



ELSEVIER

Elsevier's comments on evolutions in scientific, technical and medical publishing and reflections on possible implications of Open Access journals for the UK

February 2004

Elsevier, a division of Reed Elsevier Group plc, is a world leading publisher of scientific, technical and medical information products and services. Working in partnership with the global science and health communities, the company publishes more than 1,800 journals and 2,200 new books per year.

Executive Summary

Scientific publishing has evolved continually over hundreds of years to meet the changing needs of scientists, researchers and medical professionals. Most recently, the advent of new information technologies, and publishers' responses to these advances have further transformed scientific publishing: around the globe, scientists and researchers now have improved and easier access to scientific information that is world class in quality, while powerful new functionalities enable them to search and link easily and efficiently across a vast range of highly relevant information. This paper comments on these evolutions, including changes in the distribution, quality, access, availability and pricing of scientific information, and on current trends in publishing, most specifically on the development of Open Access journals.

The current worldwide system of Scientific, Technical and Medical (STM) publishing has evolved over hundreds of years, and we believe it serves science and medical communities well. STM publishing is truly a global market: scientific and research communities are dispersed around the world, yet fully integrated by the highly organised and efficient system of STM publishing. This system of some 2,000 STM publishers annually produces 1.2 million peer-reviewed articles, which are published only after world-leading experts in their fields have vetted their quality. These articles are then used by millions of researchers to further the progress of science and medicine. Publishers continue to serve global researchers and practitioners by organising, establishing, managing, producing and disseminating journals, defining new disciplines, establishing and actively managing editorial boards, and investing in new technologies that make new and archived research more accessible.

The substantial investments that STM publishers have made in electronic technologies are continuing to deliver dramatic productivity improvements for scientific and medical communities around the world as more users gain quicker and easier access to more content at lower per-article-costs for the institutions that serve them. For example, after investing approximately £200 million to date in its *ScienceDirect* electronic distribution platform and in other programmes (e.g. digitisation of archived journals) Elsevier has seen the following productivity-related results in the UK:

- **Access:** all UK Higher Education Institutions engaging in science and medical research and all researchers within them have access to nearly all Elsevier journals that pertain to their research programmes: 97% of UK researchers have direct access, on average, to around 90% of Elsevier journals under licence of their host institution. UK citizens have access to all Elsevier journals and articles either directly through their local libraries, or via inter-library loan agreements¹.
- **Usage:** from 2001 to 2003, the number of UK researchers downloading Elsevier's electronic articles at least once per month more than doubled from 145,000 to 360,000, while the number of Elsevier articles they downloaded tripled from 4.4 million to 13.3 million. More than 820,000 UK researchers use *ScienceDirect* regularly.
- **Functionality:** These dramatic increases in breadth and frequency of use reflect the real growth in benefits to users, who can now access a highly expanded range of articles on campus or remotely, at any time, and with much greater efficiency. For example, *ScienceDirect* allows users to perform complex searches and to retrieve full text articles, to link to other articles cited, to export content to local databases and citation management software, and to receive alerts when new journal issues are released.
- **Per article costs for customers:** In the case of Elsevier, the average cost for a retrieved article for UK users of *ScienceDirect* has fallen from £4.57 to £1.69 since 2001, a reduction of 63%. We estimate the cost to customers per article downloaded will be less than £1 within two years.

Open Access' author-pays model risks penalising the UK because British researchers produce a disproportionately high number of articles every year. By charging authors for each article that has been accepted for publication, Open Access transfers the costs of publishing from institutions

Executive Summary (continued)

like commercial corporations, and libraries that serve readers, to researchers and their sponsors (e.g. universities, governmental funding agencies and foundations). While Britain's spending on journal subscriptions currently amounts to 3.3% of the world's total, UK researchers contribute a much higher 5% of all articles published globally.ⁱⁱ As a result, we estimate that the UK Government, foundations, universities and researchers could together pay 30-50% more for STM journals in an Open Access system than they do today.ⁱⁱⁱ

Whilst individual institutions like Cambridge University and Imperial College London that are relatively prolific would pay more under an Open Access system, by contrast, commercial organisations that subscribe to many journals but contribute relatively few articles each year would pay substantially less: our estimates suggest that some commercial corporations would pay one tenth or less in an Open Access system than they pay under today's subscription model.^{iv}

In addition to these cost-transfer effects, there are other key unresolved issues concerning Open Access:

