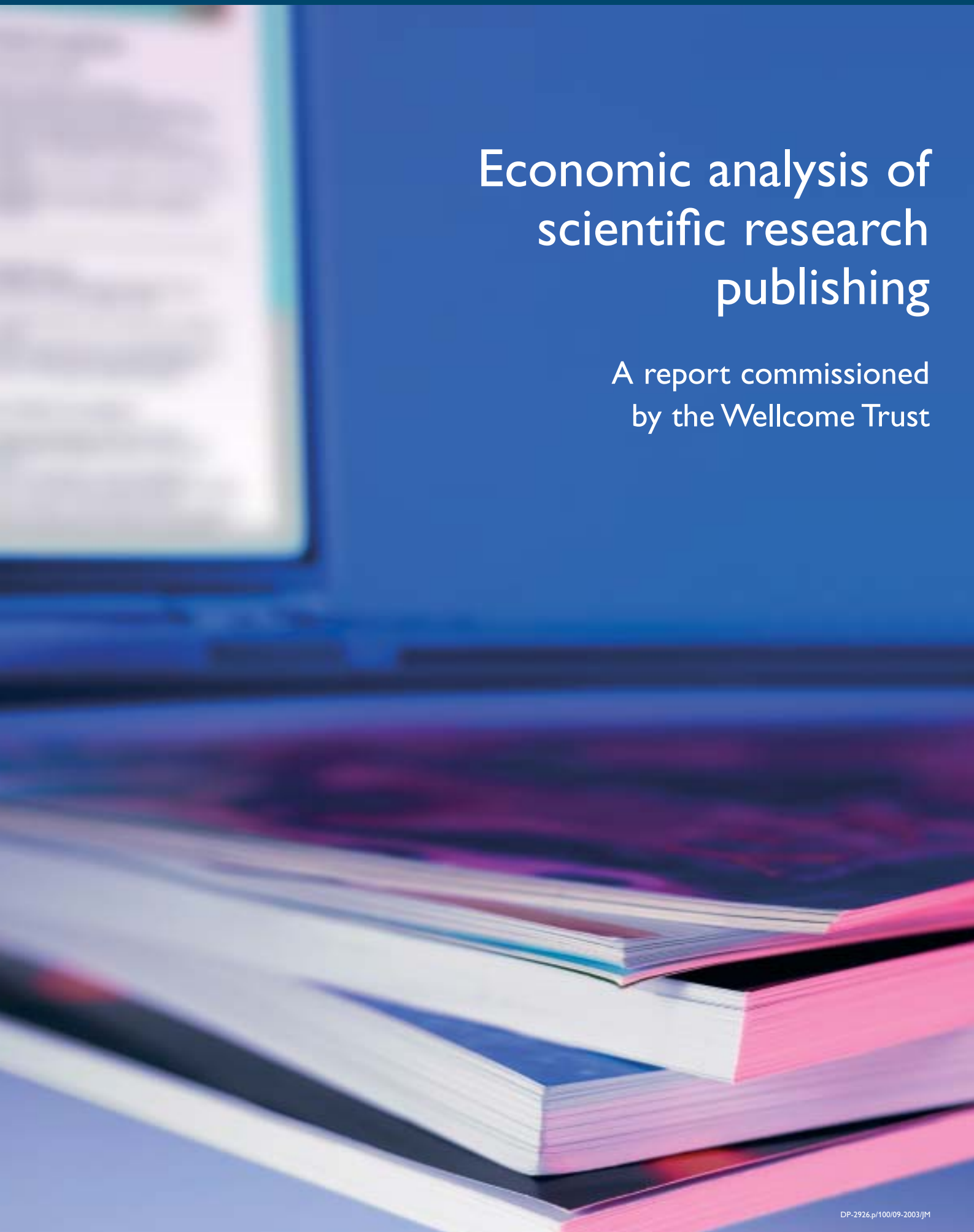

Economic analysis of scientific research publishing

A report commissioned by the Wellcome Trust

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The Wellcome Trust

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Compiled by

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Table of contents

Preface

Following recent developments in the scientific publishing market, the Wellcome Trust felt it was important to fully understand how the economics of the publishing sector are acting to influence the dissemination of the research it funds. One part of this work was to commission SQW economic and management consultants to undertake a review and the result of this research, completed in January 2003, is presented here.

The report reveals an extremely complex market for scientific publishing, which is continuing to undergo considerable change, influenced by a host of different players each striving to meet their own agenda. However, as a funder of research, we are committed to ensuring that the results of the science we fund are disseminated widely and are freely available to all.

By publishing this report, and our related position statement (http://www.wellcome.ac.uk/scipublishing) in support of open access publishing, I hope the Wellcome Trust will be able to facilitate a dialogue between the different participants in the scientific publishing field in an attempt to reform current publishing practices.

The ultimate aim of this dialogue is to develop a publishing system that meets the needs of the originators and consumers of scientific research and best promotes this as a public good – that is, to freely disseminate research outputs to all who have an interest in them.

Dr Mark Walport
Director of the Wellcome Trust
September 2003

Abbreviations

Association of Learned and Professional Society Publishers	ALPSP
Association of Research Libraries	ARL
BioMed Central	BMC
Budapest Open Access Initiative	BOAI
Department of Trade and Industry	DTI
European Molecular Biological Association	EMBO
Electronic submission and peer review	ESPERE
Full-time equivalent students	FTEs
Higher Education	HE
Higher Education Institution	HEI
HighWire Press	HWP
International Consortium for the Advancement of Academic Publications	ICAAP
Joint Information Systems Committee (Higher Education Funding Councils)	JISC
Kluwer Academic Publishers	KAP
Koninklijke Bibliotheek (National Library of the Netherlands)	KB
Library and Information Statistics Unit	LISU
Networked European Deposit Library Project	NEDLIB
National Electronic Site Licence Initiative	NESLI
National Institutes of Health (US)	NIH
Open Archives Initiative	OAI
Publishers' Association	PA
Public Library of Science	PLoS
PubMed Central	PMC
Pilot Site Licence Initiative	PSLI
The Research Support Libraries Group	RSLG
Society of College, National and University Libraries	SCONUL
The Scholarly Publishing and Academic Resources Coalition	SPARC
Science, Technology and Medicine	STM
Extensible Markup Language	XML

Executive summary

Implications of current practice for the research community

1. The current market structure does not operate in the long-term interests of the research community.

2. Commercial publishers are dominant though many top journals are published by not-for-profit organizations.

3. The 'public good' element of scientific work means market solutions are inefficient.

4. Electronic publishing is not currently challenging the dominance of commercial publishers.

Why are commercial publishers dominant? Demand

5. Demand is price-inelastic because:

   - price is unimportant at point of use for the research community;
   - journals are not easily substitutable for each other.

6. Libraries operate in the commercial market and purchase up to their budget limits.

7. Other sources of demand, such as private companies and health services, are uncoordinated.

Why are commercial publishers dominant? Supply

8. Authors face a limited number of journals, through which their work is 'purchased'. The primary concerns of authors are the reputation and reach of the journal. In general, authors are not concerned with price and cost characteristics. There is also a limited amount of substitutability between journals for authors when offering their work for publication.

9. Journals are published by not-for-profit publishers and commercial publishers – institutions with different objectives and modes of working.

10. All publishers, including commercial publishers, provide authors and editorial boards with the services and outputs they need.

Why are commercial publishers dominant? Market behaviour

11. The market can be characterized as having two interlinked parts: an academic market and a commercial market. They operate according to different rules and priorities. The academic market operates with little recognition of the existence of the commercial market. The commercial market attempts to manage the academic market.

12. Commercial publishers are currently more active than other institutions in operating in both markets. They attempt to control supply in the commercial market through mergers/takeovers and to manage demand through price and service to libraries. The commercial publishers have set up price-service packages which enhance their position and undermine the position of the not-for-profit sector. A major example of this – the 'big deal' – in effect requires libraries to take more journals than they might otherwise choose from the commercial publishers. The limits on the libraries' abilities to change the package in the 'big deal' result in cuts in subscriptions to journals from other publishers whenever the libraries face financial constraints. A further implication of these arrangements is that citations to the commercial publishers' journals are likely to increase, at the expense of the not-for-profit sector, thus increasing the apparent value of those journals.

13. The commercial publishers offer good service and speed to the academic market and many academics are currently largely unaware and unconcerned about the state of scientific publishing.

The importance of electronics

14. Electronic publishing provides speed and access to readers which is an important characteristic in scientific, technical and medical publishing.

15. Electronic delivery removes some barriers to entry on the supply side thus making it easier for new suppliers to enter the market. The threat of entry acts as a constraint on the behaviour of companies currently in the market. Some actual market entry has taken place particularly through SPARC.

16. Electronic journals are likely to challenge paper-only journals since they are popular with academics-as-users and carry lower fixed costs than paper journals. The acceptability of electronic journals to academics-as-authors is less clear at present.

17. The control of electronic access is a major issue currently being faced. The use of open archives and the ownership of copyright have significant implications for the control of access.

The current position

18. Commercial publishers are providing a high-quality, high-price service, with restrictions placed on ease of access through policies such as the 'big deal'.

19. Learned societies have been limited in their responses by their objectives, which restrict them to the areas in which they can work, and their perception that the commercial sector is not threatening the work of the societies.

20. On the demand side, SPARC and others, including the not-for-profit sector, have promoted open archives and page charges for publishing as ways of capturing the potential of electronic publication and maintaining the economic viability of publishers in general.

21. A key issue relates to the problem of achieving what many see as a desirable outcome – open archives and page charges – from a position where, for academics, publication is apparently free.

What will happen?

22. The existence of the means to create significant change does not mean change will occur. The fact that electronic media exist has implications for the market. It is up to the players in the market to decide how they will use the means at their disposal. The dominance of the commercial publishers will be challenged only if other players use the opportunities available to them.

The main players

23. Each of the main players have different objectives and different ways of working. They have different expectations of what the market will deliver for them and what their obligations to the market are. Each of them can be influenced in different ways. The main players are:
    - the commercial publishers;
    - the not-for-profit sector;
    - research libraries;
    - academic researchers;
    - library and research funders.

    (We have not included government in the list because their interest is likely to be dominated by the competitive position of the sector as a whole.)

The future?

24. This report sets out a number of possible scenarios each of which is plausible and depends upon different reactions from, and interactions between, the key players:
    - more of the same;
    - commercial withdrawal;
    - commercial publishers gain more control;
    - open access becomes dominant.

25. Research funding organizations could intervene in different ways to make one, or a combination, of the scenarios more likely. Interventions which influence the key players will change the scenarios or increase the likelihood of one over another. Our suggestions, which are not exhaustive, cover the main areas in which we believe activity may be influential and aim at changing the balance of power not restructuring the whole market. Research funding organizations could:
    - set out their position clearly, or make public their concerns or intentions;
    - support different ways of funding publications, particularly electronic page charges, through research grants;
    - provide support to the open archives initiatives;
    - actively support open access and the retention of copyright by authors and institutions;
    - coordinate, or suggest the setting up of a coordinating mechanism for, responses from the different funding bodies in the UK, Europe and, to the extent possible, worldwide;
    - coordinate, or suggest the setting up of a coordinating mechanism for, non-library demand for journals from private sector companies such as pharmaceutical companies or biotechnology companies and from health services;
    - provide support to publishers from the not-for-profit sector, for example pump priming funds for electronic archives;
    - support the setting up of not-for-profit 'big deals' to protect the not-for-profit publishers;
    - support – perhaps endow – the setting up of a central electronic deposit library;
    - exert pressure to recognize electronic journals in bibliometric assessments and impact factors.

1 Scholarly journals in science, technology and medicine

1.1 Journals are the main avenue for scholarly communication within the academic community. However, recent developments in technology, and in the marketplace, have induced evolution and change into the age-old system of stand-alone paper copies on library shelves. Before exploration of the market forces underlying much of this change, the following two chapters provide a necessary introduction to more general current positions and developments in the field of scholarly communication.

The function of scholarly journals

1.2 Although the features of scholarly journals are often envisaged as paper-copy, produced at regular intervals, with articles in standard format, their essence is more in function than form. Authors and readers (as roles, not separate entities) require different, but complementary, functions.

1.3 Authors look to journals primarily as a means of facilitating dissemination of their work to as wide an audience as possible. Publication also builds the reputation of both the author and their work within the academic community, with the systems of peer review and impact factors contributing to this. Speed of publication is important, in that in effect it establishes who holds priority over the work; electronic publishing has enhanced this, with pre-prints and e-prints now available before the corresponding paper copy in increasing numbers of journals.

