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Economic Implications of Alternative Publishing Models: Self-archiving and Repositories

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Abstract

A knowledge economy has been defined as one in which the generation and exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; it is also about the more effective use and exploitation of all types of knowledge in all manner of economic activities. One key question is whether there are new opportunities and new models for scholarly publishing that might better serve researchers and more effectively communicate and disseminate research findings.

Building on previous work, this paper looks at the costs and potential benefits of alternative models for scientific and scholarly publishing, describing the approach and methods used and summarising the findings of a study undertaken for JISC in the United Kingdom. It concludes that different publishing models can make a material difference to the costs faced by and benefits realised from research communication, and it seems likely that more open access would have substantial net benefits.

Key Words: Scientific and scholarly communication; economics of publishing; open access; OAI6

Introduction

A knowledge economy has been defined as one in which the generation and exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; it is also about the more effective use and exploitation of all types of

knowledge in all manner of economic activities (Department of Trade and Industry, 1998). Scholarly publishing plays a key role as it is central to the efficiency of research and to the dissemination of research findings and diffusion of scientific and technical knowledge. But advances in information and communication technologies are disrupting traditional publishing models, radically changing our capacity to reproduce, distribute, control and publish information. One key question is whether there are new opportunities and new models for scholarly publishing that might better serve researchers and more effectively communicate and disseminate research findings (OECD, 2005, p. 14).

Building on previous work, this paper looks at the costs and potential benefits of alternative models for scientific and scholarly publishing. The work began in Australia in 2006 with a study of *Research Communication Costs, Emerging Opportunities and Benefits* (Houghton *et al.*, 2006). This was followed by a study of the *Economic Implications of Alternative Scholarly Publishing Models* for the Joint Information Systems Committee (JISC) in the UK (Houghton and Oppenheim *et al.*, 2009). This paper summarises the findings of the latter.

Approach and Methodology

The JISC study focused on three alternative models for scholarly publishing, namely: subscription publishing, open access publishing and self-archiving.

- *Subscription publishing* refers primarily to academic journal publishing and includes individual subscriptions and the so-called Big Deal (i.e., where institutional subscribers pay for access to online aggregations of journal titles through consortial or site licensing arrangements). In a wider sense, however, subscription publishing includes any publishing business model that imposes reader access tolls and restrictions on use designed to maintain publisher control over that access in order to enable the collection of those tolls.
- *Open access publishing* refers primarily to journal publishing where access is free of charge to readers, and the authors, their employing or funding organisations pay for publication; or the publication is supported by other sponsors making publication free for both readers and authors. Use restrictions can be minimal as no access toll is imposed.

- *Open access self-archiving* refers to the situation where authors deposit their work in online open access institutional or subject-based repositories, making it freely available to anyone with internet access. Again, use restrictions can be minimal as no access toll is imposed.

As self-archiving, of itself, does not constitute formal publication, our analysis focuses on two publishing models in which self-archiving is supplemented by the peer review and production activities necessary for formal publishing, namely: (i) 'Green OA' self-archiving operating in parallel with subscription publishing; and (ii) the 'deconstructed' or 'overlay journals' model (Smith, 1999; 2005), in which self-archiving provides the foundation for overlay journals and services (e.g., peer review, branding and quality control services). Hence, each of the publishing models explored includes all of the key functions of scholarly publishing, including peer review and quality control.

Phase I: Identifying Costs and Benefits

The first phase of the JISC study sought to *identify* all the dimensions of cost and benefit associated with each of the models, and examine which of the main players in the scholarly communication system would be affected and how they would be affected by the adoption of alternative publishing models. In order to provide a solid foundation for analysis we developed and extended the scholarly communication life-cycle model first outlined by Bo-Christer Björk (2007).

Björk (2007) developed a formal model of the scholarly communication life-cycle, based on the IDEF0 process modelling method often used in business process re-engineering, to provide a detailed map of the scholarly publishing process. Björk's central focus was the single publication (primarily the journal article), how it is written, edited, printed, distributed, archived, retrieved and read, and how eventually its reading may affect practice. Björk's model included the activities of researchers who perform the research and write the publications, publishers who manage and carry out the actual publication process, academics who participate in the process as editors and reviewers, libraries who help in archiving and providing access to the publications, bibliographic services who facilitate the identification and retrieval of publications, readers who search for, retrieve and read publications, and practitioners who implement the research results directly or indirectly.

Extending the model outlined by Björk (2007), the scholarly communication process model developed for the JISC study included five core scholarly communication process activities, namely:

(i) fund research and research communication;
(ii) perform research and communicate the results;
(iii) publish scientific and scholarly works;
(iv) facilitate dissemination, retrieval and preservation; and
(v) study publications and apply the knowledge (Figure 1).