- ***By introducing an author-pays model, Open Access risks undermining public trust*** in the integrity and quality of scientific publications that has been established over hundreds of years. The subscription model, in which the users pay (and institutions like libraries that serve them), ensures high quality, independent peer review and prevents commercial interests from influencing decisions to publish. This critical control measure would be removed in a system where the author—or indeed his/her sponsoring institution—pays. Because the number of articles published will drive revenues, Open Access publishers will continually be under pressure to increase output, potentially at the expense of quality.
- ***The Open Access business model in its current form has not proven its financial viability.*** even the highest article fees charged by Open Access publishers today (\$1,500) cover only about 40% - 60% of the estimated total costs to publish an article of the quality that researchers are used to today. Remaining costs, estimated to range from £1 billion - £2 billion for the industry globally, would have to be covered by foundation, university and government subsidies. While it is conceivable that mean costs per article may fall as electronic-only publishers gain scale (currently less than 1% of articles are Open Access), Open Access publishers are unlikely to cover production costs with revenues of just \$1,500 per article, assuming they provide similar levels of quality, peer review, functionality and accessibility as researchers receive today. They would almost certainly be unable to invest in technological innovation to any significant extent or in nurturing emerging areas of science.
- ***For universal access to be a reality, publishers must continue to make articles available in multiple media formats.*** Print is used by many scientists around the world and by global citizens who are the beneficiaries of scientific and medical research. To rely on the internet alone for distribution, as most Open Access journals do, risks reducing levels of access among these beneficiaries: only 11% of the world's population uses the Internet and only 64% of UK citizens have ever been online.^v

The recent period of rapid, intense innovation in STM publishing—the context in which Open Access has emerged—is far from over. As this period continues, we expect the measurable benefits in productivity for users (i.e. access, usage, functionality and lower unit costs for customers) to continue. Elsevier, like all publishers, will continue to innovate, to observe the impact of innovations like Open Access and to assess how effectively such initiatives serve the needs of scientific and research communities. As developments prove able to bring demonstrable, substantial and sustainable improvements for those communities, Elsevier will adapt and invest accordingly. In the meantime, we believe that the market dynamics of this global industry will continue to drive innovation and to determine which publishing models can best serve the needs of the worldwide scientific and medical research communities.

1. Contributions of Scientific, Technical and Medical (STM) Publishers

Key points

- Publishers' current policies on pricing and provision of scientific journals reflect the beneficial effects of their substantial investments in electronic technologies: for example, Elsevier has invested approximately £200 million in its electronic platform, *ScienceDirect*, and in other initiatives (e.g. making 180 years' worth of articles from its premier medical journal *The Lancet* available on a single database). Publishers have developed innovative pricing, product delivery and access options to meet the market's demand for increasing amounts of high quality information to be made easily accessible.
- The "Big Deal", as Elsevier's contract with its NESLI consortium of UK customers is sometimes known, is one of a number of such options that was developed to respond to customers who wanted access to more journals.^{vi} While customers can opt to purchase any combination of journals at the point of contract negotiation, this particular option gives significant unit price discounts to institutions purchasing content previously not subscribed to. The result is that 97% of UK researchers, on average, have direct access to approximately 90% of Elsevier journals through the licence of their host institution.
- Since being introduced, the number of users, their frequency of use and the breadth of articles available have all risen dramatically, while unit costs for customers have fallen: the average cost-per-Elsevier-article-downloaded for UK NESLI users via *ScienceDirect* fell from £4.57 to £1.69 between 2001 and 2003, a decrease of 63%. We expect the average cost to customers per article downloaded to fall below £1 within two years.
- In the case of Elsevier, annual price increases to NESLI for subscribed journals have been capped at 5% for the next two years. Over this period, the number of articles published is expected to increase in line with historic trends (typically 3% per year), and usage is expected to rise, on average, by more than 50% each year (the number of Elsevier articles downloaded by UK researchers tripled in the last two years from 4.4 million to 13.3 million, continues to increase rapidly, and is expected to pass 20 million within the next year).
- The period of rapid and intense innovation is far from over. As it continues, we expect the measurable benefits in productivity and additional value for customers (as measured by access, usage of archived and current articles, functionality and decreasing article costs for customers) to continue also.

The role of STM publishers

The current global system of science publishing has co-evolved with science and scientists over hundreds of years to support the long-term interests of scientific and medical communities. Science, Technical and Medical (STM) publishers are guardians of intellectual heritage, shouldering significant responsibilities by creating, organising and developing the communications infrastructure for the research communities they serve. Globally, the more than 2,000 STM publishers receive, register and publish over 1.2 million articles each year by millions of researchers in hundreds of countries.^{vii} These articles, which have been peer reviewed by world experts, are then distributed in around 16,000 learned journals. For each of these journals, STM publishers aggregate, review, edit, prepare and produce articles submitted by researchers, and then distribute them electronically or in print to libraries and individuals. Ultimately, these vital journals are searched, read and referenced by discipline-specific scientific research communities. Increasingly, STM publishers are facilitating access to the extensive archives that they have preserved. For example, Elsevier recently made

180 years' worth of articles—published in its premier journal *The Lancet*—available in one database. In summary, STM publishing is a self-sustaining system that, we believe, serves science and medical communities extremely well.