1.4 For readers, journals offer an aggregated collection of current research in the field of interest, with peer review systems ensuring that articles are reputable, and impact factors giving some indication of the importance of the work (although the debate surrounding the true usefulness of impact factors is acknowledged).[1] Dissemination also ensures that readers become aware of current research and methodology in their fields, preventing duplication of experiments, and raising awareness of new techniques.

1.5 The necessities of the above functions apply equally to both paper and electronic forms of scientific communication.

Science, technology and medicine

1.6 All academic disciplines communicate findings through journals, but debate and discussion about the future of this system is centred mainly on those in the fields of science, technology and medicine (STM). There are several reasons why this might be the case.

1.7 Much STM research moves at pace, especially within such new and rapidly evolving fields as genomics and proteomics. Research is often highly competitive, with different teams worldwide working on similar projects. Being the first to publish in such fields can be vital for building reputations of excellence, and for attracting future funding.

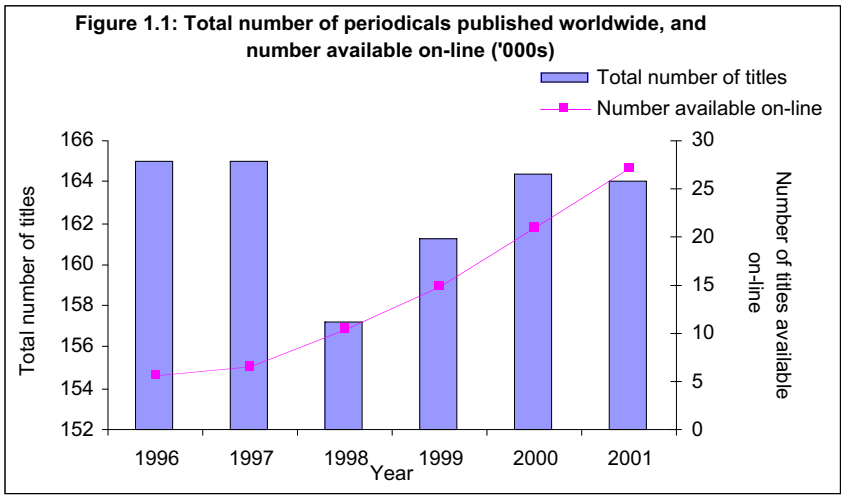
1.8 Unlike in many other disciplines, the worldwide scientific community communicates almost exclusively in English. The result is a huge potential readership base for any publication in these fields.

1 For example, Seglen P O (1997) Why the impact factor of journals should not be used for evaluating research. *British Journal of Medicine* **314**, 498–502.

The current position

Number of journals published

1.9 It is estimated that the total number of periodicals published worldwide in all disciplines is approximately 164,000.[2] Figure 1.1 illustrates the trends in the total number of journals published worldwide in the last six years, and demonstrates that an increasing proportion of these are now available online (equivalent to 16.5 per cent of the total in 2001, compared with 3.3 per cent in 1996).

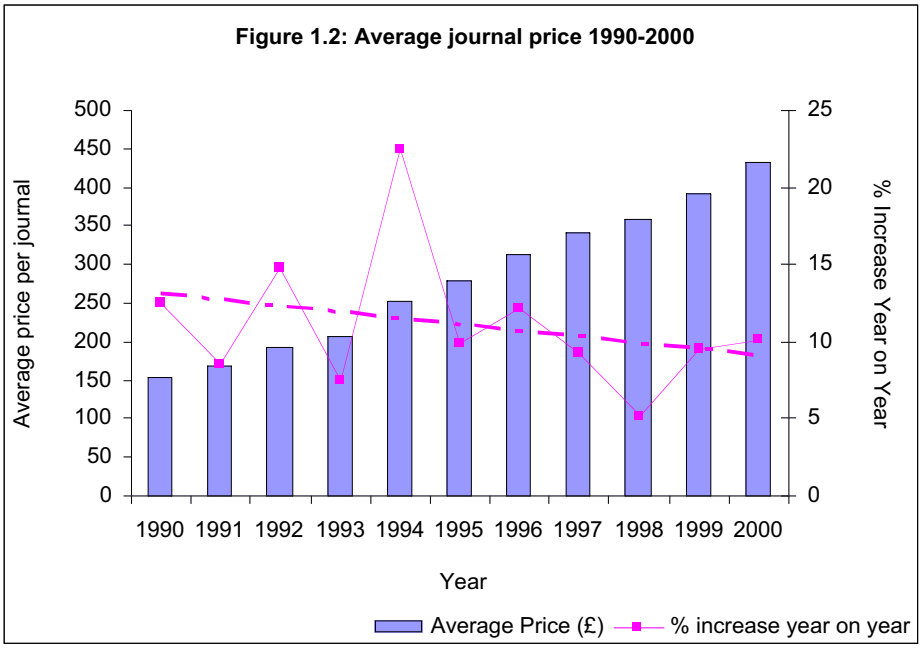


Source: Ulrich's International Periodicals Directory in LISU Annual Library Statistics 2002

1.10 Unfortunately, no separate data are publicly available on the number of STM journals within these figures.

Cost of journals

1.11 The average price increase in any journal between 1990 and 2000 is shown in figure 1.2. The percentage price increase year-on-year has varied, from 5 per cent to almost 25 per cent, over this period, and although the overall trend (the dashed line) has been for smaller price increases, these are still at a level well in excess of inflation.



Source: Blackwell's Periodical Price Indexes in LSIU Annual Library Statistics 2002

2 Ulrich's International Periodicals Directory.

1.12 According to Blackwell's periodical price indexes, the average cost of a journal in science and technology in 2000 was £671.77, up 178 per cent over the preceding ten years (see table 1.1). The average cost of a medical journal had risen 184 per cent over the same period, to £396.22. Although the average cost of a UK-published journal (across all disciplines) is £338 compared with £434 for a North American publication, the price rise in the UK over the past ten years has been greater (204 per cent compared to 155 per cent). Indeed, it is of interest to note that the average journal price increase of UK publications was 29 per cent between 1999 and 2000, compared with an average price rise worldwide of 10 per cent.

Table 1.1: Blackwell's Periodical Price Indexes, 1990–2000 (£s)

	1990	1995	1996	1997	1998	1999	2000	1 year % change	10 year % change
Humanities and social sciences	57.86	94.34	104.81	112.33	134.12	145.76	165.40	13.5	185.9
Medicine	139.38	245.55	276.23	306.58	325.00	344.91	396.22	14.9	184.3
Science and technology	241.41	445.05	499.37	546.49	560.81	616.98	671.77	8.9	178.3
Great Britain	127.52	236.32	264.21	295.28	334.89	300.49	338.24	29.2	204.5
USA and Canada	170.10	291.06	320.35	345.73	366.80	382.96	434.32	13.4	155.3
Other	182.39	341.59	393.65	423.49	391.71	556.98	583.43	4.7	219.9
Overall average	154.08	277.91	311.47	340.30	358.16	392.01	431.71	10.1	180.2

1.13 It is worth noting at this point that following the merger between Blackwell's and Swets in 2001, the methodology behind the annual periodical price report has changed, and the Swets Blackwell figures are not directly comparable with the figures compiled previously by Blackwell's. However, as the Swets Blackwell data include the most recent figures, the figures for science, medicine and technology journals are given below (table 1.2), back calculated to 1998.

Table 1.2: Serials Price Increase Report 1998–2002 (£s)

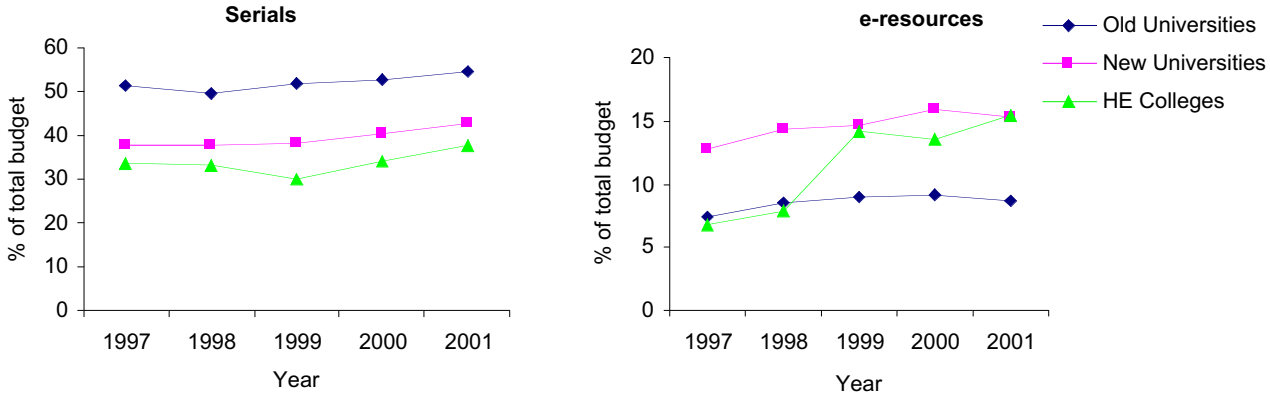
	1998	1999	2000	2001	2002	% increase 02 over 01	% increase annual average
Science	476.57	556.91	612.48	614.55	644.45	4.9	5.2
Medicine	266.27	305.81	334.40	349.55	376.59	7.7	2.3
Technology	262.93	298.70	330.43	357.03	385.45	8.0	4.0

Source: www.swetsblackwell.com

Institutional spend

1.14 On average, old universities have consistently spent more than 50 per cent of their information provision expenditure on serials over the past five years for which we have records. New universities have spent around 40 per cent on serials over the same period, and HE colleges have spent in the region of 35 per cent. In total, old universities as a collective spent £54 294 000 on serials in 2001; the equivalent figures for new universities and HE colleges were £18 146 000 and £4 352 000 respectively (figure 1.3).

Figure 1.3: Proportion of information provision expenditure spent on serials and e-resources, 1997–2001



Source: LISU Annual Library Statistics 2002

1.15 The relative proportion of spend on electronic resources[3] follows a different pattern. Old universities have spent around 9 per cent of information provision expenditure on e-resources between 1997 and 2001. The proportion spent by new universities over the same period has increased from 12.8 per cent to 15.2 per cent, and for HE colleges from 6.7 per cent to 15.4 per cent. However, the larger proportional spend in new universities and HE colleges still amounts to less absolute expenditure than the 9 per cent of budgets at old universities: £8 598 000 compared to £6 432 000 (new universities) and £1 784 000 (HE colleges).

1.16 We have not investigated the reasons for the differences between the three different institutional responses. One can speculate that the new universities and colleges took the opportunity to expand their serials lists more readily than old universities, which already possessed paper copies of many of the serials used by their staff.

1.17 The average price paid by institutions for serials is shown in table 1.3 below.

Table 1.3: Average price paid for serials (£s)

	1997	1998	1999	2000	2001
Old universities	97.77	97.83	104.34	107.15	97.83
New universities	121.47	121.52	114.56	101.21	79.68
HE colleges	80.89	85.24	86.09	87.76	77.55

Source: LISU Annual Library Statistics 2002

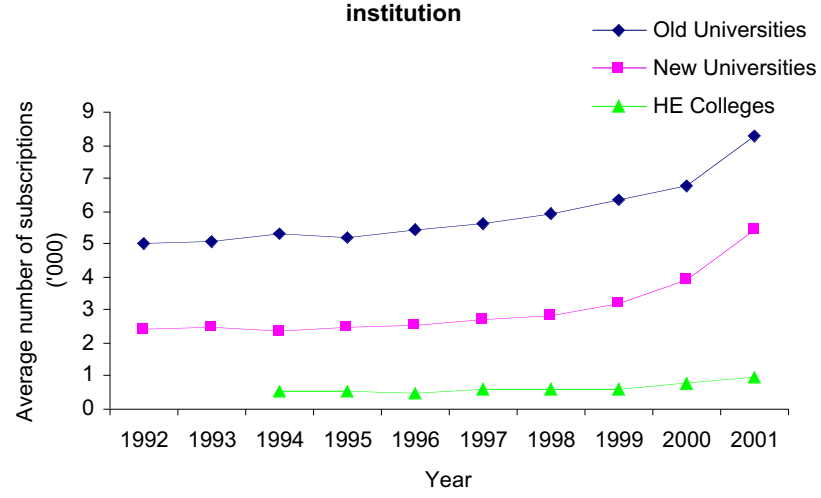
1.18 From table 1.1, the average cost of a journal published in 2000 was £431.71. However, table 1.3 illustrates that the average cost paid by a HE institution in the UK for a journal in 2000 was not more than 25 per cent of this. This would suggest that institutions are prioritising their collections with respect to cost of individual publications. There has also been a reduction in the average price paid over recent years. The advent of bundled deals such as NESLI (see section 1.24) are at least partly contributory to this, as they artificially lower the average price per title.