Each of these is further subdivided into a detailed description of the activities, inputs, outputs, controls and supporting mechanisms involved. This formal process modelling was used to identify activities and provide the foundation for activity costing.[1]

Phase II: Quantifying Costs and Benefits

The second phase of the JISC study sought to *quantify* the costs and benefits, identify and where possible quantify the cost and benefit implications for each of the main players in the scholarly communication system and, as far as possible, compare the costs and benefits of the three models.

There are three elements to our approach to quantifying costs and benefits.

- First, we explored the costs of individual process activities and then summed them to estimate system-wide costs. From this we can see cost differences and direct cost savings.
- Second, we presented cases and scenarios to explore the potential cost savings resulting from alternative publishing models (e.g., looking at impacts on search and discovery, library handling costs, etc.). From this we can explore indirect cost differences and savings.
- Third, we approached the issue from the top down and modelled the impact of changes in accessibility and efficiency on returns to R&D using a Solow-Swan model, into which we introduce *accessibility* and *efficiency* as negative or friction variables to reflect the fact that there are limits and barriers to access and to the efficiency of production and usefulness of knowledge (Houghton and Sheehan, 2006; 2009).

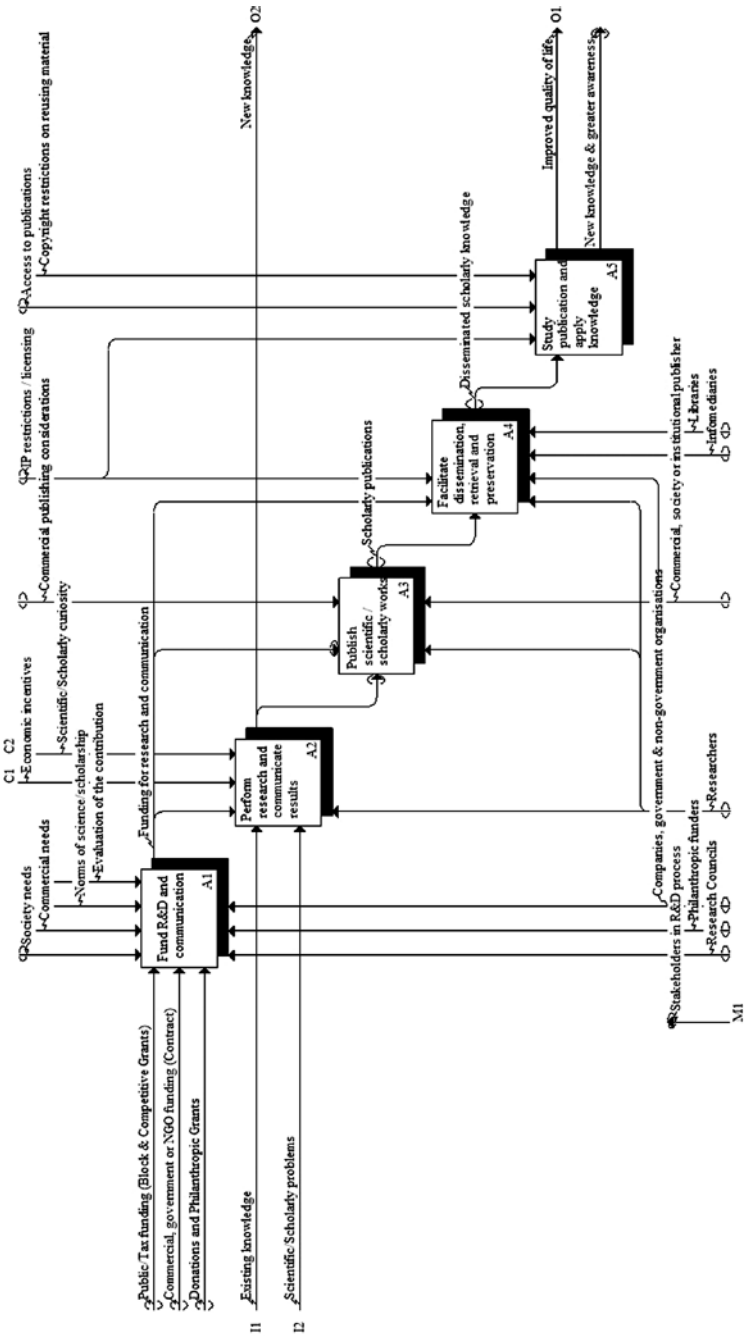


Fig. 1: The scholarly communication process.