STM publishers provide value by creating and managing independent publications for the global research community. They stand as the final guarantors of quality by financing, organising and managing editorial, peer and creative review processes. In part they achieve this by actively managing editorial boards themselves. STM journals are the "minutes of science", each article serving like a witness statement in the court of scientific opinion. By managing journals, publishers provide and disseminate undisputed records of the sources of research by registering and date-stamping authorship; by assuring quality through peer review and complex production processes; and by fixing and defending the definitive final versions of research papers in perpetuity, in part through the mechanisms of copyright transfer or publishing licence.

1. Contributions of Scientific, Technical and Medical (STM) Publishers (cont.)

Innovations in STM publishing and benefits to researchers

STM publishers have made significant investments in nurturing new areas of science and in electronic technologies. In so doing they have transformed the way science is used and accessed. As a result, scientific research is more widely available and more heavily used today than it has ever been before. In the case of Elsevier, all UK Higher Education Institutions engaging in science and medical research and all researchers within them have access, through the licence of their host institutions, to nearly all Elsevier journals that pertain to their individual research programmes: consequently 97% of UK researchers have direct access, on average, to around 90% of Elsevier journals under licence of their host institution. UK citizens have access to all Elsevier journals and articles either through their local libraries, or via inter-library loan agreements. Electronic access has dramatically increased usage of journals, enabling researchers to search, find and retrieve a very broad range of relevant content remotely, at any time, with striking speed and ease. For example, *ScienceDirect*, Elsevier's electronic journal platform, allows users to perform searches by author, title, publisher, or keyword enquiry to retrieve full text articles and their components (e.g. abstracts), to link to other articles cited, to export content to citation management software and to receive alerts when new journal issues are released.

These benefits are resulting in dramatic growth in usage. For example, from 2001 to 2003, the number of UK researchers using Elsevier's electronic articles at least once per month more than doubled -- from 145,000 to 360,000 -- while the number of Elsevier articles downloaded by researchers grew, on average, by 73% per year -- from 4.4 million to 13.3 million. In total, as of January 2004, 820,000 UK researchers were regular users of *ScienceDirect*.

Evolution of pricing and growth in value for customers and end-users

The pricing environment has changed quite significantly in recent years as scientific publishing has migrated from a print to an online environment, with new pricing paradigms emerging to reflect changes in the product and dramatic increases in availability and access opportunity.

Elsevier's pricing has adapted, and continues to adapt to changing market needs. From 1999 to 2003, Elsevier's prices to UK higher education institutional customers increased, on average, by 6% per year.

Factors driving annual increases, beyond cost inflation, include the annual growth in the size of the literature (3% per year on average), rising costs to serve exponential usage growth, and the costs required to deliver additional functionality. In the case of the NESLI consortium of UK customers, annual price increases for subscribed journals for the next two years are capped at 5%.

Customer benefits, measured by breadth, speed and functionality of access, and reflected by great growth in article usage, have all increased dramatically, delivering significantly more value for the price paid. For example, while the overall prices have increased at 6% per year from 1999 to 2003, the cost per Elsevier article downloaded for NESLI members decreased by 63% from 2001 to 2003 -- from £4.57 to £1.69.^{viii} We expect the average cost to customers per article downloaded to fall below £1 within two years. Over the same period, the number of *active UK users* grew annually by 58% per year on average, while the number of articles downloaded *per user* grew annually by 21% per year on average.

Elsevier charges universities to access electronic articles and journals based on the prices they paid for content in the print versions. In general, customers may receive both print and electronic versions by paying a platform fee and an additional e-content fee. This gives electronic access to the last five years and to the current year of the titles held in print. Customers can choose to subscribe only to the electronic versions of journals by paying 1-3% less than they did for print only collections.

The "Big Deal", as Elsevier's contract with NESLI is sometimes known, gives significant unit price discounts to customers purchasing content previously not subscribed to, or journals previously cancelled due to prior budget constraints. The recently signed agreement with 114 research institutions, covering 1.3 million (97%) UK researchers, provides direct access, on average, to about 1,600 of some 1,800 Elsevier journals with full *ScienceDirect* functionality. Institutions opting to purchase content they are not subscribing to at present receive discounts of up to 97.5% on the print catalogue price. As many institutions have opted to purchase more journals to take advantage of these unit price discounts, the mean price paid by NESLI members per Elsevier journal has decreased by 34% since 2001. Additionally, as stated above, future price increases for NESLI customers have been capped at 5% for the

1. Contributions of Scientific, Technical and Medical (STM) Publishers (cont.)

term of this agreement. This mutually agreed contract will be re-negotiated at the end of its two year term.