3 The major component of e-resources spend is on electronic serials; however, electronic serials do not account for the total amount.

Subscription data

1.19 On average, all UK HE institutions have been steadily increasing the number of journals they subscribe to over the last few years (figure 1.4). Old universities now subscribe to 52 per cent more titles per institution than was the case five years ago, new universities subscribe to 116 per cent more titles per institution over the same period, and the figure for HE colleges is an increase of 92 per cent. No doubt bundling has played a major part in these rises.

Figure 1.4: Average number of journal subscriptions per institution



Source: LISU Annual Library Statistics 2002

1.20 In terms of the number of journals per FTEs, old universities subscribe to 740 journals per 1000 FTEs (up 23 per cent over five years), new universities to 380 journals per 1000 FTEs (up 88 per cent), and HE colleges to 289 journals per 1000 FTEs (up 41 per cent).

1.21 Divine Faxon Library Services[4] are predicting average price rises per journal for 2003 to be of the order of 10 per cent, assuming that paper prices rise only slightly, and that the US dollar holds its position against the Euro and the GBP. As library budgets are not rising in line with price increases, and subscriptions of non-core journals are being cut, some publishers are attempting to counter this by guaranteeing lower price increases to those subscribers who commit to maintaining their subscriptions for at least one year, or to those who sign up to journal packages.

1.22 The Library and Information Statistics Unit (LISU) has concluded[5] that ventures such as SPARC (see para 4.8) have not had a direct effect on the price of journals, and suggests that with fewer library funds available, publications through such initiatives only serve to increase the number of titles available, and that they compete for subscriptions against existing titles.

Journal bundling

1.23 With increasing numbers of STM journals coming into circulation, and price rises above inflation, few libraries have been able to add extra subscriptions to their collections, or even maintain subscriptions at a constant rate. To counteract this, commercial publishers introduced the concept of 'bundling', whereby print and digital format are provided as a bundle, often with all digital journals bundled together as a single product (i.e. subscription to several print journals can bring digital access to the entire STM journal range of that publisher). This has enabled the publishers to maintain traditional pricing models, and to spread print production costs across the whole subscription base for that publication, including those who only subscribe to digital format.

4 www.faxon.com/proj/

5 LISU Annual Library Statistics 2002. Loughborough, LISU.

NESLI

1.24 Some of the earliest bundling deals in the UK were carried out through the Pilot Site Licence Initiative (1996–1998), subsidized by the Joint Information Systems Committee, Higher Education Funding Councils (JISC). Five commercial STM publishers collaborated through PSLI to offer higher education institutions bundles of their journals. Partly following on from PSLI, the National Electronic Site Licence Initiative (NESLI) commenced in 1998, whereby individual publishers make 'bundle' deals for electronic access to meet the needs specified by libraries and other users. Deals vary between publishers, with some publishers offering subscribing institutions several different options for electronic access, while others do not. NESLI is due to finish in December 2002, when JISC will replace the appointed managing agents (Swets Blackwell and the University of Manchester). A modified national scheme will be rolled out at the start of 2003, with negotiation, licensing and subscription collection all included in the service, and the building of relationships between commercial publishers and HEIs seen as core.[6]

The 'big deal'

1.25 The 'big deal' is a different concept, in operation throughout the US and western Europe. Commercial publishers offer subscribers a bundle of online journals, in packages prescribed by them and which meet their commercial needs, as a non-negotiable entity for a single price. This price includes a cap on annual price increases for a number of years, and the bundle usually gives access to all of the journals of the commercial publisher. Current policy at Elsevier is to negotiate the prices of electronic site licence bundles for its journals separately to consortia of universities, with price dependant on the total willingness to pay.

Disadvantages of bundling

1.26 Although the amount of accessible information is initially increased for the subscriber, bundling eliminates the abilities of librarians to selectively control the content of their collections. Through the 'big deal', libraries are obliged to pay the entire cost of the subscription for its duration, and so cannot unsubscribe to certain bundle journals to free up money for subscription to a journal from another publisher. Also, some institutions are finding that the much publicized 'added value' offered by NESLI and the 'big deal' has not actually been forthcoming[7], as the level of use of those extra journals now available is not sufficient to justify the cost.

1.27 The Ingenta Institute was established in 1998 to inform on scholarly communication within the research community. Preliminary findings (published 21 August 2002) of the 2001–2002 study into the impact of site licensing and consortia developments indicate that the current consortia negotiation system is seen by both publishers and librarians as being transitory, with one-off funding being found by librarians to fund consortia deals in the short term. It is evident that bundling is unlikely to provide the subscription model of the future, not least because the continued production of paper copies, which is fundamental to the 'big deal' is not definite. In order to understand what format this model may take, an examination of current developments in journal publication is required.

6 For recent developments see www.nesli2.ac.uk

7 White S and Davies J E (2001) Economic Evaluation Model of National Electronic Site License Initiative (NESLI) 'Deals'. LISU Occasional Paper No 28.

2 Current developments in science, technology and medicine journal publishing

2.1 Recent years have seen many new developments in STM journal publishing, coming forth from both commercial and non-commercial arenas. Librarians and academics have also started to play an active rather than passive role in shaping (or attempting to shape) the publishing model of the future, partly driven by discontent at the 'big deal', and by copyright issues.

2.2 Future publishing models are based around the assumption that e-publishing is here to stay, and therefore most current developments have been related to e-journals. As well as the possibilities opened up by increasingly more sophisticated technologies, e-only journals are raising debate over online accessibility and archiving. Some discussion of these developments follows.

New technologies

Manuscript management

2.3 New developments in software are providing unprecedented channels for e-journals. Data published on-line can include hyperlinks to cited articles and further reading, and links could also be provided to the raw data for checking and evaluation. There are several online peer review and manuscript management schemes now available, including the free eFirst XML and eprints. It is becoming easier for journals to cut costs by making at least some of their processes electronic (although publishers argue that no more than 20–30 per cent of the cost of a paper journal can be eliminated by switching to e-publication).

2.4 Electronic submission and peer review (ESPERE) was started in 1996, and provides a good example of one such commercial manuscript management system. It provides an online method for reviewing manuscripts where each manuscript is posted at a separate URL to which the author(s), editor and referees have different levels of access. More than 20 journals from six different publishers now use this system. Authors and referees have been very positive, so much so that *Proceedings of the Royal Society A* accepted only online submissions (through ESPERE) from January 2003. Benefits include no postal delays, more rapid peer review, tracking of progress online, and reduced costs to both the author and the publisher.

2.5 The International Consortium for the Advancement of Academic Publications (ICAAP) also specializes in developing technology for the delivery of online publications. It has recently introduced myICAAP to its product range, which allows manuscripts to be easily tracked through the peer review and publication process, and which can be used to register as the editor of a new journal. The site claims that some academics now manage up to five online publications with little outside assistance through this scheme, and visitors to the site are encouraged to add themselves to the online referee database.

Discussion fora

2.6 The increasing use of online noticeboards and discussion groups has provided sites for academics and librarians worldwide to debate the current issues in scientific journal publishing. Some of these discussions have no doubt helped to shape some of the developments that follow, and the worldwide membership of some of the pressure groups that have sprung up (2.21, 2.22) has inevitably been enabled by their electronic nature.

Archiving

2.7 The potential of electronic technologies for library archiving has been the subject of research, for example the Networked European Deposit Library project (NEDLIB) ran between January 1998 and January 2001, with the aim of 'constructing the basic infrastructure upon which a networked European deposit library could be built'. A consortium of eleven European partners, led by Koninklijke Bibliotheek of the Netherlands, cooperated with industrial partners in building a set of tools that could be used for building digital deposit systems. The Digital Preservation Coalition is the body responsible for current UK digital preservation strategies and facilities, including ensuring data retrievability for the future.

2.8 Within the field of scholarly publishing, the movement of increasing numbers of commercial publishers towards producing e-versions of their paper publications caused the library community to recognize that a digital journal archive was necessary, not only to store electronic copy, but also to ensure permanent availability. This became an increasing priority as e-only journals began to enter the marketplace. Several different organizations have emerged as key players in this field.

BioMed Central

2.9 BioMed Central (BMC) is an independent commercial publisher that supports the objectives of PubMedCentral (PMC; see 2.14), and provides immediate free access to all of its 56 free publications online (and also to a number of journals which require a subscription charge). A pre-publication history (referees reports, corrections) is posted for all medical BMC journals, and some others, which is presumably to ensure rigour. The publishers plan to make online submission and peer review technology available without charge to groups of scientists who wish to run their own open archive journals. Published authors retain copyright, in line with the ideals of PMC (and all published articles are available on PMC without delay). There is speculation (by BMC) that they may introduce page charges to those that can afford them, by the end of 2002. BMC is funded primarily by Current Science, based in London. This organization appears to be a conglomerate of publishing interests (mostly biomedical), database management and a producer of mapping and navigation software, who describe themselves as "a group of independent companies that collaborate closely with each other to publish and develop information and services for the professional biomedical community".[8]

HighWire Press

2.10 Stanford University runs the non-profit HighWire Press (HWP), which now archives 342 HWP-based journals, and 4500 Medline journals, across the biological, medical, physical and social sciences. HWP does not support free access to all linked articles, rather it works within the individual subscription policies of the societies and the publishers. Some journals are available as free back issues (between three months and two years after publication, depending on the journal), for a free trial period, or as completely free access. HWP is non-commercial, and is now almost financially self-sufficient – in the past it has accessed grants from the National Science Foundation and charitable organizations.

2.11 HWP has recently introduced a 'papers in press' series for one of its headline journals, *Journal of Biological Chemistry.* Original manuscripts are available online within two hours of being accepted by reviewers, minimizing turnaround time.

The Budapest Open Access Initiative and the Open Archives Initiative

2.12 The Budapest Open Access Initiative (BOAI) was launched as an action plan calling for open access in February 2002. It endorses author self-archiving (of publications or pre-publications), and the founding of new open access journals (which could be supported by page charging or other methods). It promotes

8 http://current-science-group.com/

interoperability between journal access and linking systems conforming to standards developed by the Open Archives Initiative (OAI).[9]

Commercial archives

2.13 On 20 August 2002, Elsevier signed an agreement with the Koninklijke Bibliotheek (the National Library of the Netherlands, KB), whereby KB will become the (first) official digital archive for Elsevier journals in STM. KB will receive e-copies of all STM journals published by Elsevier (i.e. all those on Science Direct). Elsevier is currently digitizing back copies of all its journals (to volume 1 if possible), with hope of completion within the next two years. Access is to be provided through KB to all those who are permitted access to the library's collections (on a walk-in basis); there is an agreement that the archive will be freely available online if Elsevier or a successor failed to make the constituent journals available on a commercial basis.

Search engines

PubMed Central

2.14 The PubMed Central (PMC) initiative was proposed in 1999 (and has been operational since February 2000) by the then-director of the National Institutes of Health, Harold Varmus. Although the original aim was a digital repository providing "a comprehensive electronic archive of the peer-reviewed literature relevant to the biological sciences", it now functions more as an archive-search engine hybrid. It was set up originally to allow only searches of material present in full-text on the PMC site, but in the wake of pressure, PMC now permits articles to be deposited for archiving purposes, without making the full-text available at the PMC site, but rather through links to the publisher's site. Journals wishing to participate provide contents or links free of charge, following a suitable delay beyond the date of publication (recommended as a maximum of six months), and PMC only publishes articles from the peer-reviewed literature, where authors maintain copyright. Currently 95 journals have deposited their content on the PMC site, although 56 of these are BioMed Central journals.

2.15 *Science* (as an umbrella organization) cautions against PMC, not least because it is located at NIH, which funds much of the biomedical research that PMC does and will archive. Also, there is concern that niche journals may go to the wall (unless there are per-page publication charges – see later) as there is some evidence of subscription cancellations if the journal is freely accessible.[10] Societies (such as the American Society of Biochemistry and Molecular Biology, which partners with HighWire Press) are considered in contempt of the demands of the Public Library of Science open letter (2.21), as they do not wish to sign their content over to PMC.