Source: JISC EI-ASPM Project (http://www.cfses.com/EI-ASPM/SCLCM-V7/).

A full description of the modelling approach and details of its operationalisation can be found in the JISC Project Report (Houghton and Oppenheim, *et al*., 2009).

Summary of Findings

Drawing on a wide range of data sources, activity surveys and tracking studies, we estimate costs for activities throughout the scholarly communication process at the national level and for higher education in the UK (For details see Houghton and Oppenheim *et al*., 2009).

Publisher Costs Per Journal Article

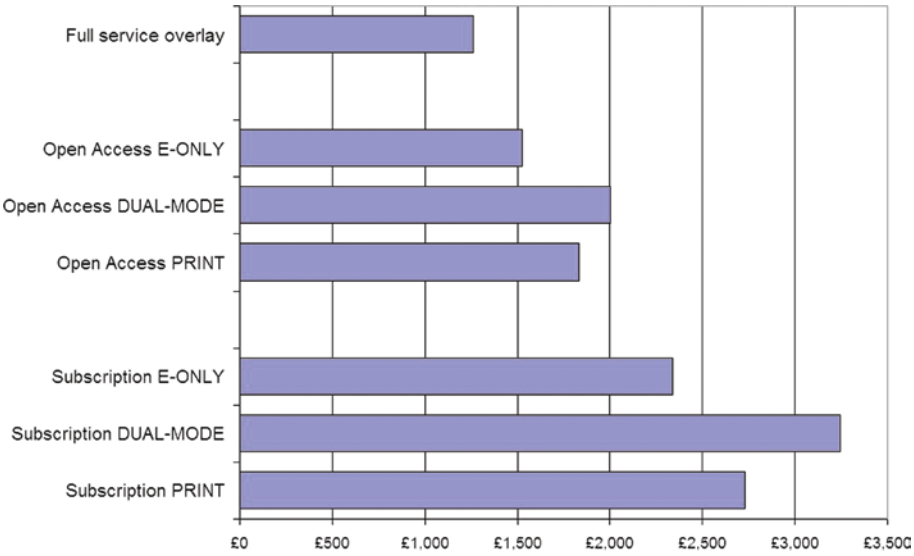
One key challenge is to separate the cost impacts of publishing models from those of publishing format, so we can explore the cost differences between subscription and open access publishing models independent of differences between print and electronic production. Our approach was to estimate costs for print, dual-mode (i.e., parallel print and electronic) and electronic-only formats for subscription and open access business models, and then compare subscription and open access models as if they were all electronic or 'e-only'. All of the costings include commercial publisher margins.

For *subscription publishing*, we estimate an average publisher cost of around GBP 3,250 per article for dual-mode production, GBP 2,730 per article for print only production and GBP 2,335 per article for e-only production (excluding the costs associated with external peer review and value-added tax) (Figure 2).[2]

For *open access publishing*, we estimate average per article costs at GBP 1,525 for e-only production. Excluding the costs of copy printing and delivery, we estimate the cost of dual-mode open access publishing at around GBP 2,000 per article and print only open access publishing at GBP 1,830 per article.[3]

We include the implied publisher costs of *overlay services to open access self-archiving* (i.e., the overlay services model), with the same commercial management, investment and profit margins applied. This suggests that operating peer review management, editing, production and proofing as an overlay service would cost around GBP 1,125 per article excluding hosting, or GBP 1,260 including hosting.

Fig. 2: Estimated average publisher costs per article by format and model (GBP, circa 2007).



Note: These costs exclude the external costs of peer review and VAT. Overlay services include operating peer review management, editing, proofing and hosting, with commercial margins. Estimates for print and dual-mode open access publishing exclude copy print and delivery related costs, assuming that the content is produced print ready and print is an add-on.
Source: JISC EI-ASPM model: author's analysis.

The Impact of Alternative Scholarly Publishing Models

Summing the costs of production, publishing and dissemination *per article* in electronic-only format suggests that average subscription publishing system costs would amount to around GBP 8,295 per article (excluding VAT), average open access publishing costs would amount to GBP 7,485 per article and average open access self-archiving costs GBP 7,115 per article (including overlay review and production services with commercial margins). At these costs, open access publishing would be around GBP 815 per article cheaper than subscription publishing, and open access self-archiving with overlay services around GBP 1,180 per article cheaper (Figure 3).

For higher education, these journal article cost differences would have amounted to direct savings of around GBP 80 million per annum circa 2007

Fig. 3: Scholarly communication system costs per article (GBP, circa 2007).