The so-called “Big Deal” is just one of a number of service options that Elsevier provides: customers can opt to purchase any combination of journals at the point of contract negotiation. This particular option has contributed significantly to the growth in access noted above, and was developed to respond to customers who wanted access to journals outside of their core collections at favourable rates, i.e. to content they had not previously subscribed to or had cancelled. For access to un-subscribed journals in a consortia environment, Elsevier charges between 2.5% and 7.5% of the catalogue price (i.e. discounts of between 92.5% and 97.5%). Individual institutions can choose sole access to their subscribed journals

or combine with access to other Elsevier journals (e.g. subject collections, a title list customised for the NESLI consortium, or all Elsevier titles). These options lead to different pricing levels, giving institutions the option to broaden their collections as well as more ways to manage their budgets. Usage statistics are now also provided for individual journals enabling institutions to manage their budgets better (for example, by cancelling journals with low usage as contracts are renewed).

It is clear that this period of rapid and intense innovation and transformation is far from over. We expect to see continued changes in product delivery, pricing and access options in response to evolving market demands and emerging technologies.

2. The STM Marketplace

Key points

- The market in scientific publications is global and highly competitive: some 2,000 publishers annually publish approximately 16,000 unique learned journals containing about 1.2 million articles selected from papers submitted by millions of researchers around the world.
- Competition for authors' articles occurs within dozens of narrow subject areas. Field-specific learned societies frequently enjoy a leading share within subject areas and no single competitor has disproportionate power.
- The ongoing emergence of new journals, publishers and publishing models indicate the low barriers to entry, and are a sign of a healthy competitive marketplace.
- Ongoing innovations in science and advances in publishing technologies contribute to a dynamic and healthy marketplace.
- STM markets have become even more dynamic and even more competitive: price per article downloaded has fallen, while usage and access levels have dramatically increased.
- Market dynamics will ensure that publishers continue to meet the needs of scientific research communities effectively and efficiently.

A global marketplace

The STM publishing marketplace, made up of more than 2,000 publishers and 16,000 learned journals, is truly global: British researchers use articles that have been written by researchers from all over the world, while those researchers in turn read articles written by British researchers. Each STM journal is unique, with its own distinctive scope and orientation, qualities, editorial style and reputation. Competition for authors' articles generally occurs within narrow subject fields among a small number of journals covering these fields, with societies (e.g. Royal Society of Chemistry, American Chemical Society) typically enjoying a leading share of articles and first claim on author loyalty as society members.

A competitive marketplace

STM markets are highly competitive: among the 2,000 STM publishers none has disproportionate power. The UK Office of Fair Trading (OFT) noted in September 2002 "the overall market is fragmented, with the top six publishers accounting for just 37% of rated journals and 44% of articles. The top publisher (Elsevier) accounted for just 13% of the journals, rising to 18% following its merger with Harcourt." ^{ix}

Frequently, publishers launch new journals as new scientific disciplines emerge, and as research output grows. (For most of the 20th century, the number of STM journals has grown, on average, at a reasonably steady 3.25% per year.) New publishers, sometimes experimenting with new business models, have also

entered the market recently, reflecting the low barriers to entry.

A dynamic market rapidly changing due to technology and the progression of science

As technological innovation and the advancement of science continue to change the market, STM publishers respond in a variety of ways: by launching titles as new sub-disciplines arise, changing the scope of existing titles, making sure that the journals' editors fairly represent the leading edge in their fields, and adding search, retrieval and display functionality to improve the productivity of research. As more articles become available electronically, usage statistics have enabled library customers, who have always had discretion about how to spend their budgets, to make even more informed spending choices. Technological innovations have also lowered the cost of entry for new competitors because electronic-only publishers do not incur costs associated with the production, warehousing and distribution of print copies. Finally, technology is enabling an explosion of access within subscriber bases: libraries can provide distributed access to all subscribed journals across their institutions and to licensed users remotely, at any time. No longer do libraries have to provide only one or a few current "shelf" copies while storing back copies inconveniently in another location.

In such a dynamic market, new technologies redefine the way scientists and researchers access and use information, and business models continue to evolve. STM markets have become even more dynamic and

2. The STM Marketplace (continued)

even more competitive: costs per article have declined, usage has increased, new journals have been launched at higher than historical rates, and in the case of Elsevier, annual price increases for NESLI customers, for example, have been capped at 5% for the next two years.

Market dynamics will ensure that publishers continue to meet the needs of scientific research communities effectively and efficiently.