E-BioSci

2.16 E-BioSci is a European information platform initiative, coordinated by the European Molecular Biological Organization (EMBO), and due for prototype launch soon (though it has been put back on a number of occasions). Information will be stored either as archive or document on an E-BioSci, or on publishers' websites. The initiative is being funded for the initial three years by the EU 5th Framework programme, and is set up to be integrateable with PubMed Central. There is added interest because of the initial proposal to link E-BioSci with the information coming out of the European Molecular Biology laboratories of the European Bioinformatics Institute in Cambridge, giving access to structural genomic information.

9 Further information about both initiatives can be found at www.soros.org/openaccess/index.shtml and www.openarchives.org/index.html respectively.

10 www.nature.com/nature/debates/e-access/Articles/Richardson.html

CrossRef

2.17 In December 1999, leading commercial publishers (including Reed-Elsevier, Springer, OUP, Blackwell Science, Wiley and Macmillan) launched CrossRef[11], with the aim that it would become "the citation linking backbone for all scholarly information in electronic form". It is operated though the Publishers International Linking Association (PILA), which is non-profit and independent; the chairman is employed by Elsevier, and the board consists of representatives from other commercial publishing houses, alongside members of learned societies. CrossRef allows free searching across all journals, that member publishers produce, from a single access point, but stores no content; journal articles are tagged through digital object identifiers (DOIs). Publishers set their own access standards – once an author and title is located, any access to further material will be subject to charges applied by the publisher. 158 publishers are now members, allowing access to 6630 journals and 5.1 million research articles. However, should commercial publishers be able to withhold indefinitely the peer review papers that they publish from barrier free, full electronic libraries? There is also speculation that citations of articles in commercially published journals may fall as commercial publishers 'protect' their articles behind a screen of passwords and inaccessibility.

ScienceDirect

2.18 ScienceDirect was launched in 1999, as Elsevier's own search engine, for those who subscribed to paper copies of its journals. Now, through its links to CrossRef, it is the world's largest single-site full-text journals database, with more than 1700 STM journals available for searching. Guest users can search tables of contents and abstracts, with full-text articles available for a charge of US$30 per article. Licensed users have free full-text access to articles in those journals they subscribe to, and can access non-subscribed journal articles for a charge.

2.19 Following the merger with Harcourt, Reed-Elsevier have launched a new portal, ScienceDirect E-Choice, which enables institutions to opt for e-only access to full-text articles from subscribed journals of both publishers, at a reduced charge to paper subscription. Print copies can be purchased additionally, at a discounted rate; the reasoning being that this allows libraries budgeting flexibility.

Scirus

2.20 Scirus is a 'scientific information only' search engine, initially developed by Elsevier, but now freely available on the Internet. It focuses only on those sites likely to contain scientific content, primarily those with the web addresses ending .edu, .org, and .ac.uk. Journal sources such as Medline and BioMed Central (below) are also included. Searching results in a list of relevant material, which can be further split into journal articles or web pages.

Pressure groups

2.21 The Public Library of Science (an American organization) is currently running an online 'open letter' which reads as follows:

"We support the establishment of an online public library that would provide the full contents of the published record of research and scholarly discourse in medicine and the life sciences in a freely accessible, fully searchable, interlinked form. Establishment of this public library would vastly increase the accessibility and utility of the scientific literature, enhance scientific productivity, and catalyze integration of the disparate communities of knowledge and ideas in biomedical sciences.

11 www.crossref.org

We recognize that the publishers of our scientific journals have a legitimate right to a fair financial return for their role in scientific communication. We believe, however, that the permanent, archival record of scientific research and ideas should neither be owned nor controlled by publishers, but should belong to the public, and should be freely available through an international online public library.

To encourage the publishers of our journals to support this endeavour, we pledge that, beginning in September 2001, we will publish in, edit or review for, and personally subscribe to, only those scholarly and scientific journals that have agreed to grant unrestricted free distribution rights to any and all original research reports that they have published, through PubMed Central and similar online public resources, within six months of their initial publication date."[12]

2.22 At first glance, this would appear to have the best of intentions, but there is strong opposition from within academic circles. The Federation of American Societies of Experimental Biology (FASEB)[13] does not agree with the coercive tone of the action; learned societies recover publishing expenses through subscriptions, and FASEB is more interested in allowing member societies to pursue individual strategies to assure viability of publications – most FASEB member journals allow free and open access to full text articles between six and 12 months following publication, and there is open access to titles and abstracts of all articles through PubMedCentral.

2.23 Public Library of Science also demands that information is available for posting on any server, anywhere. There is currently no software package that can ensure accuracy of each reposting, and with maintaining integrity comes added costs. If the author holds the copyright, they cannot ensure the accuracy of re-postings, including loss of hyperlinks, supplementary material, and corrections.

Issues of trust

2.24 There is some suggestion that the initial slow uptake of e-only journals has been at least in part due to distrust of e-publishing on the part of academics. Parallel publishing (where a paper journal has been made available in electronic format) has been a necessary step in creating credibility for e-journals, even though journals published in this way have much higher associated costs than e-only journals, due to paper output. The publication on the web of the sequences derived from the Human Genome Project as they became available, and online publication of other genome maps may also have acted to increase academic confidence in use of the web as a means for dissemination of robust scientific data.

Final comments

2.25 It is clear that the current state of flux in the scholarly publishing arena is set to continue for some time yet. Different market initiatives are emerging in an attempt to gain the edge, and it is to these that we now turn.

12 www.publiclibraryofscience.org/openletter.shtml (18 November 2002)

13 FASEB consists of 21 societies with more than 60 000 members.

3 The market for science, technology and medicine journals

The publishing market in context

3.1 Publishing is a global business, traditionally linked entirely with the production of printed material in different forms. The terms 'printing' and 'publishing' have sometimes been used as synonyms. With the growth of new technologies it is more accurate to think of publishing as a set of activities acquiring, selecting, editing, presenting (in print or electronic form), marketing and selling content. Each may have different market characteristics – in simple terms, the supply of, and demand for the activities and their outputs may be different for each subdivision of the publishing market. In the market for academic journals, as is well known, some of the activities are carried out by academics and some by publishers and we shall return to the implications of this later.

3.2 The importance of English as an international language has given the UK's publishing industry an international dimension. This is increasingly the case as English becomes the preferred second language worldwide. In scientific journals English has already become the normal means of communication. This creates new opportunities for publishers as more of the world opens up to English, and from the UK's point of view, subjects UK publishing to increasing competition from English language products produced elsewhere.

3.3 A parochial, UK-centric approach is not appropriate for an analysis of the market for STM journals except insofar as it influences the attitude and activity of key players within the UK, in particular, in this context, Government. The Department of Trade and Industry estimated the total turnover of publishing in the UK in 2000 to be of the order of £22 billion.[14] As a sector, on this estimate, publishing is significantly bigger than pharmaceuticals manufacture (£12 billion) and about half the size of telecommunications (£42 billion). The publishing sector employed 164 000 people in 2000 compared with 65 000 for pharmaceuticals manufacture and 234 000 for telecommunications. It is a sizeable industry and one which forms a cornerstone of the 'knowledge economy'. As such it is potentially a sector which will be favoured by Government. Publishing potentially has an international market; the UK has a long tradition as a centre of publishing excellence and the Government is looking to sectors of this sort to be the cornerstone of international competitiveness in the medium to long term particularly since the UK economy is likely to depend upon the success of industrial sectors which use high-level skills. The future of the market for STM journals has to be interpreted, therefore, as part of the bigger picture which puts a high value on UK competitiveness.

3.4 In addition the output of publishing is enormously important for education, and for social and cultural life. It is also influential in political life, making regulation and control of publishing more complex than most sectors. There are well-known rules, for example, about concentration of media ownership and issues about data protection and privacy. The growth in electronic communication has created new challenges to regulation, rules of ownership and copyright. Academic journals are a small and peculiar part of this world. They are vitally important as vehicles for the dissemination of knowledge but tiny in the context of publishing turnover. (UK libraries spent approximately £77 million [figures from the Publishers' Association] on all [not just UK] academic journals in 2000, equivalent to 0.35 per cent of UK publishing turnover.) Academic journals have an importance which is disproportionate to their financial value and are taken seriously by publishers and Government. The proposed merger of Reed-Elsevier and Harcourt would not have been taken to the Competition Commission if that were not true. But as part of the economic picture of publishing, they are relatively insignificant.

14 Department of Trade and Industry (2002) 'Publishing in the knowledge economy; Competitiveness analysis of the UK publishing media sector' Crown Copyright.

Costs of publishing

3.5 There are very few data available on costs. Looking at the print side of publishing, figures are available on employment costs.[15] Between 1998 and 2000 costs per employee increased by 25 per cent and value-added per employee increased by roughly the same factor over the same period. Paper prices have been volatile though if fluctuations are evened out the price has been roughly constant over the period 1990–2002, that is there does not appear to be a trend increase in paper prices. To the extent that it is possible to generalize, therefore, there does not seem to have been a significant increase in costs per unit.

3.6 In terms of broad measure of performance, the DTI places the UK publishing industry in the top rank internationally.[16]

Journal publishing

3.7 Data for journal publishing are not readily available. The Publishers' Association (PA) and Association of Learned and Professional Society Publishers (ALPSP) commissioned surveys in 1999 and 2000[17] but their results are too generalized to give an adequate picture for the STM market, and give only a relatively superficial account of journals in general. (The aggregate data which are the only data available cover a wide variety of journals from professional to specialized scientific areas.) Information is also available from the Competition Commission report on the Reed-Elsevier and Harcourt merger. The DTI combined these data in their 2002 report and their figures are used here.

3.8 Revenue and cost data vary widely by journal, depending on subject matter, circulation and ability to attract advertising. Gross margins for journals are around 35 per cent.

3.9

Table 3.1 Typical income and costs of a journal, percentage of total

Revenues	**STM**	**Humanities and Social Sciences**
Subscriptions	85	74
Single copy/back volumes	6	2
Advertising/mailing lists	5	2
Offprints/reprints	1	8
Permissions	1	0
Page charges/submission fees	0	12
Other	2	0
Total	**100**	**100**
Costs		
Production	58	56
Postage	6	7
Distribution	2	2
Total	**66**	**64**
Gross margin	**34**	**36**

Source: Page G, Campbell R, Meadows J (1997) *Journal Publishing*. Cambridge University Press, in DTI (2002) Table 6.5, p 37.

15 Annual Business Inquiry, Office for National Statistics, National Statistics website: www.statistics.gov.uk. Crown Copyright material is reproduced with the permission of the Controller of HMSO.

16 DTI, *op cit*.

17 Hourican R (2002) *Combined Journal Publishing Surveys 1999 and 2000,* London, The Association of Learned and Professional Society Publishers and the Publishers' Association, ref TFPL 01/158.

3.10 In STM the Competition Commission estimated a considerable variation in the launch of new journals per year with no obvious trend. Many new journals are unsuccessful but medium-sized publishers appeared to be the most successful at launching new journals.

3.11 The difficulty in launching new journals is that library budgets are limited. A new journal can be successful only if it is able to displace an existing journal. (This is an important feature of the market and we shall return to it.) Successful, new journals therefore have to reflect closely the interests of the research community.

3.12 However, some journals are regarded as essential. If the prices of these journals rise, the opportunities for new entrants are reduced. Some publishers of leading journals have tended to raise the price and size of these journals thus limiting the opportunities for new entrants.

3.13 As already noted, over the ten years 1990–2000 journal prices have tended to increase much more rapidly than inflation.

3.14

Table 3.2 Percentage annual price increases in journals

	Science and Technology	Medicine	Humanities and Social Sciences	Inflation (based on RPI)
1990	12.5	13.5	11.9	9
1991	9.0	-1.9	18.3	6
1992	14.1	16.5	14.5	4
1993	7.8	5.9	6.9	2
1994	23.5	21.8	17.2	2
1995	10.5	8.8	7.3	3
1996	13.5	12.3	11.1	2
1997	9.3	10.7	7.4	3
1998	2.4	6.0	9.5	3
1999	10.6	5.9	9.4	2
2000	10.0	12.0	14.0	2

Source: Blackwell's in DTI (2002) Table 6.6, p 37.

New technologies

3.15 In 2000, 91 out of 169 publishers produced electronic journals. Between them they published 1940 titles electronically. In 1999 the number of titles produced electronically was approximately 1200.[18] The growth of electronic titles in academic journal publishing is expected to continue and it is the one sector of publishing in which this development is seen as fundamental to a successful future.

3.16 A point made in the literature and by a number of respondents, however, is that the industry in general is unclear about the appropriate business model for electronic media. Outside the journal market early responses by publishers appear to have been defensive; companies moved to some form of electronic publishing because of fears about online competition taking over. The Internet is seen as an opportunity but it is hard to monetise.