Note: Includes the direct costs of writing, peer review, publishing and disseminating in e-only format, and excludes VAT. Self-archiving includes publisher production and review costs, including commercial margins (i.e., overlay services).
Source: JISC EI-ASPM model: author's analysis.

from a shift from subscription to open access publishing, and GBP 116 million from a shift to open access self-archiving with overlay services.

In addition to direct cost differences there are potential system cost savings. In a highly simplified form, the following figures summarise the estimated impacts for the UK nationally and for UK higher education of unilateral national and worldwide adoption of alternative open access journal/article publishing models, including: (i) 'Green OA' self-archiving in parallel with subscription publishing; (ii) 'Gold OA' or author-pays journal publishing; and (iii) the 'deconstructed' or 'overlay journals' model of self-archiving with overlay services. Reported increased returns arising from enhanced access are from public sector and higher education R&D spending expressed as annual increases in current values.[4]

As many of the potential cost savings cannot be fully realised unless there is worldwide adoption of open access, in the unilateral national open access

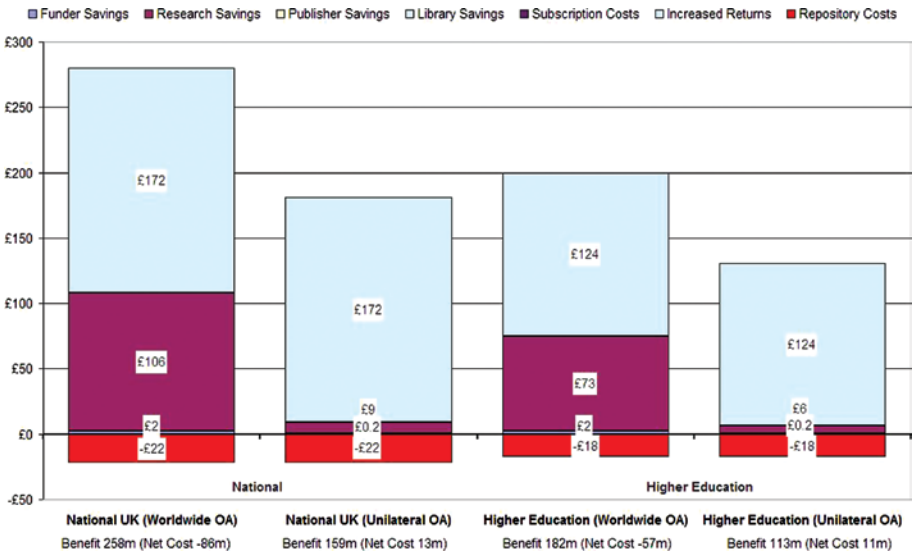
scenarios funder, research, library handling and subscription cost savings are scaled to the UK's article output (i.e., are in proportion to the share of worldwide journal literature that would be open access as a result of the unilateral adoption of alternative open access models by the UK). In the 'Green OA' model self-archiving operates in parallel with subscription publishing, so there are no publisher, library handling or subscription cost savings. As increased returns to R&D are diffuse and occur throughout the economy they cannot be considered a part of the internal scholarly communication system cost-benefits, so we separate modelled increases in returns to R&D resulting from enhanced access from the cost impacts and present the net scholarly publishing system cost impacts of the alternative publishing models. Where net cost is negative it represents a saving, and where positive it represents a cost (i.e., effectively, the investment required to obtain the increased returns and realise the benefits).

We estimate that *open access publishing* for journal articles using the 'author-pays' model might bring system savings of around GBP 500 million per annum nationally in the UK in a worldwide open access system (at 2007 prices and levels of publishing activity), of which around GBP 430 million would accrue in higher education. *Open access self-archiving without subscription cancellations* (i.e., 'Green OA') might save around GBP 108 million per annum nationally in a worldwide Green OA system, of which around GBP 75 million would accrue in higher education. The *open access self-archiving with overlay services* model explored is necessarily speculative, but might produce similar savings to open access publishing using the 'author-pays' model.

These savings can be set against the cost of open access publishing, which if all journal articles produced encountered author fees of GBP 1,500 would have been around GBP 170 million nationally in 2007, of which GBP 150 million would have been faced by the universities. Similarly, with estimated repository costs at around GBP 22 million nationally and GBP 18 million for the universities, the potential net benefits from 'Green OA' self-archiving or from self-archiving with overlay production and review services would be substantial.

Figure 4 summarises the potential cost impacts of 'Green OA' self-archiving in parallel with subscription publishing circa 2007. Indicatively, it suggests that in an all open access world, 'Green OA' to all journal articles produced in the UK during 2007 might have generated an approximate net benefit of around GBP 258 million (per annum), including a net cost saving of around

Fig. 4: Estimated impact of 'Green OA' self-archiving (GBP millions per annum, circa 2007).