3. New publishing models, including Open Access

Key points

- Open Access' authors'-pay-per-article model risks penalising the UK because British researchers produce a disproportionately high number of articles every year. While Britain's spending on journal subscriptions currently amounts to 3.3% of the world's total, UK researchers contribute a much higher 5% of all articles published globally.^x One consequence of increasing numbers of Open Access journals is that UK researchers and their sponsors could together pay 30-50% more for STM journals than they do today.
- In an Open Access system, costs will be transferred to relatively prolific nations (like the UK) and institutions, like Cambridge University and Imperial College London, who will pay more. Less prolific institutions, particularly commercial corporations, will pay much less - in some cases as little as one tenth of what they pay today.
- Open Access in its current form has not proven its financial viability: author fees cover only 40%-60% of the estimated costs to publish articles at the levels of quality that researchers are used to, with remaining costs, (estimated to range from £1 billion - £2 billion for the industry globally) currently covered by university, foundation and government agency subsidies.
- While mean costs per article could fall as electronic-only publishers gain scale (currently less than 1% of articles are Open Access), we estimate that they would have to fall by as much as 40% - 60% for the British academic system to pay the same in an Open Access system as it does today.^{xi} Reductions of this magnitude would almost certainly mean that publishers would have difficulty maintaining today's high quality of STM journals, and would have little if any margin to continue investing in technology and in nurturing emerging areas of science.
- The quality of research articles might also be threatened as Open Access publishers come under pressure to publish more and increase revenues, potentially compromising the rigour of the peer review processes as they reject fewer articles.
- Market dynamics will determine whether Open Access can serve the needs of the scientific research community more efficiently and effectively than other publishing models.

The alternative publishing landscape

New technologies have created opportunities for STM publishers to deliver research-related content more quickly and cost-effectively, creating a landscape of innovative publishing initiatives that include pre-print servers, self-archiving in university repositories and electronic-only publishers with traditional business models. Open Access appeared on this landscape as a result of these new technologies and the publishing industry's low barriers to entry. Alternative publishing is a broad market development that is being embraced differently by a range of players.

The many new publishing models that can be considered Open Access are distinguished primarily by their business approach. Most Open Access journals, instead of charging subscription fees, charge authors (and either directly or indirectly those who fund them) to

publish articles accepted for publication. Hybrid publishing models also exist. For example, *The Journal of Biological Chemistry* considers itself to be an Open Access publisher because it makes its papers freely available at the end of one year. Other journals, such as *Florida Entomologist*, offer authors the choice to pay an article fee to be published (in which case the article is made available to all) or not, in which case the article is available only to paid subscribers.^{xii} It is as yet unclear whether such arrangements are sustainable for the long term.

The lack of subscription fees does not mean that Open Access journals are free. Their publishing costs -- primarily labour, technology and production -- are the same as those of any traditional publisher, although the fledgling operations of Open Access publishers do not compare with the scale, complexity and efficiency of leading STM publishers. Open Access's pay-per-article model means that publishing costs are in part paid for by researchers and by the governments, universities and foundations that fund them. As article fees cover

3. New publishing models, including Open Access (continued)

less than 40% - 60% of today's industry costs per article (at levels of quality that researchers are used to) the remainder will have to be covered by subsidies from governments and funding agencies or investors and philanthropists.

The current state of Open Access

Open Access is in its infancy, representing less than 1% of published STM articles. Its journals typically offer only basic text and images with virtually no or limited search and cross-linking functionality. Unlike traditional STM publications that may be distributed via print and online, Open Access journals are typically distributed via the Internet only. This limits the availability of Open Access journals to those researchers in nations and institutions that have the required technological infrastructure. It also limits general availability: only 64% of UK adults have ever used the Internet^{xiii}

Implications of increasing numbers of Open Access journals

Open Access will continue to evolve in response to market forces, particularly as it seeks additional sources of operating revenue to make it financially viable. It will grow if it proves more effective and/or efficient in meeting the needs of the scientific community.

One consequence of the growth of Open Access in its current form is that publishing costs will be transferred from the consumers of research, particularly commercial organisations, to authors and those who fund them (e.g. governments, universities). A wide range of supporting evidence shows that costs exceed \$3,000 per article at existing quality levels (e.g. defined by acceptance levels of author submissions, peer review standards, distribution and electronic functionality). For example, the Open Society Institute suggests Open Access publishers will need to recoup \$3,750 per article published, consistent with John Cox Associates, who estimates per article costs to be \$3,500 - \$4,000 per article. By contrast, *Science* magazine estimates that it would have to charge \$10,000 per article in a pay-per-article model, a function of its high quality and concomitant high rejection rates. Similarly, the American Institute of Biological Sciences estimates that the journal *BioScience* would have to charge \$7,000 per article.^{xiv} Given the wide range of costs per article across journal types, we use the OSI guidelines of \$3,750 when

estimating the effects of moving to an Open Access model, whether for the UK alone, or globally. This figure is in line with Elsevier's estimated mean costs per article across the range of its some 1,800 journals.

If all global articles were published under today's Open Access model (i.e. where the highest author fees of \$1,500 per article cover just 40% - 60% of estimated publishing costs) then globally, government and non-profit organisations would have to provide significantly increased annual subsidies of £1 billion - £2 billion to make up the difference.