3.17 Some of those points carry over into academic journal publishing, though here electronic delivery is seen as an essential component of any future scenario and this point is picked up in more detail later. The appropriate business model, however, is uncertain and the market has been characterized as being in turmoil.

[18] Hourican (2002) *op cit*.

Demand for science, technology and medicine journals

3.18 The issues here are straightforward and well known (though they do not seem to have been fully understood in a number of analyses of the STM journal market). Demand for journals comes from the research community. Primarily that community is not interested in price except insofar as price makes it difficult for them to access articles they wish to read, through squeezing library budgets, for example. Demand is determined by the standard of the work sought which is in turn underpinned by the quality of peer reviewing. Ease of access to articles is also important including, for STM, speedy access to the latest scholarship.

3.19 In economics terms this means that price-elasticity is low, in other words readers will not normally be much influenced by price in their decision whether or not to read a particular article. Demand is relatively unresponsive to price. A primary reason for this is that journals are not close substitutes for each other. While some overlap occurs, journal editors position their journals to meet the requirements of specific sections of the research community. There are a number of high status journals which reach a broad section of the community but more specialized journals have unique coverage. A specialized journal thus acquires a significant amount of monopoly power. Readers are not able to find alternative sources.

3.20 Two other factors are in play here. Firstly, readers are normally unaware of price since typically journals are purchased on their behalf by academic libraries. Secondly, where price is known by readers, for example when purchasing articles separately, the potential reader has only limited knowledge of the content of the article from abstracts or previous knowledge of the author's work, or crucially from the reputation of the journal in which the article is placed. It is not possible therefore to operate entirely according to rational choice precepts: the reader does not know accurately what benefit will accrue from the article (as against the journal) before the article has been read and cannot therefore easily assign a value to the article to compare with price. This latter point has been laboured in order to counter arguments claiming economic efficiency for a business model for journal articles in which the reader pays.[19] These arguments suggest in simple terms that the appropriate price for journal articles would be determined if readers were aware of price and operated directly in the market. We are suggesting that readers cannot know in any level of detail what benefit they will receive from an article and that conventional demand analysis, with respect to particular articles, is therefore less appropriate.

3.21 Demand for journals is exercised *in the market* primarily by libraries. Their demand is derived from the requests made to them by their academic communities. Since knowledge dissemination is generally regarded as a public good to be maximized, libraries will attempt to maximize their purchase of articles subject to the budget constraints under which they operate. Price is important in this context. The higher the price the tighter the budget constraint. But it is worth emphasizing that libraries will normally spend up to the limit of the budget. They do not behave in the same way as consumers typically behave, purchasing extra amounts of a product until the benefit they get is matched by the price they pay. Libraries spend the whole of the budget. If price falls they will buy more, if price rises they will buy less up to the limit of the budget.

3.22 Libraries attempt to ascertain, from their readers, a ranking of journals and other purchases. Various methods are used and generally relate to some measure of frequency of use. But that measure is inadequate, as libraries recognize, because frequency of use is determined partly by the size of the relevant section of the research community. Some journals appeal to highly specialized areas but are absolutely essential for researchers in those fields. In such circumstances libraries have to rely on the judgements of their readers for guidance on which items to purchase and (reluctantly) which to drop.

19 For example, Fishwick F et al (1998) 'Economic implications of different models of publishing scholarly electronic journals for professional societies and other small or specialist publishers' Report to the Joint Information Systems Committee, January.

3.23 There are two further sources of demand for journals. The first arises from individual subscriptions to journals or individual membership of learned societies in which receipt of the journal is one of the benefits of membership. This is an important issue for learned societies which is taken up in the next section. The second source of demand comes from private sector companies such as pharmaceutical companies or biotechnology companies and from health services. There are no readily available statistics setting out the size of this demand segment. Informal assessments suggest that the total size of the segment is small in relation to libraries but that it could be sufficiently large such that, if it operated in some sort of coordinated way, it may be able to exert some influence on the market.

Supply of science, technology and medicine journals

3.24 For the suppliers of articles the same is true. The factors here are well known but we have set them out briefly to give a complete picture. There are a limited number of journals to which authors can submit. They are facing a single buyer. (The term used for this is a monopsony.) As with demand, however, price is unimportant for the suppliers of articles. Academic authors seek to place their articles in journals which are widely read and highly acclaimed (with high impact factors). In STM the speed of publication is also an important factor. The career path of authors and their opportunity to acquire research funds is partly determined by the journals in which they publish. In such circumstances authors are primarily concerned with achieving publication in the highest quality journal they can reach. In most cases they are unaware of the name of the publisher and are unlikely to know the price of subscriptions or restrictions placed by the publisher on access. They may be aware of the name and reputation of the editor and editorial board who, like the author, will concentrate on dissemination of good quality work to the widest possible audience. The monopsony power of the editor is used to require changes in the article after review or to reject articles on behalf of the wider research community.

3.25 Publishers wish to publish high-quality articles to the widest possible audience but, for commercial publishers, this is not because of some quasi-altruistic wish to generate public goods but to produce profit. (There does appear to have been a cultural shift in publishing in this respect and we will come back to this point later.) In generating profit publishers will treat authors and editorial boards very well. Authors may find that their work is available online and accessible via well-used databases. Colour may be used extensively which can be important for clarity in STM articles. Editorial boards will be well supported by the publisher.

3.26 In this respect it is important to note that publishers add value to the process of knowledge dissemination. As in all publishing, they acquire, select, edit, present (in print or electronic form), market and sell content. Acquisition and selection is carried out largely by the editorial board and the reviewers whom they approach. It is frequently done free of charge. Copy editing will be undertaken by the publisher who will then print or make available copy in a suitable form electronically. Marketing, particularly of new journals, requires considerable effort and is usually looked upon as a medium-term project: readership levels are encouraged through discounted subscriptions, for example, at the beginning of a journal's life. Selling is also a significant activity though less important than for other published products since the market is largely self-evident. Most of these tasks are not ones which the academic community would wish to take on itself. Copy editing, marketing and selling are time-consuming tasks and editors of journals express relief that such things are taken on by the publisher. Furthermore, it has been widely acknowledged that the commercial publishers have been important in permitting new directions to develop. For example, academic disciplines have sometimes been reluctant to embrace new combinations of subjects and the commercial publishers have spotted opportunities.

3.27 Learned societies have occasionally found themselves in difficulty in considering new academic areas. The objectives of learned societies are likely to be defined as pursuing particular research agenda and areas of study. They are not constituted to reach out in to different academic areas. Groups of academics are likely to come together and establish new learned societies, and associated journals, and commercial publishers have sometimes facilitated this.

3.28 Probably the most important factor in the sale of any STM journal is its impact factor and this is outside the direct control of the publisher. Other quality measures, such as the reputation of the editor, are important for the publisher and publishers will go to significant efforts to recruit good people when editors change. The advice of the academic community is sought and publishers do not regard this task as trivial. The editor and editorial board contribute substantially to the success or failure of any journal. Increasingly the publisher's attitude to making articles available electronically, through, for example, open archives, can be important in recruiting academics to such positions. The academic community can therefore exert considerable influence over publishers in these key areas.

3.29 A final peculiarity on the supply side is the existence of a number of not-for-profit organizations, or perhaps more accurately organizations which try to earn satisfactory profits but which are not profit maximizers. These are learned societies and university presses. Satisfactory profits are those which enable the organizations to fund their primary objectives, which includes the dissemination of scientific work. Such profits can be substantial. Some university presses (OUP, CUP and Harvard University Press, for example) are seen by some as very little different from the main commercial publishers and some commercial publishers retain elements of attitudes which prevailed in publishing in the past, but as a generalization the distinction between profit-seeking commercial publishers and not-for-profit publishers is sufficiently accurate and analytically helpful.

3.30 Learned societies follow the objectives of their society. In publishing journals they will attempt to earn a return for the society. This sector produces a disproportionate number (in terms of their overall size) of the essential journals and can usually command an income which meets the societies' needs, particularly since journal income is boosted by subscription income (which can be sizeable). Some societies do find themselves in financial difficulty and in those cases the financial deal with commercial publishers in relation to some aspects of the publication of their journal can be a major consideration. Many societies contract out some parts of the publishing activity, for example marketing. In the UK, Blackwell's has a major stake in contract publishing and is reported to provide good customer care. It is able to retain most of its journals from one year to another because of the customer care which arises from its specialist interest in contract publishing and is viewed, by some, as an 'honorary not-for-profit publisher'.

3.31 There is very little movement between publishers for journals run by learned societies. It is relatively rare for learned societies to see publishing as a major burden and in general they seem happy to take on major components of such activities.

3.32 University presses try to make a return for their host institutions but see themselves as producing high-quality work in return for profit, rather than concentrating on the production of profit by means of publishing. Staff from a university press, for example, describe the care which is taken by academic staff in deciding what to publish, though the publishing operation is expected to produce a positive return. In such circumstances staff would have targets in terms of the number of books published. Conversely staff interviewed in preparing this report, who had spent time in commercial publishing, usually though not exclusively with Elsevier, described the company's objectives as targeted on revenue and profit. A 'good' but low-profit book would be dropped. While we are concerned with STM journals, the publishers' approach to books is a good indicator of their overall approach.

3.33 In academic publishing, learned societies and university presses still regard themselves as providers of knowledge. The primary objective is the quality of the academic output. Alongside this the hard edge of the rest of publishing has begun to appear. Profit seeking companies can see opportunities and their behaviour is in some respects different from firms and societies already in the market.

3.34 There has been a cultural shift in publishing generally, away from long discussions in which publisher and client talked about the merits of the book, towards a much harder edged commercial reality. Industries tend to establish cultural norms and this has been widely acknowledged in the business and management literature. A particular activity will be carried out in a similar way in one industry, but in a different industry the same activity will be carried out differently. Publishing has traditionally been less aggressively commercial than other sectors of the economy. In mainstream publishing hard edged commercialism has been commonplace for many years though the names of companies which promoted commercialism, such as Pergamon, are often spoken of disparagingly and this in itself is confirmation of some continuation of older cultural values. Publishing academic journals has always sat at the non-commercial end of the publishing industry. It has been a small specialized market and has not attracted the commercial publishers until recently. However, its merits as a stable or growing source of demand (with the additional benefit of subscription income and little reliance on advertising) has been spotted and the more gentle, traditional culture is faced with attitudes and approaches typical of highly competitive consumer goods markets. (The CEO of Elsevier, Crispin Davis, was recently described in *Forbes* magazine as "an unlikely choice [for Elsevier CEO]. Davis had previously worked for Proctor & Gamble, mostly in Cincinnati, Ohio, before messing up at Guinness, then resurrecting his reputation at Aegis, a midsize European buyer of ad space".)[20]

Public goods

3.35 One other aspect of the market needs to be reflected upon. We have used the term public goods earlier to describe the output of the research community. This is a technical term in economics which has some relevance in the context of this market. Public goods are those which the public values but which markets find it difficult to allocate. Defence is a good example for our purposes. Most people value defence in principle. However, it is impossible to exclude single individuals from defence services and a self-interested individual would therefore refuse to pay for defence assuming that he or she could benefit (sometimes called free-riding) from the services purchased by neighbours. In such circumstances markets tend to provide less of a public good than the community actually wants. Defence is therefore paid for by a different means. Individuals do not pay a subscription based on their own evaluation of the value of defence and free-riding opportunities. It is paid from taxation.

3.36 Scientific research is similar. Individuals cannot be excluded from the benefits of research. It is therefore better to pay for it according to some collective measure of its value and this is currently handled through publication output (related to peer review and impact factors) and a mixture of public and private research funding.

3.37 The benefits of research, however, are derived principally from access to research results. To the extent that the dissemination of research results is less than it might be from given resources, then we can argue that the welfare of society is sub-optimal and this is an important factor to consider in evaluating practices such as the 'big deal'. In effect the 'big deal' excludes those who do not have access to libraries which pay subscriptions to the relevant publishers. The cost of extra individuals reading research results is negligible particularly when articles are available electronically. If readers acquire virtually any benefit from reading the articles currently denied to them, then benefits to society would be greater than costs and we can see that existing pricing behaviour and structures leads to a sub-optimal outcome. (Authors paying for pages is a potential solution which we shall come back to later.)

3.38 It is not always easy to find ways of coping with such problems. There is an extensive literature on public goods and free rider problems in economics. In cases similar to the issue we are dealing with here, the problem is often considered in terms of property rights.[21] Solutions are found by allocating property rights in ways which try to maximize benefits. The ownership of copyright is the relevant consideration here and we will take this up below.