Source: JISC EI-ASPM model: author's analysis.

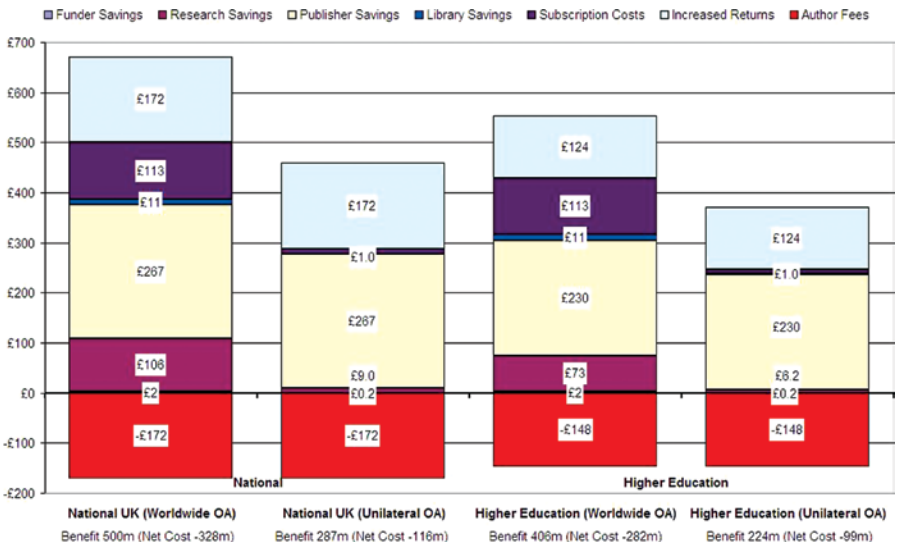
GBP 86 million. Whereas the unilateral national adoption of 'Green OA' in the UK may have generated little more than half the net benefit while incurring a net cost of around GBP 13 million (i.e., effectively the investment required to realise the benefit).

Figure 5 summarises the potential cost impacts of 'Gold OA' publishing through the author-pays model, and Figure 6 the cost impacts of self-archiving with overlay production and review services (i.e., the deconstructed or overlay journals model). Each includes indicative net benefit and net cost implications.

Comparing Costs and Benefits

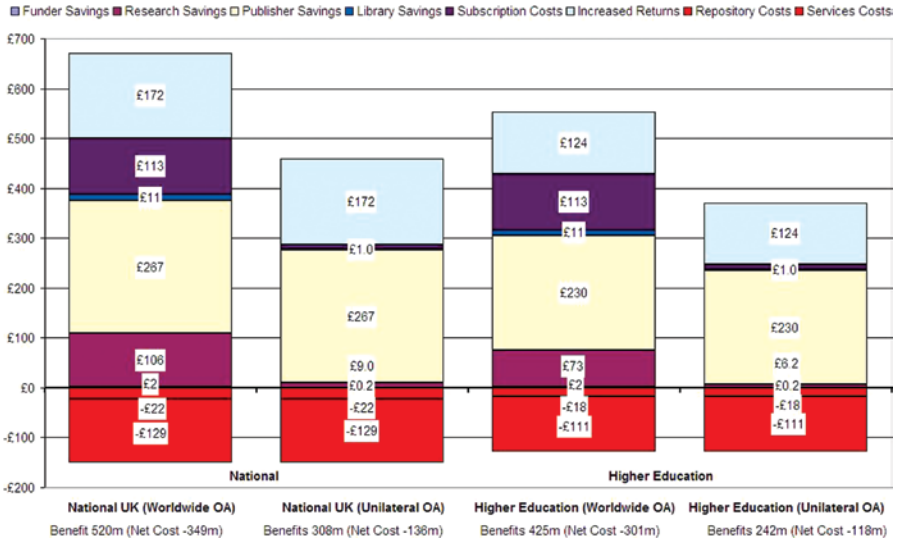
Modelling the impacts of an increase in *accessibility* and *efficiency* resulting from more open access on returns to R&D over a 20-year period and then comparing costs and benefits, we find that the benefits of open access publishing models are likely to substantially outweigh the costs.

Fig. 5: Estimated impact of 'Gold OA' publishing (GBP millions per annum, circa 2007).



Source: JISC EI-ASPM model: author's analysis.

Fig. 6: Estimated impact of OA self-archiving with overlay production and peer review services (GBP millions per annum, circa 2007).



Source: JISC EI-ASPM model: author's analysis.