A second consequence is that because they charge on a per-article basis, Open Access publishers will penalise relatively prolific universities (like Cambridge University, Imperial College London, Yale University and the University of California) and nations like the UK, whose researchers produce a disproportionately high number of articles every year. While UK spending on journal subscriptions currently amounts to 3.3% of the world's total, UK researchers contribute a much higher 5% of all articles published globally. We estimate that UK researchers and their sponsors could together pay 30-50% more for STM journals in an Open Access system than they do today. For this reason, it is feasible that institutions funding authors (e.g. foundations, universities) could limit or discourage authors from publishing too frequently to contain their costs. Conversely, institutions might pressure journals to accept articles in the interests of self-promotion.

By contrast, commercial institutions that subscribe to many journals but contribute relatively few articles each year would pay substantially less. Our estimates suggest that some commercial corporations, who currently account for around 20% of annual global STM journal spending, would pay one tenth or less in an Open Access system than they pay under today's subscription model. The portion of publishing costs that these commercial institutions currently cover though their subscriptions would be transferred to authors and their sponsors in more prolific institutions.

While it is conceivable that mean costs per article may fall as electronic-only publishers gain scale, we estimate that the average cost to publish an article would have to fall by as much as 40% for British researchers and their sponsors to pay the same for STM journals in an Open Access system as British

3. New publishing models, including Open Access (continued)

libraries pay under today's subscription model. At these levels, publishers would likely have to reduce levels of quality control (the higher a journal's rejection rates, the higher its per article costs) and/or reduce levels of ongoing investment, for example in technological innovation and in nurturing new areas of science. For example, Elsevier alone has launched, on average, 31 new journals each year in emerging areas of scientific enquiry since 1988. It is also not clear how costs that are incurred *after* an article is published (e.g. to maintain archives and upgrade technology) would be funded in such situations.

A third factor is that if high quality journals are to remain in business long term without subsidies, they will likely have to raise their per-article fees substantially to cover their technology and editorial costs. If Open Access publishers are to improve the basic functionality of their current offerings (e.g. by adding search functionalities, linking and profiling), costs will again increase. Alternatively, Open Access publishers may abandon their no-subscription-fee approach and adopt hybrid models that incorporate a subscription component, as BioMedCentral has already done.

Fourth, the quality of research articles might well suffer as Open Access publishers compromise the rigour of their peer review processes by rejecting fewer articles so that they can publish more and increase revenues. Weaker articles, or articles that serve commercial interests, may therefore get published when previously they would have been rejected. By contrast, the current subscription system supports a highly independent peer review process in which publishers actively manage editorial boards. In an Open Access environment, there could be pressures from institutions to shape editorial direction as well as on the volume of submissions.

Finally, assuming that cited research continues to be the primary measurement of research institutions' quality, with quality the basis for funding allocation, it is unclear whether Open Access journals will affect the Research Assessment Exercise (REA). ISI, the industry standard that provides key data for the REA on the quality of research, currently measures only two out of some 500 Open Access journals because the rest are too new or too irregularly published to give valid data. Presumably this number will increase as Open Access

journals become established but at this point it is too early to assess what portion of Open Access journals will appear in ISI-rated journals even two years from now (the minimum time required before ISI will consider rating a journal). The greater the proportion that meet ISI's strict criteria to be rated, the less will be the impact on the REA.

The market dynamics of this global industry will determine whether the Open Access model can meet scientific research community needs as efficiently and effectively as other forms of publishing.

Elsevier, like all publishers, will continue to innovate, to observe the impact of innovations like Open Access and to assess how effectively such initiatives serve the needs of scientific and research communities. As developments prove themselves to bring demonstrable, substantial and sustainable improvements for those communities, Elsevier will adapt and invest accordingly.

4. Copyrights and access

Key point

- The Legal Deposit Libraries such as the British Library have established new and effective systems to make electronic scientific publications available. The laws governing the deposit of electronic material to the Legal Deposit Libraries have just been enacted in 2003, and implementation discussions with publishers are ongoing.

Legal Deposit Libraries

The Legal Deposit Libraries such as the British Library have made significant investments in making non-print scientific publications available for researchers, including via the British Public Library Catalogue (BPLC) and British National Bibliography (BNB) systems. The British Library's system (called ESTAR) provides on-site electronic access to the full text of over 2,000 major journals held by the British Library, mainly in the fields of science, technology and medicine.^{xv} In addition, the British Library provides electronic copies of scientific articles through its document delivery and inter-library loan services throughout the UK.

The laws governing the deposit of electronic material to the Legal Deposit Libraries have just been enacted in 2003 and implementation discussions with publishers are ongoing. In the Netherlands, Elsevier has set up an electronic archive at the Royal Library of the Netherlands, a library similar in function to the UK Legal Deposit Libraries, to provide back-up copies of all published journals in perpetuity.

