,333	6,094	3,060	2,599	1,645
Number in ISI journals	8,086	5,976	2,626	603	1,122
Articles as % of all	91.9	91.3	62.3	50.5	43.4
ISI as % of articles	97.0	98.1	85.8	23.2	68.2
<b>RAE2001</b>					
Submitted outputs	9,931	6,933	4,353	5,328	3,530
Journal articles	9,726	6,673	4,039	2,777	1,846
Number in ISI journals	9,638	6,113	3,714	520	1,106
Articles as % of all	97.9	96.2	92.8	52.1	52.3
ISI as % of articles	99.1	91.6	92.0	18.7	59.9

Table 1. Comparison between Research Assessment Exercises of 1996 and 2001 to illustrate changing proportion of serial articles among the research outputs submitted in various disciplines (Units of Assessment, UoAs).

Table 1 shows that articles were more common in 2001 than in the previous RAE. We can break the data down by the individual UoAs. Take, for example, the data for UoA14 biological sciences. There are 9,000 items submitted in RAE1996, of which 8,300 are journal articles, of which just over 8,000 or 97%, are on the Thomson databases. Later, at RAE2001, there are 9,900 items submitted, of which 9,700 are journal articles, of which 9,600 are articles in ISI journals. There is an increase to 99% of articles submitted being in journals that are catalogued on the Thomson Scientific databases. However, when one looks across to UoA19 physics there is a drop from 96% down to 91%. Further afield, in law and sociology, there is a relative increase in journal articles but a decrease in the Thomson coverage. So those subjects are drawing on a wider range of serials than catalogued by Thomson.

That raises a question about how well the Thomson data represents research performance and how well citation indices reflect the underlying research performance of those disciplines in the UK. Current work by Evidence for the European Commission reveals some of the disparities and also the extent to which management decisions rather than research factors affect coverage. Thomson's European and especially, UK, social science coverage has improved significantly over the last decade but it has not done so evenly by discipline or by country.

Overall, then, we see that the RAE2001 outputs for science and engineering were usually articles and often in Thomson journals. That is less true for

other subject areas so our analyses always need to bear this in mind.

There are also 'university factors' which come to bear. We have a lot of information about the performance of individual institutions, subject areas and grades. Across the range of universities, those that submitted more articles tended to have a highly statistically significant proportion of articles that were submitted in the Thomson journal database. We have not investigated what that means in underlying cultural terms, but certainly those that are more journal-dependent also have a higher proportion of material in Thomson journals.

We can burrow into individual subjects and look at the journals submitted to a particular UoA. For UoA19 physics, for example, we can get a list of the most frequent journals, i.e. those journals from which the greatest number of articles were submitted to RAE2001 (see Table 2 following). We can diversify lists, e.g. all items submitted to that UoA, or just the count for those items submitted by units subsequently awarded the 5 and 5\* grades. If we rank by frequency for the two different groups, there are some minor differences but there is a cultural commonality.

By contrast, when we look at UoA43 business & management (see Table 3 following), we get a different pattern and the rank by frequency for high-graded units differs considerably from other units. So we are seeing a cultural differentiation. Whether that is because they are working in different areas, or because there is competition to

Journal title	Articles in RAE2001, UoA19		Rank by frequency	
	Count for all units	Count in 5/5* units	For grade 5/5* units	For all units
<i>Physical Review Letters</i>	786	672	1	1
<i>Monthly Notices Of The Royal Astronomical Society</i>	728	590	2	2
<i>Physical Review B</i>	442	342	3	3
<i>Physics Letters B</i>	345	335	4	4
<i>Astrophysical Journal</i>	267	223	5	5
<i>European Physical Journal C</i>	152	151	6	8
<i>Nuclear Instruments &amp; Methods In Physics Research Section A-a</i>	149	144	7	9
<i>Applied Physics Letters</i>	180	139	8	7
<i>Astronomy and Astrophysics</i>	181	134	9	6
<i>Physical Review D</i>	140	131	10	10
<i>Nature</i>	120	112	11	12
<i>Nuclear Physics B</i>	108	107	12	14
<i>Physical Review A</i>	131	83	13	11
<i>Journal of Physics B-atomic Molecular And Optical Physics</i>	104	79	14	15
<i>Journal of Physics-condensed Matter</i>	115	76	15	13
<i>Journal of Geophysical Research</i>	96	64	16	16
<i>Journal of Applied Physics</i>	89	63	17	17
<i>Physical Review E</i>	79	63	17	18
<i>Zeitschrift Fur Physik C - particles And Fields</i>	58	57	19	22
<i>Journal of Chemical Physics</i>	68	50	20	19
<i>Physical Review C</i>	65	46	21	21

Table 2. Physics

The most frequent serials submitted to RAE2001 in UoA19 physics show little cultural contrast between high-graded units and others: all units display the same perception of the most influential journals to submit. Serials are ranked by frequency for data from all units that submitted and for the data only for the units that were subsequently given a high 5 or 5\* grade. Titles in grey were not on Thomson databases at the RAE census date.