First, we explored the cost-benefit implications of simply adding open access publishing and self-archiving to current activities, all other things remaining the same (i.e., *ceteris paribus* scenarios). Then we explored the implications of open access publishing and self-archiving as alternatives to current activities, by adding the estimated system savings to the estimated increases in returns (i.e., net cost scenarios).[5]

These cost-benefit comparisons suggest that the additional returns to R&D resulting from enhanced accessibility and efficiency alone would be sufficient to cover the costs of parallel open access self-archiving without subscription cancellations (i.e., 'Green OA'). When estimated savings are added to generate net costs there is a substantial increase in the benefit/cost ratios, and for both open access publishing and self-archiving alternatives (i.e., 'Gold OA' and 'Green OA') the benefits exceed the costs, even in a transitional period. Indicative modelling of post-transition 'steady-state' alternative systems suggests that, once established, alternative open access publishing and/or self-archiving systems would produce substantially greater net benefits.

For example, during a transitional period we estimate that, in an open access world:

- The combined cost savings and benefits from increased returns to R&D resulting from open access publishing all journal articles produced in the UK's universities using an 'author-pays' system would be around 3 times the costs;
- The combined cost savings and benefits from open access self-archiving in parallel with subscription publishing (i.e., 'Green OA') would be around seven times the costs; and
- The combined cost savings and benefits from an alternative open access self-archiving system with overlay production and review services (i.e., 'overlay journals') would be around four times the costs (Table 1).

Indicative modelling of post-transition 'steady-state' alternative systems returns benefits of around seven to eight times costs for open access publishing and self-archiving with overlay services, and fourty times the costs for the 'Green OA' self-archiving.

Table 1: Summary of benefit/cost comparisons by scenario and model (GBP millions and benefit/cost ratio)

Scenario	Costs	Benefits		Benefit/Cost Ratio
		Savings	Returns	
Ceteris Paribus Scenarios				
Transitional Model:				
OA Publishing in HE (unrealistic)	1,787	..	615	0.3
OA Publishing Nationally (unrealistic)	2,079	..	850	0.4
OA Self-archiving in HE	189	..	615	3.2
OA Self-archiving Nationally	237	..	850	3.6
Simulated Steady State Model:				
OA Publishing in HE (unrealistic)	1,787	..	6,976	3.8
OA Publishing Nationally (unrealistic)	2,079	..	9,505	4.6
OA Self-archiving in HE	189	..	6,876	36.3
OA Self-archiving Nationally	237	..	9,505	40.0
Net Cost Scenarios				
Scenario (UK Unilateral OA)				
Transitional Model:				
OA Publishing in HE	1,787	2,990	615	2.0
OA Self-archiving in HE (Green OA)	189	67	615	3.6
OA Self-archiving in HE (Overlay Services)	1,588	2,990	615	2.3
OA Publishing Nationally	2,079	3,479	850	2.1
OA Self-archiving Nationally (Green OA)	237	96	850	4.0
OA Self-archiving Nationally (Overlay Services)	1,580	3,000	850	2.4
Simulated Steady State Model:				
OA Publishing in HE	1,787	2,990	6,876	5.5
OA Self-archiving in HE (Green OA)	189	67	6,876	36.7
OA Self-archiving in HE (Overlay Services)	1,588	2,990	6,876	6.3
OA Publishing Nationally	2,079	3,479	9,505	6.2
OA Self-archiving Nationally (Green OA)	237	96	9,505	40.4
OA Self-archiving Nationally (Overlay Services)	1,580	3,000	9,505	7.9

Table 1. (Continued)

Scenario	Costs	Benefits		Benefit/Cost Ratio
		Savings	Returns	
Scenario (Worldwide OA)				
Transitional Model:				
OA Publishing in HE	1,787	5,198	615	3.3
OA Self-archiving in HE (Green OA)	189	786	615	7.4
OA Self-archiving in HE (Overlay Services)	1,588	5,198	615	3.7
OA Publishing Nationally	2,079	6,054	850	3.3
OA Self-archiving Nationally (Green OA)	237	1,132	850	8.3
OA Self-archiving Nationally (Overlay Services)	1,580	5,224	850	3.8
Simulated Steady State Model:				
OA Publishing in HE	1,787	5,198	6,876	6.8
OA Self-archiving in HE (Green OA)	189	786	6,876	40.5
OA Self-archiving in HE (Overlay Services)	1,588	5,198	6,876	7.8
OA Publishing Nationally	2,079	6,504	9,505	7.5
OA Self-archiving Nationally (Green OA)	237	1,132	9,505	44.8
OA Self-archiving Nationally (Overlay Services)	1,580	5,224	9,505	9.3

Note: Compares open access alternatives against subscription access, with costs, savings and benefits expressed in Net Present Value over 20 years (GBP millions). Increased returns to R&D relate to higher education R&D expenditure (HERD) and national public expenditure on R&D (PUBRD). Source: JISC EI-ASPM model: author's analysis.