20 Morais R (2002) 'Double Dutch No Longer' *Forbes.com* http://www.forbes.com/global/2002/1111/044_print.html accessed 8 November 2002.

21 Hardin G (1968) 'The tragedy of the commons', *Science*, vol 162, 13 December.

Market behaviour

3.39 Behaviour in the STM journal market has been modelled using game theory. McCabe[22], for example, analysing STM *paper* journals, was able to demonstrate persuasively why profit-maximizing publishers were able to raise prices in the way they did in the ten years between 1988 and 1998 and why the market was prone to merger. He also showed that prices charged were well above the costs incurred by the publishers.

3.40 One aspect of McCabe's analysis in this context is that average costs, in STM journal publishing, decline with output as a result of economies of scale. What this usually means is that the market will tend towards monopoly since the bigger scale firm will be able to produce more cheaply than its smaller competitors. In STM journals, because of the demand and supply characteristics outlined above, an overall monopoly is unlikely to arise (McCabe did not address this issue). Small producers of high-quality journals will survive, firstly, because the research community values their products and is not responsive to price changes in a conventional way and, secondly, because each journal already possesses elements of monopoly.

3.41 The market is thus very complex. Different players in the market respond to different variables. Academics respond to impact factors and quality measures. Libraries spend the whole of their budgets and try to obtain a portfolio of journals which best meets the needs of the academic community they serve. Commercial publishers attempt to maximize profits through manipulating price and availability of journals. Not-for-profit publishers attempt to acquire a satisfactory return, which enables them to fulfil other objectives, whilst at the same time maximizing the availability of their output.

3.42 One way to simplify this is to think of two markets. The first is the academic market. Here the supply of and demand for articles are determined by factors relating to current research concerns and the quality of output. The second commercial market, which shadows the first, is a relatively conventional market with publishers providing a product to libraries. The publishers are a mixture of profit-maximizing and profit-satisficing companies. The libraries respond to price by increasing or reducing purchases until their budget limit is reached.

3.43 The academic market can reach an equilibrium relatively easily – a position in which the supply of articles and the demand for them reflects the research community's sense of what is appropriate. Articles will be supplied so long as research is funded (based on previous success in publishing) and the output of the research is regarded as valuable by the senior members of the profession – those who review articles and edit journals. Demand for articles will also be based on professional views of the value of the research, and hence access to research funding, promoting further research and refinement of ideas. In its ideal form this is a virtuous circle and it reflects the nature of scientific output as a public good.

3.44 The commercial 'shadow' market, however, is vital to the success of the first academic market. Without it the first cannot operate since an essential feature of the first market is that work is disseminated and evaluated. The problem is that the variables which influence behaviour in the commercial market do not have a strong relationship with the concerns of the academic market, nor the wider community, in the context of the furtherance of science as a public good.

22 McCabe M J (2000) 'Academic Journal Pricing and Market Power: A Portfolio Approach', Unpublished paper, School of Economics, Georgia Institute of Technology, USA.

What is happening in the market?

3.45 The commercial market is dominated by the concerns of the commercial publishers. They are the economic agents who are pushing the boundaries. Their behaviour disconcerts other players in the market. As mentioned above, commercial publishers recognize that the journals market is a good place to be. Demand for articles is likely to grow given the increasing complexity of science and the evidence of the recent past. Revenues are based on subscriptions and a relatively passive group of libraries who find it difficult to coordinate and assert their market power. In addition, ultimate control over the supply of products – academic articles – resides in the academic market where a group of professionals produce work of high value but are concerned only with the responses of their peers, are highly individualistic and largely uncontrollable.

3.46 In these circumstances the commercial, profit-maximizing publishers recognize that control of the essential journals is enormously valuable, that competition from the not-for-profit firms is potentially damaging and that the products of the not-for-profit firms must be marginalized, if they, the profit maximizing firms, are to achieve their objectives. On the demand side they realize that the total spend by libraries on journals is likely to be static, or grow slowly as libraries move away from the purchase of monographs and other texts. The static total spend, however, is independent of the number of journals purchased. If the price of journals increases libraries will spend the same amount on fewer journals. The trick, for the commercial publishers, is to make sure that at least some of those journals come from the not-for-profit firms.

3.47 The logical outcome is firstly mergers or take-overs, in order to gain control of essential journals. Secondly, attempts are made to focus the spend of libraries into the products of the commercial publishers. This has been done by grouping journal titles and offering the 'big deal', referred to earlier, in which libraries gain access to a wide range of relatively unimportant journals as well as the essential journals controlled by the publisher. Price rises over the period of the contract are agreed at the time of the initial contract and libraries find themselves forced to cut journals from suppliers outside the big deal in order to stay within budget. At the same time very effective databases, such as ScienceDirect, have been established with restrictions on access which favour the commercial publisher (in the case of ScienceDirect: Elsevier).

3.48 Not-for-profit publishers thus find themselves squeezed out. Many of the essential titles are published by the not-for-profit sector and to that extent the sector can remain independent. But they find it increasingly difficult to survive under the pressure of the commercial publishers and may be willing to join the stables of those publishers in order to secure a more comfortable future and to obtain income which enables them to promote other (laudable) objectives. The not-for-profit sector is trying to set up its own version of the 'big deal' through ALPSP, with a number of small not-for-profit publishers combining together to achieve the critical mass required to make a 'big deal' feasible. The activity is very time-consuming and needs a large number of journals to justify it. It is hard for the not-for-profit sector, where each publisher typically controls very few journals, to engage in this kind of thing. The big-deal, however, is relatively unpopular in its commercial form as we commented earlier, and this may be only a short term problem for the not-for-profit sector.

What does this mean for the research community?

3.49 None of this works directly in the interests of the research community. Electronic publishing is not currently challenging the dominance of the commercial publishers, though in some circumstances it could, as we discuss below. Furthermore, the nature of scientific research as a public good makes it very difficult for a non-regulated market to perform efficiently. Certainly, the current distribution of property rights, with copyright handed over completely to the publisher, does not encourage us to think that the needs of all stakeholders will be taken into account.

4 Changes in the market

Recent changes on the supply side

Mergers and acquisitions

4.1 For a number of years the market has seen a large number of mergers and takeovers. Some interviewees believe that we may be reaching the end of this activity simply because the opportunities for merger are now more limited. Competition authorities in Europe and the USA have become concerned with the implications of reduced competition, though the criteria which are adopted in both jurisdictions are not easy to apply to the peculiarities of this market. The usual criterion is that competition is likely to be adversely affected where a single supplier controls more than a given percentage of the market. In the USA this is 30 per cent, in the UK 25 per cent. In the STM journals market, however, a simple percentage does not give the full picture. An individual journal has monopoly power. The competition authorities are aware of the complexity of the area. McCabe[23] suggests that a proposed merger between Reed-Elsevier and Wolters-Kluwer in 1998 collapsed because of opposition by anti-trust authorities but interestingly the opposition from the EU related to a potential monopoly in European legal publishing (in which it was easier to apply conventional competition rules) rather than academic journals.

4.2 The opportunities for mergers and acquisitions are now more limited but not negligible. The list of units for sale includes US publisher Houghton Mifflin, KirchMedia and Bertelsmann in Germany. Some companies are in trouble and need cash to save the parts of the business that are still in a relatively good financial position. Others wish to become number one in a specific publishing market, rather than spreading themselves across several media sub-sectors. Bertelsmann Springer and Wolters Kluwer are both good examples in which scientific publishing is no longer considered a match with the companies' mass-market goals. Some sources say that a recent Kluwer Academic Publishers (KAP) deal could set the stage for future consolidation in the scientific publishing sector.

4.3 Wolters Kluwer is shedding non-core businesses and has sold KAP to two private equity firms Cinven and Candover. This is an interesting development. Why would private equity firms be interested in scientific publishing? The answers lie as much in the economic cycle as in the particular features of STM publishing. The scientific, technical and medical information publishing industry enjoys sustainable growth throughout the economic cycle. It is less prone to fluctuations than many other sectors. Publishing is currently a hot area for private equity firms as the industry is stable and still offers plenty of scope for pan-European consolidations. Private equity firms were attracted to the KAP deal because of the possibility for consolidation in the sector, currently dominated by Reed-Elsevier with a 30 per cent market share, but otherwise made up of small players. The size of Reed-Elsevier makes it difficult to get regulatory approval for further purchases in the sector. But Reed-Elsevier's success shows the potential benefits from getting bigger in the sector. Private equity firms have masses of funds that they have been unable to spend in the last two years and are expected to look for synergies with their existing portfolio interests. Both Cinven and Candover have interests in publishing. Cinven purchased the healthcare and business publishing activities of Vivendi Universal Publishing in April 2002. Candover's media deals include Regional Independent Media, Centaur Communications and Orion. Current speculation is that Cinven and Candover will seek to buy Bertelsmann Springer's scientific publishing unit and Blackwell Publishing Ltd. The suggestion is that they plan to build acquired business into the number two position in the publishing sector, rivalling market leader, Reed-Elsevier.

23 McCabe (2000) *op cit*.

Electronic access

4.4 Comments from across the range of perspectives – academics, librarians, commercial and not-for-profit publishers and learned societies – were unanimous in seeing electronic access as the major source of articles for the research community in future. Paper journals were seen as playing an important, though probably, diminishing part. Academics have become used to the convenience of electronic access at their desktops. Questions were raised about the serendipitous connection which is sometimes made when browsing along a shelf of paper publications, and the loss of this is clearly a disadvantage, but that is not seen as a sufficient reason to hold back widespread use of electronic journals. There are also benefits in bringing journal access to researchers outside the wealthy nations. African academics, for example, have been able to gain access to work unavailable in paper copy in their home countries.

4.5 Problems still arise over peer review and the confidence of the academic community that they are reading work of acknowledged quality. The quality of electronic versions of paper journals is taken for granted. Journals issued purely electronically are viewed with some suspicion by the academic community but this appears to be decreasing.

4.6 Payment for electronic access is, in many respects, the great unresolved area. The 'big deal' is disliked by libraries and interviewees are sceptical that it has a long term future. Libraries have found themselves tied in to contracts which are too tightly controlled and provide them with resources they do not necessarily want. On the surface, access to a very wide range of journals – for some libraries significantly increasing their 'stock' – is an attractive option and brings down the average rate of increase in the price of journals. In practice academics do not use all the journals offered and libraries are concerned about the ways in which their acquisitions options are narrowed. The position here is not entirely clear cut, however. A number of libraries have reported an unexpectedly high use of some bundled journals.

4.7 Other payment methods include payment by readers for access to articles and payment by authors for the publication of articles. We discuss these options in paras 4.30 – 4.32 below.

The Scholarly Publishing and Academic Resources Coalition (SPARC)

4.8 SPARC is an alliance of universities, research libraries, and organizations started, in 1998, as a result of an initiative by the Association of Research Libraries (ARL), an American membership association of major US academic libraries. The coalition was built as a response to what the libraries saw as market dysfunctions in the scholarly communication system. The ARL believes the dysfunctions have reduced the dissemination of scholarship and crippled libraries. SPARC is seen as "a catalyst for action, helping to create systems that expand information dissemination and use in a networked digital environment while responding to the needs of scholars and academe".[24]

4.9 SPARC has set up new journals, or worked with others in setting up new journals which have successfully competed for authors and have established reputations for quality. Twenty-two journals, or 'partnership projects' and their origins are listed on the SPARC website (www.arl.org/sparc). This has, SPARC claims, pushed down the price of journals and has involved editors and editorial board members more prominently in the business aspects of their journals. SPARC membership is approximately 200 institutions in North America, Europe, Asia, and Australia. It has just established SPARC Europe, based in the UK. Members commit themselves to buying SPARC approved journals.

4.10 This initiative is interesting since it represents the response which many external observers would expect to see: institutions setting up their own journals in competition with the (claimed) over-priced commercial options. It has achieved some success in challenging established leading journals. *Organic Letters*, for example, published by the American Chemical Society with a subscription price of US$2500 per year, now has a higher impact factor than *Tetrahedron Letters*, published by Elsevier (subscription price US$10 300 p.a.), the journal it is attempting to displace.