Customer licence and copyright agreements

Elsevier's own *licence* policies allow faculty, students and staff at customer institutions to download and print materials accessed through their licence and to share copies with their research colleagues within their institutions. Members of the public who enter a library

on a walk-in basis and who are permitted by the library to use its resources are permitted on-site access to all Elsevier materials available through the library's licence.

Elsevier's *copyright* policies permit authors to use their own articles in a variety of ways: for teaching; in preparing revised and expanded new works (e.g. books); by making copies for their research colleagues; by posting the pre-print version of their articles widely, including on Web-based pre-print servers; and by posting the final version on their institutions' Intranets or other secure networks ("self-archiving").

5. Scientific integrity

Key points

- The rise of electronic publishing has increased the need to monitor quality stringently and to ensure attribution of authorship as more information is circulated with greater ease
- STM publishers have so far been the most effective in minimising the risks of scientific fraud and malpractice through their organisational and oversight roles in managing editorial offices, peer review and independent guardianship of the scientific record
- By introducing an author pays model, Open Access risks undermining public trust in the integrity of scientific publications that has been established over hundreds of years. The subscription model, in which the users (and institutions that serve them, like libraries) pay, ensures high quality, independent peer review. This critical control, which prevents commercial interests from influencing decisions to publish would be removed in a system where the author—or indeed his/her sponsoring institution—pays.

New challenges to the integrity of STM publishing

Though the current system of STM publishing has evolved in a competitive environment over hundreds of years to meet the needs of the global scientific community efficiently and effectively, today the rise of electronic publishing presents new opportunities and new threats. Along with many benefits, electronic publishing has also created new challenges for the science and medical community as more information can be circulated without the need of independent publishers. The “information explosion” and the free exchange of content have therefore increased the need to monitor quality and attribute authorship of research.

STM publishers have so far been effective in protecting the quality of research (e.g., via electronically enabled peer review systems). While peer review on its own cannot generally determine whether any given paper under consideration is “correct” or not, it does allow the manifestations of grossly unreliable interpretation, inadequate data or incorrect attribution of authorship to be filtered out. The need to corroborate and repeat research results that appear to be questionable is built into the scientific method. Such self-correction is more than adequate for the long-term identification of outright scientific fraud and operates independently from any particular business model. Under the current system, fraud and malpractice are rare, at levels low enough to be of minimal concern to the research community, as publishers bear the responsibility and costs of monitoring, investigating and resolving issues of plagiarism. In an author pays model, there is increased

risk that such disputes will not be resolved effectively given individual researchers’ lack of resources and legal expertise both to identify infringements and pursue transgressors.

Publishers, together with their journal editors, have been vigilant in identifying and taking action against issues such as multiple publication and plagiarism. While the number of such cases reported has risen recently, this seems to be more a function of the greater ease with which duplication and plagiarism can be identified in an electronic environment than of a decline in standards or lack of vigilance by guardians of the scientific record.

Threats to scientific integrity from new business models

The Open Access phenomenon within the context of electronic publishing is too new and encompasses too broad a range of publishing models for anyone to determine definitively whether scientific fraud and malpractice will increase or decrease relative to the current system that has evolved to minimise these risks.

New business models requiring authors to pay for publication could, in theory, threaten to reduce the quality of research articles if publishers were to lower their review standards to enable them to publish a greater proportion of the articles submitted. The introduction of an author pays model could threaten to undermine public trust in the integrity of science that has been established over hundreds of years by the

5. Scientific integrity (continued)

peer review system in which quality is the sole factor determining whether an article should be published.

There are also other possible risks to the integrity of science. The current subscription-based STM model covers the significant costs involved in managing the quality of published research (i.e. via editors, peer review coordination, copy-editing, communications, maintaining perpetual archives of the original article, and analysis pertaining to disputes and claims). Current Open Access business models raise serious doubts about the ability to cover the costs of these value-added services because today's highest author fees cover only an estimated 40% - 60% of publishing costs. Financial stability is an absolutely necessary condition for editorial independence, the cornerstone of excellence in science and trust in the scientific process. An STM journal that is losing money or lives on the margins of losing money will have little editorial independence: there will be extreme pressure to mould content and opinion to secure greater revenue. Subscription models have proven themselves to be guardians of editorial freedom and independence. This means leading, not following, medical and scientific opinion through the editorial voice of STM journals and shaping the global conversation of science and medicine, channelling it to what matters and where it matters most. Any substantial change to the publishing model that erodes this freedom would damage the hugely valuable oversight and evaluation functions that journals have contributed to science and society.