get into particular journals, is not clear. There are several ways in which the data might be interpreted but more 'on the ground' exploration is required and expert views within the specific community must be collated before a sound interpretation can be made.<sup>7</sup>

Another factor emerging from analyses of serials' data is changing culture. Evidence surveys for the ESRC allowed us to talk to social science researchers about the ways they judge research quality. They assert that bibliometrics are not a good way of indexing quality. So how do they reach a judgement about a particular publication they have read, about the work of a colleague, about the work of a group somewhere else, and how do they judge who the leading researchers are? It emerges that they make extensive use of publications' material but do so in a very expert and individual way which does not translate easily into a processing analysis. Nonetheless, more UK social science researchers are using journal data

and more are shifting to journal articles, so journals are going to be important for social sciences in the future. Certainly, that shift is driven by North American influences, but whether it is a good thing for UK and European social sciences is unclear.

Publication data throws light on other aspects of research. For example, it tells us about the way in which disciplines link together. We have data about journal usage across UoAs, which are non-exclusive disciplinary categories. Physicists use journals seen as core by 'chemistry', while chemists use some 'physics' journals. We can analyse journal similarity in the RA2 database across UoAs and build a picture of how the UoAs interact with one another. We can measure the degree of interdisciplinarity that is taking place and burrow into each discipline to see relationships at the institutional level.<sup>8</sup>

The data also tells us something about the differential use of journals within cultures and the affect of this on assessment. For example, we can

Journal title	Articles in RAE2001, UoA43		Rank by frequency	
	Count for all units	Count in 5/5* units	For grade 5/5* units	For all units
<i>Journal OfThe Operational Research Society</i>	113	58	1	3
<i>Journal Of Management Studies</i>	115	49	2	2
<i>British Journal Of Management</i>	108	42	3	4
<i>British Journal of Industrial Relations</i>	84	41	4	6
<i>Journal of Business Finance and Accounting</i>	61	39	5	12
<i>Organization Studies</i>	75	37	6	10
<i>European Journal of Operational Research</i>	59	36	7	13
<i>International Journal of Operations &amp; Production Management</i>	86	35	8	5
<i>Human Relations</i>	79	35	8	8
<i>International Journal of Human Resource Management</i>	76	34	10	9
<i>Journal of Marketing Management</i>	125	31	11	1
<i>Organization</i>	38	27	12	14
<i>Economic Journal</i>	38	27	12	17
<i>Accounting and Business Research</i>	36	25	14	18
<i>Journal of Banking &amp; Finance</i>	35	25	14	19
<i>European Journal of Marketing</i>	81	24	16	7

Table 3. Business & management

The most frequent serials submitted to RAE2001 in UoA43 business & management show a cultural contrast between high-graded units and others, which is not found in science disciplines. This may imply that slightly different sub-disciplines are present in the top-ranked units. Serials are ranked by frequency for data from all units that submitted and for the data only for the units that were subsequently given a high 5 or 5\* grade.

Titles in grey were not on Thomson databases at the RAE census date.

### The future

see from Table 3 that there is some differentiation between units according to the frequency with which articles from different journals are submitted for assessment. We can pull out the citation data for these articles and then normalize that against the average citation count per article for either the journal (and year) of publication or against the wider field. The two outcomes for UoA13 psychology (Figure 3 following) would lead us to different interpretations of research performance. Impact (counts of citations per paper) normalized at journal level shows little variation between data for units at different RAE grades whereas impact data normalized at field level shows a correlation between rising impact and rising grade.

There is much residual variance in this data: impact alone is no predictor of grade. Nonetheless, the correlation at field level is interesting and the difference between the analyses according to the level of ‘zoom’<sup>9</sup> raises many questions about the significance of journal impact factors, the community’s response and the usage pattern of journals.

There are two take-home messages. First, this information will have sparked interest in the way we can make use of the data that comes out of serials not just as research indicators but as descriptors of and tools to explore the dynamics of research culture. The data in the RA2 database is freely available,<sup>10</sup> contains a rich source of information about the way in which journals are used, the way in which people submit material, and the way in which they perceive journals. It is certainly telling us that there is an increasing profile for serials across all subjects and that is going to go on increasing and is going to penetrate into areas where monographs and other forms of publication have been more important in the past. There are interesting associations to be drawn out here between particular serials and particular parts of the disciplinary base. And the way in which the journals are being used gives us more information about the structure of that disciplinary base.