24 www.arl.org/sparc (14 November 2002)

4.11 It is not surprising that such an initiative began in the USA, given US business culture. It may be significant that the initiative was undertaken by the research libraries, however. The research community might have been another source of this kind of activity but the focus of attention of the research community and learned societies is narrower and difficult to coordinate. The libraries experience directly the budget implications of the changing market. Academics are at arm's length and may be completely unaware of the changes which are taking place. SPARC does find it difficult to get academics to take new journals seriously. Many academics are reluctant to change. The relationship between libraries and the academics to whom they provide services is an important factor in the extent to which SPARC can exert more market power. LISU argues that SPARC has simply added to the number of journals available and has not influenced the market in other ways.

4.12 In the UK there has been a less directly confrontational response. Publishers and libraries have worked together closely, according to ALPSP, in order to work out licences, agreements on fair dealing and rules about, for example, inter-library loan facilities for electronic journals. The Research Support Libraries Group, RSLG (chaired by Sir Brian Follett and due to report in early 2003) reflects, in some ways, this less confrontational approach. The RSLG has terms of reference to make recommendations to the HE Funding Bodies, the British Library and the National Libraries of Scotland and Wales on a national strategic framework and mechanisms for promoting collaboration in, and integration of the development and provision of library collections, their long-term management, and services to support research.

Open archives and search engines

4.13 Open archives are potentially important as a source of research output. We have discussed the main archives currently in operation in paragraphs 2.7–2.13. In principle, an open archive is one from which the materials deposited can be accessed by anyone without hindrance at any time. If the articles in archives can be quality assured, probably through peer review, they could transform the journal market. Articles would be readily available to all who wished to see them. One key factor in the development of open archives focuses on property rights. Who has the right to publish articles in this way?

4.14 This is a problem of the same nature as those faced in discussions of public goods and is resolvable in principle through tighter control of copyright. Copyright is typically passed by academics to the publisher upon acceptance of their manuscript for publication, and copyright agreements usually allow the publisher to place restrictions on the use of content. There is some evidence that publishers have requested payment from universities for copyright even when the work has been written by a member of staff in that institution. Universities are reviewing their institutional property rights, of which this is a part, to try to ensure the universities themselves are able to promote the exploitation of ideas, and receive some of the benefit from intellectual property, but this is often controversial.

4.15 Learned societies, however, are concerned that the response of the academic community to the greedy behaviour of some commercial publishers, could create real problems for them. Open archives would challenge their existing approaches. ALPSP has recently debated these issues (September 2002). There are mixed responses from the not-for-profit sector but the intuitive attraction of open access is important and is consistent with the objectives of typical learned societies. The societies recognize that open access may be less profitable but that it could be sustainable long-term if appropriate funding mechanisms could be put in place.

4.16 Journals or archives are of limited use if they cannot be searched efficiently. Contents pages, indexes (even journals of literature which provide an index) and, with electronic archives, search engines provide the means through which the research community can find the materials they need. The control of search engines is thus an important feature of the market. Search costs can be very high without effective search engines. The leading search engine for scientific publishing (partly because of its connection to CrossRef) is ScienceDirect, an Elsevier product. It sections off the journals market in a way which favours Elsevier's own publications. (For medicine, Medline is the market leader, a public sector service of the US National Library of Medicine.)

4.17 Peer-reviewed archives with appropriate search engines fulfil most of the functions of journals. There is less need for a collection of articles, in a journal with a particular title, if metadata conventions allow searches using all relevant categories. The journal or something like it, however, is currently the only effective means of carrying out peer review and is easily rated through impact factors. It also provides a conceptual envelope through which the research community is able to interpret particular theoretical or methodological approaches and find the latest research in any field efficiently.

4.18 Given the opportunities presented by electronic access, some commentators have been predicting the demise of the paper journal for a number of years. The paper journal remains but electronic access is becoming easier and more sophisticated. The academic community is also now much more familiar with electronic articles and, in STM, appears to have a preference for electronic delivery in many cases. The use of paper journals is therefore likely to change substantially. The difficult question is how to fund the new approaches.

Recent changes on the demand side

UK higher education libraries

4.19 Notwithstanding the mechanisms for cooperation which are in place, there is a great deal of unhappiness, and sometimes anger, in university libraries. The Society of College, National and University Libraries (SCONUL) has made representations on behalf of university libraries which express considerable concern about the behaviour of the commercial publishers. SCONUL has also made available to us a range of letters and reports (focusing on the recent Reed-Elsevier merger with Harcourt) which indicate that university librarians are deeply worried about the potential behaviour which may arise following that merger. SCONUL continues to present its concern about the negative impact of the current structure of the journals market on HE library provision. The impression which arises from individuals involved directly with HE libraries is a sense of powerlessness. Library budgets are squeezed and the publishers appear to have the whip hand. There was considerable disappointment that the Competition Commission and Office for Fair Trading did not take a stronger line on the Reed-Elsevier merger with Harcourt. The powerlessness arises partly from the remoteness of these issues from the day-to-day work of libraries, which with budgetary pressure, are becoming increasingly difficult to sustain. Even when dealing with publishers, libraries are often faced with important but more mundane problems, relating, for example, to the rights of different categories of users to access various datasets. Discussions about open access are taking place in libraries but they can easily slip into the less urgent category, particularly when academic users are unaware or relatively unconcerned about the issues.

SPARC

4.20 SPARC is a demand side initiative but is working largely on the supply side in attempting to promote journals which accept its principles. Part of SPARC Europe's brief is to raise awareness on the demand side within Europe.

The Public Library of Science

4.21 The Public Library of Science (PLoS) open letter started in September 2001 and has now been signed by nearly 40 000 scientists from just under 200 countries. It is an attempt to make scientific and medical literature freely accessible to scientists and to the general public worldwide. The Public Library of Science, an American association of scientists, is trying to establish international online public libraries of science that will archive and distribute the complete contents of published scientific articles and develop new ways of searching and linking information. As already discussed, the open letter urges publishers to allow the research reports that have appeared in their journals to be distributed freely by independent, online public libraries of science.

4.22 It is not clear how influential this letter has been. It is remarkable, however, in bringing together a large body of scientists who have committed themselves to restricting their own publishing opportunities to journals which grant unrestricted free access six months after publication date.

4.23 In December 2002, the PLoS initiative announced a major success. The Gordon and Betty Moore Foundation awarded a US$9 million grant to the Public Library of Science to enable it to launch new journals allowing scientists to make their works freely and universally available online. PLoS plans to begin by publishing two journals, *PLoS Biology* and *PLoS Medicine*, that will undertake rigorous peer-review and high editorial standards, but will recover the costs of these services by fees on each published paper. All published work will be immediately available online, with no charges for access or restrictions on subsequent redistribution or use. Publication is expected to begin in the second half of 2003.

4.24 The Howard Hughes Medical Institute in the US has endorsed the approach PLoS is taking to its new journals by offering to cover the costs of open access publication by means of a budget supplement to each of its investigators.

A single repository or archive

4.25 There has been discussion about long-term archives for scientific material in electronic form. There is a problem about the long-term availability of electronic literature. Currently, there is no equivalent of a copyright library for electronic material. It is unlikely that publishers will archive their own material and keep it for many years. They cannot, in any case, commit themselves to a project of the magnitude of a copyright library because their ownership might change, or they may cease to exist.

4.26 SPARC is interested in institutional repositories in which universities and other research institutions archive their own intellectual endeavour. Universities, for example, would make available papers published by staff of the university, including working papers, datasets and doctoral dissertations. Many universities already make working papers available and the use of the web for these purposes is becoming more widespread. Given university budgets in the UK, a bigger commitment to such activities may well be wishful thinking. It also fails to acknowledge sufficiently the autonomy of most academics and departments in the UK.

4.27 ALPSP, HE librarians, the British Library, the Research Libraries Support Group (and probably others) appear to have reached conclusions that some central archive will be established. Enabling legislation is expected to go before the Commons in the spring of 2003 which will, in effect, put electronic publications on the same footing as other published material in the UK. If the enabling legislation were activated, all UK publications would have to be deposited at the deposit libraries. As far as we can ascertain, however, no provision for the funding of such deposit libraries has been made. The legislation will not require such institutions to be established.[25]

4.28 The existence of a central archive could transform the market. Access to all UK publications would be possible and would act as a brake on excessive pricing. To protect publishers from potential ruin, it is proposed that access would be heavily constrained, probably to terminals in the deposit libraries. (The archive recently agreed between Elsevier and the National Library of the Netherlands has similar access limitations.) In addition, such an archive would ensure the continued existence of intellectual capital just as copyright libraries do for the printed page. Without funding such benefits are purely hypothetical.

25 Further information on the progress of the Legal Deposit Libraries Bill can be found at www.parliament.uk; www.bl.uk and www.alpsp.org.

Implications of current changes

4.29 Electronic access is clearly important, but the existence of the means to create significant change does not mean change will occur. The fact that electronic media exist has implications for the market and will influence the behaviour of all players. However, it is up to the players to decide how they will use the means at their disposal. The dominance of the commercial publishers will be challenged only if other players use the opportunities available to them, in particular electronic dissemination but also challenging assumptions about property rights. The continued interest of Reed-Elsevier, indicated by its take-over of Harcourt, and the upsurge in interest from private equity businesses, shown by the purchase of KAP from Wolters Kluwer, lead us to believe that commercial publishers will continue to play a major role in the sector.

Current business models

4.30 There are a number of features of the STM journal market which can now be drawn together. The implications of these features can be interpreted differently and produce different expectations of the future.

- Commercial publishers, particularly Elsevier, are beginning to dominate the market. Other publishers are to some extent happy to hide behind Elsevier and to raise prices by similar percentages. The starting point for Elsevier prices is frequently four times the level of other publishers. A similar percentage increase is therefore massively more significant when undertaken by Elsevier. (Elsevier's actions are not limited to the STM market. The company is carrying out directly parallel activities with Law publications.) Elsevier has been accused of price gouging.[26] Nevertheless the service provided by Elsevier is high-quality and meets the needs of customers (at a price).
- Meanwhile Elsevier is vilified by libraries and, to a lesser extent, by the research community. The vilification arises from a view that Elsevier is trying to dominate and is doing so from a position which is unsympathetic to the needs and cultural expectations of the research community and which will exert influence over public goods in ways which are favourable to Elsevier.
- Learned societies and other not-for-profit organizations do not like or support Elsevier's actions. They are not, in general, alarmed by the actions Elsevier is taking however, provided the research community does not respond with a backlash which damages them. Elsevier's actions may be considered distasteful but the societies are not directly harmed by them because Elsevier does not control a sufficient number of the essential journals to threaten their existence.
- There has been a response from users. Research libraries in the USA have established SPARC and are beginning to spread SPARC's influence worldwide, for example through SPARC Europe. The SPARC response is part of a wider and less coordinated reaction (revulsion) by the academic community at the potential control of scientific dissemination by an unsympathetic, profit-maximising company. (Price is by no means the only factor in this response.) Open archives and associated search engines are being widely touted and increasingly accepted.
- Many academics are largely unaware of the changes which have taken place in the STM journals market. Their objectives in publishing and reading articles are largely disconnected from the price of journals and from activities taking place in the commercial market.
- Some of these responses may threaten the current structure of the journals market.

4.31 Currently the market is funded primarily by a mixture of subscriptions to learned societies or to the journals themselves plus a small number of single purchases of individual journals or articles. Subscription charges are usually banded so that individual subscriptions are lower than those charged to institutions.

4.32 Some funding occurs via page purchases by readers but this currently contributes only a small proportion of revenue, around 6 per cent in STM which is more significant than in other areas (see table 3.1).

26 Morais (2002) *op cit*.

4.33 There is increasing interest in making page charges to authors for publishing their work. It is relatively common for authors to be charged for extra pages or for extra colour figures. This is taken much further when authors place articles on an open archive site like BioMed Central. For a page fee (approximately US$500 per article for BioMed Central) the article is posted in an online journal. (Printed versions can be sold at cost by printing on demand.) This is a very recent phenomenon. The new PLoS journals reported in paragraph 4.23 adopt this approach. Table 3.1 (taken from a DTI report published in 2002) shows that such charges currently produce virtually zero income for STM journals though they are much more significant as a proportion of income in the humanities and social sciences.

4.34 Charging in this way rather than through subscriptions could make an enormous difference and we have touched on its relevance on a number of occasions above. Journal income would be protected if the charge per page was set appropriately and the ownership of the copyright could be different from current practices. It would transform relationships since the research community would find itself directly involved. Library budgets would no longer pay for the journals themselves. Libraries would become institutions through which access to scientific materials was facilitated rather than negotiators with publishers. Funding institutions would have to become directly involved in funding the dissemination of research as well as the research activity itself. For many commentators this is a desirable outcome. The question is how do we get to there from here? And this is a difficult question. In effect it is asking how authors can be persuaded to publish their work in a journal which charges them a fee rather than one which is free (to them). The decision by the Howard Hughes Medical Institute to support its investigators in using the new PLoS journals is an important part of that package because it answers questions like these. The move to page charges is further complicated by the fact that the few examples which currently operate in this way are not primarily the core journals with the highest impact factors.