Summary and Conclusions

The analysis summarised in this paper compares three scholarly publishing models as if they were alternatives. In reality, of course, there are a number of variations and hybrids (e.g., delayed open access, open choice/author choice, etc.) and the models co-exist in various mixes in different fields of research. Nevertheless, these three models do have some key defining characteristics, and these characteristics have cost implications for producers, intermediaries and the users and consumers of content. They also have implications for the efficiency of research, the accessibility of research findings and its impacts, and, thereby, for returns to investment in R&D.

Preliminary analysis of the potential benefits of more open access to research findings suggests that different publishing models can make a material difference to the benefits realised, as well as the costs faced. It seems likely that more open access would have substantial net benefits in the longer term and, while net benefits may be lower during a transitional period they are likely to be positive for both open access publishing and self-archiving alternatives (i.e., Gold OA) and for parallel subscription publishing and self-archiving (i.e., Green OA). Both of the self-archiving and repositories models (i.e., Green OA and Overlay Journals) appear to be more cost-effective than 'author-pays' publishing.

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References

Arundel, A. and A. Geuna (2004): 'Proximity and the use of public science by innovative European firms,' *Economics of Innovation and New Technology* 3(6), pp. 559–580.

Bailey, C.W. (2006): 'What is Open Access?' in Jacobs, N., ed. (2006): *Open Access: Key strategic, technical and economic aspects*, Chandos Publishing, Oxford.

Bailey, C.W. *et al.* (2006): *Institutional Repositories*, SPEC Kit 292, ARL, Washington DC.

Björk, B-C. (2007): 'A model of scientific communication as a global distributed information system,' *Information Research* 12(2), paper 307.

Björk, B-C., A. Roos and M. Lauri (2008): 'Global annual volume of peer reviewed scholarly articles and the share available via different Open Access options,' *Proceedings of ELPUB* 2008, Toronto, June.

CEPA (2008): *Activities, costs and funding flows in the scholarly communications system in the UK*, Report commissioned by the Research Information Network (RIN), May.

Department of Trade and Industry (1998): *Building the Knowledge Driven Economy: Competitiveness White Paper*, London: Department of Trade and Industry.

EPS, *et al.* (2006): *UK scholarly journals: 2006 baseline report — An evidence-based analysis of data concerning scholarly journal publishing*, Research Information Network, Research Councils UK and Department of Trade and Industry.

European Commission (2006): *Study on the economic and technical evolution of the scientific publication markets in Europe*, European Commission, Brussels.

Friedlander, A. and R.S. Bessette (2003): *The Implications of Information Technology for Scientific Journal Publishing: A Literature Review*, National Science Foundation Special Report, NSF, Washington DC.

Halliday, L. and C. Oppenheim (1999): *Economic Models of the Digital Library*, eLib, United Kingdom Office of Library and Information Networking.

Houghton, J.W. (2005): 'Economics of Publishing and the Future of Scholarly Communication' in Gorman, G.E. and F. Rowland, (eds.) (2005): *International Year Book of Library and Information Management 2004–2005: Scholarly Publishing in an Electronic Era*, Facet Publishing, London; etc.

Houghton, J.W. and P.J. Sheehan (2006): The Economic Impact of Enhanced Access to Research Findings, CSES Working Paper No. 23, Melbourne: Victoria University, http://www.cfses.com/documents/wp23.pdf

Houghton, J.W. and P.J. Sheehan (2009): 'Estimating the Potential Impacts of Open Access to Research Findings,' *Economic Analysis and Policy* 39(1), March, http://www.eap-journal.com/.

Houghton, J.W., C. Steele and P.J. Sheehan (2006): *Research Communication Costs in Australia, Emerging Opportunities and Benefits*, Department of Education, Science and Training, Canberra.

Houghton, J.W., B. Rasmussen, P.J. Sheehan, C. Oppenheim, A. Morris, C. Creaser, H. Greenwood, M. Summers and A. Gourlay (2009): *Economic Implications of Alternative Scholarly Publishing Models: Exploring the Costs and Benefits*, London & Bristol: The Joint Information Systems Committee (JISC), http://www.cfses.com/EI-ASPM/.

Kaufman-Wills (2005): *The facts about Open Access: A study of the financial and non-financial effect of alternative business models for scholarly journals*, ALPSP Special Report.

King, D.W. (2007): 'The cost of journal publishing: a literature review and commentary,' *Learned Publishing* 20(2), April, pp. 85–106.