Endnotes

ⁱ Of 178 UK Higher Education Institutions (HEI) 152 include scientific and medical researchers (the remainder are typically intensively focused on the Arts, e.g., Edinburgh College of Art, Falmouth College of Arts). These 152 research-focused HEIs fall into three categories: first, 114 who subscribe to *ScienceDirect* under the NESLI agreement; second, 22 who subscribe to *ScienceDirect* but not under the terms of the NESLI agreement; and third, 16 do not subscribe to *ScienceDirect*, but do subscribe to Elsevier journals. Institutions subscribing to *ScienceDirect* cover 99% of UK researchers (97% in the first category, 2% in the second); The third category accounts for 1% of British science and medical researchers. The mean number of Elsevier journals subscribed to in each of these three categories (weighted by the number of researchers within each) is 1,583, 216 and 30 respectively. The number of journals that an institution subscribes to reflects the scope of its research focus (those with a narrow focus subscribe to fewer journals).

ⁱⁱ According to ISI, UK researchers publish about 60,000 articles annually; Globally, 1.2 million STM articles are published annually; UK spending on journals is £82 million; global costs are estimated to be \$3,750 x 1.2 million = \$4.5 billion. Uses exchange rate of £1 = \$1.822.

ⁱⁱⁱ According to ISI, UK researchers publish about 60,000 articles annually; publishing costs per article are assumed to be \$3,750, as suggested by the Open Society Institute's (OSI) *Guide to Business Planning for Launching an Open Access Journal* when identifying minimum revenues required per article. A second data point is from publishing industry consultants John Cox Associates who estimate mean costs per article currently to be between \$3,500 and \$4,000.

60,000 UK articles published at \$3,750 = \$225 million = £124 million at exchange rate of £1 = \$1.822. Alternatively, costs per article would have to be \$2,490 for 60,000 articles to cost £82 million (i.e., \$149 million at £1 = \$1.822). Ranges allow for approximately a 20% margin of error in these estimates.

By comparison, *Science* magazine estimates that it would have to charge \$10,000 per article in a pay-per-article model, a function of its high quality and concomitant high rejections rates. (See Alan Leshner, *Science* executive editor and AAAS head, quoted in *Science*, Vol. 302, #5645, 24 October 2003, p. 552.) Similarly, Richard O'Grady, executive director of the American Institute of Biological Sciences (AIBS) estimates that the journal *BioScience* would have to charge \$7,000 per article (see quotation in *Science*, Vol. 302, #5645, 24 October 2003, p. 553). Given the wide range of costs per article across journal types, we use the OSI guidelines of \$3,750 when estimating the effects of moving to an Open Access model, whether for the UK alone, or globally.

^{iv} Selected commercial corporations that are Elsevier customers who each have historically spent more than £1 million on annual subscription fees have also each authored less than 100 articles per year. At \$3,750 per article, these institutions would pay less than one tenth of their current subscription fees. At lower article fees, of course, they would pay even less.

^v Over the period July to September 2003 an estimated 11.9 million households in the UK could access the Internet from home, according to the Expenditure and Food Survey (EFS). That amounts to 48% of all UK households. According to

figures from the October 2003 National Statistics Omnibus Survey, an estimated 64% of adults in Great Britain have ever used the Internet.

^{vi} NESLI stands for National Electronic Site Licence Initiative.

^{vii} While there is no universally used number for the total number of learned journals, we use 16,000 journals, to reflect the convergence of two widely used estimates: first, Tenopir and King's estimate of 17,000, "Trends in scientific scholarly journal publishing in the U.S.," *Journal of Scholarly Publishing*, Vol. 28 #3, April 1997; and second, Mabe's ranged estimate of 14,000 – 16,000 in Mabe, "The growth and number of journals" in *Serials* Vol.16, no2. July 2003.

^{viii} Similarly, citing LISU data on journal prices paid by UK Higher Education Institutions from 1997 to 2001, The Wellcome Trust noted, "There has been a reduction in average price paid over recent years." *Economic Analysis of Scientific Research Publishing*, The Wellcome Trust, January 2003, paragraph 1.18, page 4. Note: LISU is the Library and Information Statistics Unit. Unit costs fell from €6.60 per download in 2001 to €2.44 in 2003. Currencies were converted at £1 = €1.446.

^{ix} *The Market for Scientific, Technical and Medical Journals*, A statement by the OFT, September 2002. OFT396, p.6.

^x See endnote ii.

^{xi} See endnote iii.

^{xii} See ARL Bimonthly Report 227, April 2003 "On the Transition of Journals to Open Access" by David Prosser, *SPARC Europe*. See also www.fcla.edu/FlaEnt/.

^{xiii} See endnote v.

^{xiv} See endnote iii.

^{xv} The independently funded "JSTOR" system used by the British Library provides access to digitised "back files" of more than 100 core scholarly journals in 16 fields. For each journal there is a fixed period of time, ranging in most cases from two to five years, that defines the gap between the most recently published issue and the date of the most recent issues available in JSTOR.