5 Conclusions

5.1 We have assumed that the growth of scientific publications will continue as the volume of scientific work increases and as the career prospects for academic researchers retain their dependence on high-quality publications.

5.2 Our analysis of the market and the nature of STM journals leads us to the strong conclusion that electronic publishing will become increasingly common and well accepted. The particular manner in which that might happen, however, is less clear.

5.3 Our analysis also indicates that the commercial publishers are likely to take an increasing interest in the STM journals market and that their objectives are not wholly aligned with those of the research community. It is clear that the commercial publishers carry out many activities very well and provide many researchers with most of the things they need effectively. Taking the dissemination of scientific research as a whole however, the individual actions of academic staff, prompted and supported in some cases by commercial publishers, do not add up to an outcome which best serves the needs of the community as a whole. We are not confident that the different forces operating in the market will necessarily produce better outcomes of themselves.

5.4 The main drivers affecting the market for STM journals relate primarily to the attitudes and actions of the main players. How will each of the following act and respond to changing circumstances, in particular to the opportunities afforded by electronic technologies? And importantly, how can the behaviour of different players be influenced to generate outcomes which are more desirable for the research community?

- The commercial publishers. Our assessment is that the commercial publishers regard this market as a long-term investment capable of generating solid profits. Elsevier, as the market leader and most active player, appears to be attempting to exploit the market more than other publishers and has adopted tactics which indicate it sees continuing potential to achieve high profits. The sale of Kluwer's journals has been explained as a response by capital providers to find a relatively secure home for their funds and that subscription income and the relative unimportance of advertising revenue were significant. In the current economic and financial climate we expect the commercial sector to continue to remain an important part of the market. Since control of the core or essential journals is a prerequisite of financial success we expect to see the major publishers continue to seek such control. This is likely to occur through (1) the provision of better facilities for authors and researchers so that they prefer the commercial publishers' journals, (2) the squeezing out of other journals through policies such as the 'big deal', (3) the use of search engines which favour commercial publishers' journals thus increasing profits and citations to those journals, (4) good treatment of editors, editorial boards and reviewers, (5) the use of data, obtained, for example, from usage statistics for journals, to spot new opportunities, (6) takeovers or mergers where these are possible and deliver core journals, (7) price increases as high as the market can bear.

- The not-for-profit sector is in general committed to promoting and disseminating scientific activities. The university presses have more complex objectives but appear to operate with a sympathy for the needs of the research community. The learned societies have objectives which require them to pursue such ends and they seek profits only to fulfil these objectives. It is likely that they would forego profit if that enabled them to fulfil their objectives (without putting their existence at risk), through, for example, open archives and page charges. Their constitutional structures and objectives may make them slow to take up new scientific areas. University presses may be able to take up new areas more quickly, particularly if they see competition from the commercial sector as significant for their survival.

- Research libraries. The libraries are on the front line, trying to meet the needs of the research community through interactions with the different players on the supply side. They have become increasingly aggressive, through initiatives such as SPARC and we expect this to continue. The relatively comfortable relationship, which has been reported to us, between publishers (widely defined) and libraries in the UK is unlikely to continue in our view. Library budgets are unlikely to

increase and librarians, through their national bodies, such as SCONUL, appear to us to be alarmed about the current situation and anxious to assert whatever market power they possess.

- Academic researchers. The evidence we have seen does not lead us to believe that academic staff are aware of the transformations which have taken place in the STM journal market in any depth. The PLoS letter and open archives initiatives appear to be widely known in general terms. Academic researchers will be concerned to ensure that their publication routes and access to good work are retained. The primary focus for most researchers is to publish in the best journal possible. We do not envisage an increase in academic interest in the journals market except insofar as it threatens publication. Leverage is most likely with individual academics through peer review and editorial work. Academics guard their reputations jealously and behave with high levels of integrity. In an extraordinarily individualistic way they aspire to pursue the common good. Changes may be possible in the approach of academics if new evaluation tools through, for example open archives, can be moulded, such that individuals believe their work is providing them with the reputational gains they need, while contributing to a better research environment. The ownership of copyright is part of this debate. A move to page charges would bring academics into the market much more extensively.

- Library and research funders. Funding sources have leverage since they can require activities to take place as part of an award. Limitations requested by funding sources could potentially intrude on academics' freedom to publish, particularly if publishers are powerful enough to refuse to acquiesce to the conditions required by the funders. The coordination of libraries through UK institutions, such as SCONUL, and global initiatives, such as SPARC, brings more power to them but their influence is ultimately restricted by the attitudes and activities of the research community. Just as with the libraries, and learned societies, there is the potential for countervailing power to the extent that funding agencies are able to speak with one voice. Greater coordination of non-library demand, namely private sector companies and health services would also change the balance of power in the market but there is no sign of such coordination taking place.

5.5 Set out below are some scenarios below which attempt to put the combinations and permutations available into realistic possibilities. We cannot be confident about what will happen but it is likely to be close to one of the suggestions or some combination of them.

Possible future scenarios

Scenario 1: More of the same

5.6 Journals are published increasingly online. Learned societies are squeezed through the domination of the new technologies by commercial publishers. Commercial search engines and archives become significantly more effective than others through investment, by commercial publishers, in providing users with excellent facilities. An uneasy status quo holds with commercial publishers making high profits and the rest of the sector just surviving. Commercial publishers manipulate price and service to libraries. Libraries' funds are under continuous threat as universities search for ways to cut costs. Academics ignore problems and send articles to preferred journals with relatively little concern for who is the publisher.

Scenario 2: Commercial withdrawal

5.7 Journals are published increasingly online. Open archives grow rapidly funded via pages bought by authors. Profits fall across the sector. Learned societies are happy to find alternative funds elsewhere. Commercial publishers lose much of the control currently exercised by them and divest themselves of many journals. Some small journals fail. Library budgets remain squeezed but control of journals and dissemination remains with the academic community. Academics actively support open archives and purchasing pages largely because research funding institutions deliberately favour such an option and a number of major journals decide to take this route, as a result of pressure from funding bodies and organizations such as SPARC.

Scenario 3: Commercial publishers gain more control

5.8 Paper journals largely disappear. Major disputes arise about access to search engines and archives. Commercial publishers refuse to allow third-party archiving and will not give continued access to journals unless a subscription to the e-journal is maintained. Learned societies struggle to maintain e-access at levels of support offered by commercial publishers and find themselves under pressure to pass more responsibility for publishing to the major publishers. Academics continue to send articles to preferred journals with relatively little concern for who is the publisher. Library budgets are restricted by university cost cutting.

Scenario 4: Deposit libraries and open access become dominant

5.9 Electronic deposit libraries are established. Journals are published increasingly online. Access to articles is guaranteed through the deposit libraries but constrained to ensure the profitability of publishers. Inter-library loans, or purchase direct from journals, are used for the purchase of one-off articles; otherwise payments are made by authors for pages in open access journals. Academics insist top journals support open access. Commercial publishers provide open access and reduce prices to maintain the continuing supply of good quality work from academics. Some publishers drop journals but retain a significant presence because they regard the security of product demand and income, largely independent of advertising and the economic cycle, to be valuable features of the market. Library budgets are used to focus on *access* to learning resources as research funds are switched into supporting page charges for authors.

Interventions

5.10 Each of these scenarios is possible and each is predicated upon assumptions about the behaviour of the key players. We are not in a position to know what future funding organizations prefer. However, we believe the funding organizations could potentially have a significant impact on the STM market both as suppliers of funds for research and as trusted institutions largely independent of the current debate.

5.11 The funding organisations could influence others through:

- setting out their own position clearly, whatever that might be, or by making public their concerns or intentions;
- drawing together groups of institutions or academics to support them in their own responses to market changes;
- engaging in the market directly.

5.12 Set out below are some tentative suggestions as first thoughts on the kind of interventions which could be influential. Each suggestion aims at increasing countervailing power, with respect to the commercial publishers, in some segment of the market. We have not suggested direct actions by the funding organizations to change the structure of the market, such as might be possible, for example, via legislation on competitiveness and restrictive practices. We have not done this firstly, because we believe the attitude of the authorities to this market is more inclined to support the publishing sector as a whole, as part of increasing the international competitiveness of the UK economy. And secondly, because, given the complexity of this market, and the nature of the key players, any structural change would be very long term.

5.13 If the funding organizations wish to engage with the market in some way, they could:

- Support different ways of funding publications, particularly electronic page charges, through research grants. Such an action would involve including some provision in research grants to enable academic staff to pay for publication of their work. This would give more power to the not-for-profit sector in enabling them to move to a system of page charges without risking their survival, and increase the power of academics in enabling them to seek publication outside the commercially controlled conventional journals. It might also prompt commercial publishers to consider setting up (or transferring to) journals based on page charges. Journals of this kind are free to the reader and thus potentially transform the economics of the scientific journals market.

- Provide support to the open archives initiatives, through supporting their case, provide funding for open archives or set up an archive for the research for which the funding organization has provided resources. Action of this kind would support academics who wished to retain elements of copyright enabling them to publish in open archives as well as commercial journals. If the funding organizations required the researchers they finance to place their work in open archives, rather than simply support open archives, the impact would be more dramatic. The balance of power would then depend upon the ease with which researchers could continue to publish in reputable journals, as compared with the ease with which commercially published journals could continue to secure top-quality work.

- Actively support open access and the retention of copyright by authors and institutions. The funding organizations' intervention in this area might persuade academics of the merits and difficulties of particular cases more successfully than university employers are currently able to do. The opening up of a wider public debate on the complexity and subtlety of copyright would take power away from the commercial publishers. Many academics do not question signing over their copyright to the publisher. Many are cynical about the universities' attempts to gain greater control over the work of academics. An open debate, sponsored by a trusted neutral body, could inform the academic community of their rights and responsibilities more successfully than is currently the case. This might include, for example, working towards universal acceptance of the six-month limit on copyright suggested in the PLoS letter.

- Coordinate, or suggest the setting up of a coordinating mechanism for, responses from the different funding bodies in the UK and Europe. If US responses could also be brought into the picture, for example the NIH, this could exert a powerful influence on the market. The funding bodies currently exert little influence on the publishing end of the research process. Partly this is because their resources do not usually directly fund publication. Making the market aware of the (combined) preferences of funders is likely to carry considerable weight.

- Coordinate, or suggest the setting up of a coordinating mechanism for, non-library demand for journals from private sector companies such as pharmaceutical companies or biotechnology companies and from health services. Demand from this segment of the market is small in relation to libraries but, if it operated in a coordinated way, it may be able to exert some influence on the market. Although we have no measure of the size of this segment it is unlikely to be trivial.

- Provide support to publishers from the not-for-profit sector, for example pump priming funds for electronic archives. Such an action would increase the opportunities for academics to publish in open archives outside the commercial sector and could create pressure on the commercial sector to promote open archives in competition with the not-for-profit sector, in order to secure the highest quality work. For this to be successful, academics would need to be persuaded of the value of open archives.

- Support the setting up of not-for-profit 'big deals' to protect the not-for-profit publishers. This would provide more power to the not-for-profit sector and would make it less likely for their journals to be dropped when libraries came under financial pressure.

- Support – perhaps endow – the setting up of a central electronic deposit library. The proposed legislation for an electronic deposit library is likely to be enabling. Without funding such deposits will not be established. A central archive would have the ability to make articles available independently of the publishers. A key feature would be the negotiation of accessibility rules. The rules would be based on the need to make academic research available as widely as possible, while maintaining the profitability of publishers sufficiently to ensure that journals were not driven out of existence.

The best balance here is not immediately obvious. There is no reason, in principle, why access to articles should not be wider than the deposit libraries themselves. An electronic archive would bring power back to the research community.

- Exert pressure to recognize electronic journals in bibliometric assessments and impact factors. Wider recognition of electronic journals will increase the desirability, for academics, of publishing in less traditional, more accessible ways.

5.14 Each of these interventions influences one or more of the key players. The overall effect of any changes depends upon the interrelationship between the key players but shifting power away from the major commercial publishers is likely to increase access as a whole, to the benefit of the research community. This is not a simple zero sum game, however. Extra power for researchers through open archives, for example, could bring a significant growth in access. Conversely, if commercial publishers abandoned scientific publishing, it is likely that the net effect would be negative.

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