King, D.W., S. Aerni, F. Brody, M. Herbison and P. Kohberger (2004): *Comparative cost of the University of Pittsburgh electronic and print library collections,* University of Pittsburgh, May.

King, D.W., C. Tenopir and M. Clarke (2006): 'Measuring total reading of journal articles,' *D-Lib Magazine* 12(10), October 2006.

Mansfield, E. (1991): 'Academic research and industrial innovation,' *Research Policy* 20(1), 1991, pp. 1–12.

Mansfield, E. (1998): 'Academic research and industrial innovation: an update of empirical findings,' *Research Policy* 26, 1998, pp. 773–776.

OECD (2005): *Digital Broadband Content: Scientific Publishing*, OECD, Paris.

Prosser, D.C. (2005): *The Next Information Revolution — How Open Access will Transform Scholarly Communications*, in Gorman, G.E. and F. Rowland, eds. (2005): *International Yearbook of Library and Information Management 2004–2005: Scholarly Publishing in an Electronic Era*, Facet Publishing, London, pp. 99–117.

Rowlands, I. and D. Nicholas (2005): *New Journal Publishing Models: An international survey of senior researchers*, CIBER report.

Schonfeld, R.C., D.W. King, A. Okerson and G.E. Fenton (2004): *The non-subscription side of periodicals: changes in library operations and costs between print and electronic journals*, Council on Library and Information Resources, Washington DC.

Smith, J.W.T. (1999): 'The Deconstructed Journal, a new model for Academic Publishing,' *Learned Publishing* 12(2), pp. 79–91.

Smith, J.W.T. (2005): Open Access Publishing Models: Reinventing Journal Publishing, *Research Information*, May–June.

Swan, A. (2008): 'The business of digital repositories,' in Weenink, K., L. Waaijers and K. van Godtsenhoven (eds.): *A DRIVER's Guide to European Repositories*, Amsterdam University Press.

Tenopir, C. and D.W. King (2000): *Towards electronic journals: realities for scientists, librarians and publishers*, SLA Publishing, Washington DC, and elsewhere.

Tenopir, C. and D.W. King (2002): 'Reading behavior and electronic journals,' *Learned Publishing* 15(4), pp. 259–265.

Tenopir, C. and D.W. King (2007): 'Perceptions of value and value beyond perceptions: measuring the quality and value of journal article readings,' *Serials* 20(3), pp. 199–207.

Tenopir, C., D.W. King, S. Edwards and L. Wu (2009): 'Use of Scholarly Journals and Articles by University Faculty: Changes in Information Seeking and Reading Patterns over Nearly Three Decades' Aslib Proceedings: New Information Perspectives, 2009, http://cissl.scils.rutgers.edu/~tefko/Courses/e553/Readings/Tenopir%20electr%20journals%20Aslib%20Proc%202009.pdf

Universities UK (2007): *Publishing research results: the challenges of open access*, Policy Briefing, Universities UK, London, April.

Van de Sompel, H. *et al.* (2004): 'Rethinking Scholarly Communication: Building the system that scholars deserve,' *D-Lib Magazine* 10(9) September.

Waltham, M. (2005): *JISC: Learned Society Open Access Business Models*, JISC, June.

Waltham, M. (2006): 'Learned society business models and open access: overview of a recent JISC funded study', *Learned Publishing* 19(1), January, pp. 15–30.

Weenink, K., L. Waaijers and K. van Godtsenhoven (2008): *A DRIVER's Guide to European Repositories*, Amsterdam University Press.

Notes

[1] Details of the entire model in 'browseable' form can be found on the Web at http://www.cfses.com/EI-ASPM/SCLCM-V7/.

[2] These publisher costs are derived from those reported in the literature and are inflated where necessary and converted to pounds at 2007 annual average exchange rates.

[3] It is impossible to estimate the cost of printing and delivery in open access publishing as it depends on the number of copies involved, and in the absence of subscriber counts that number cannot be known. Therefore, estimates for print and dual-mode open access publishing exclude actual copy print and delivery related costs, assuming that the content is produced print ready and print is an add-on.

[4] Increased returns are recurring gains from one year's R&D expenditure. Such returns can be expressed in Net Present Value (NPV), lagged and recurring over the useful life of the knowledge. For the sake of simplicity and transparency in these figures we have simply taken the original value of annual returns as indicative. In the cost-benefit comparisons below, returns are presented in Net Present Value and lagged.

[5] Of course, the scenario adding open access publishing to current activities is 'unrealistic', as parallel publishing all articles in open access and subscription journals simultaneously would not be possible given the copyright demands of subscription publishing.