Second, the serials data has the potential to exert a profound influence on public policy. In March 2006 the UK Chancellor of the Exchequer announced

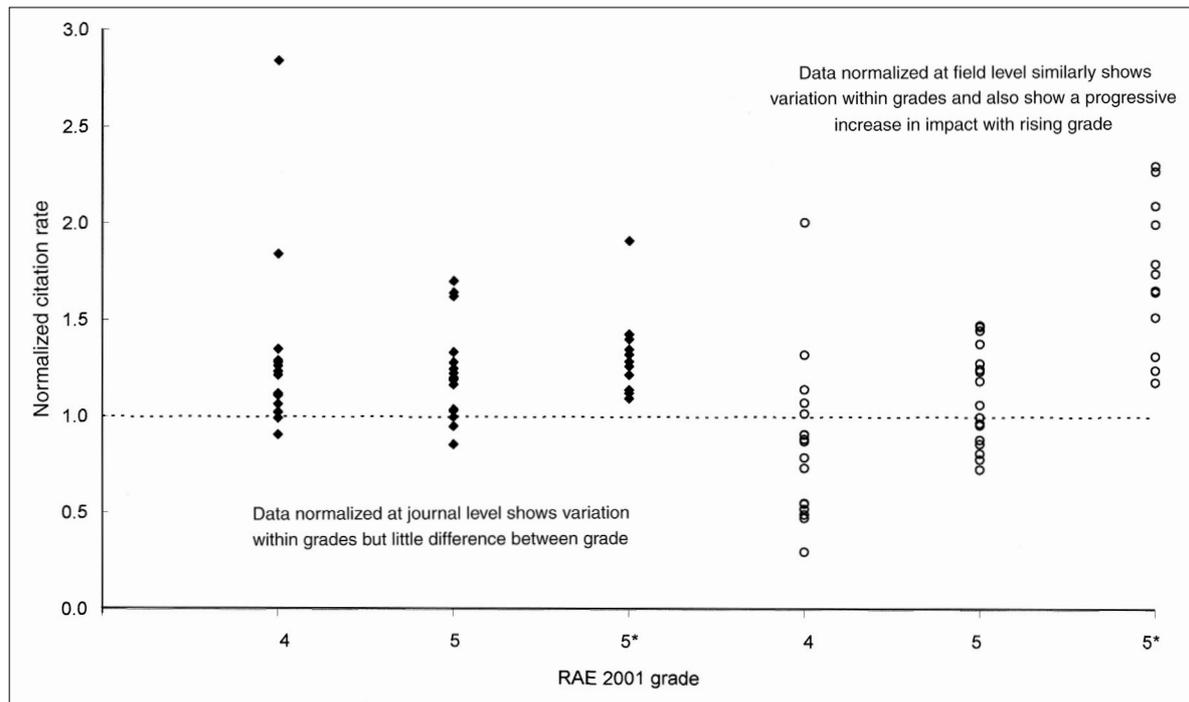


Figure 3. Psychology

The citations to date for articles submitted to RAE2001 can be collated. These counts can then be compared with (or normalized by) the average citation count for the journal volume in which the article was published or the average for the broader field in the year of publication. This analysis is applied to data for UoA13 psychology units at different RAE grades. In this graph each point is the average for a particular university's submission in this subject area. The graph reveals no correlation between journal-normalized impact and grade but there is a correlation between rising grade and rising field-normalized impact.

that the RAE would be replaced by a metrics-based system. The function of allocating core finance could be performed by a correlation with other funding sources; the function of assessing and profiling research quality could not. What, then, can be used for this second function? The arguments in this paper should suggest to readers that the serials data would, at least for science and technology and perhaps for some of the social sciences, provide a ready source of critical evidence. Expert competency in managing such data will be in demand.

## References

1. Adams, J. and Bekhradnia, B., *What future for dual support?* Higher Education Policy Institute report Summary 6 (February 2004).  
<http://www.hepi.ac.uk/articles/>
2. Adams, J., Research Assessment (editorial). *Science*, 2002, 296, 805.
3. Evidence Ltd. 2005 report to the Office of Science & Technology on its Public Service Agreement target indicators.  
[http://www.ost.gov.uk/research/psa\\_target\\_metrics.htm](http://www.ost.gov.uk/research/psa_target_metrics.htm)
4. Adams, J. and Smith, D., *Funding research diversity*. A report to Universities UK, 2003. ISBN 1 84036 102 6.
5. Adams, J., Bailey, T., Jackson, L., Scott, P., Small, H. and Pendlebury, D., *Benchmarking of the international standing of research in England – a consultancy study for the Higher Education Funding Council for England*, 1998. CPSE, University of Leeds. 108 pp. ISBN 1 901981 04 5.
6. Adams, J., *Benchmarking international research*, *Nature*, 1998, 396, 615–618.
7. Bence, V. and Oppenheim, C., *A comparison of journal submissions to the UK's RAE 1996 and 2001 for UoA 43 Business and Management Studies*. *European Management Journal*, 2004, 22, 402–417.

8. Adams, J., Bailey, T. *et al.*, *Op cit.*, 1998, ISBN 1 901981 04 5.
9. Zitt, M., Ramanana-Rahary, S. and Bassecoulard, E., Relativity of citation performance and excellence measures: from cross-field to cross-scale effects of field normalization. *Scientometrics*, 2005, 63, 373–401.
10. <http://www.hero.ac.uk/rae/>  
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