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Economic implications of alternative scholarly publishing models:

Exploring the costs and benefits

JISC EI-ASPM Project

**A report to the Joint Information Systems Committee
(JISC)**

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This is a summary of the full report, and section numbers mention herein refer to those in the full report, which is available here from 27th January 2009:

<http://ie-repository.jisc.ac.uk/278/>

Summary

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” (DTI 1998). In a knowledge economy, innovation and the capacity of the system to create and disseminate the latest scientific and technical information are important determinants of prosperity (David and Foray 1995; OECD 1997).

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 models of scholarly publishing, radically changing our capacity to reproduce, distribute, control, and publish information. ***The key question is whether there are new opportunities and new models for scholarly publishing that would better serve researchers and better communicate and disseminate research findings*** (OECD 2005, p14).

Aims and approach

Debate on the economics of scholarly publishing and alternative publishing models has focused almost entirely on costs. And yet, from an economic perspective, the aim is to have the most cost-effective system, not (necessarily) the cheapest, and however much one studies costs one cannot know which is the most cost-effective system until one examines both costs and benefits. Hence, ***the aim of this project was to examine the costs and benefits of three alternative models for scholarly publishing (i.e. subscription publishing, open access publishing and self-archiving)***. In so doing, it seeks to inform policy discussion and help stakeholders understand the institutional, budgetary and wider economic implications.

The project involved two major phases:

- *Phase I: Identification of costs and benefits* – sought to describe the three models of scholarly publishing, identify all the dimensions of cost and benefit for 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; and
- *Phase II: Quantification of costs and benefits* – sought, where possible, to quantify the costs and benefits identified; identify and where possible quantify the cost and benefit implications for each of the main players in the scholarly communication system; and, where possible, compare the costs and benefits of the three models.

While wide-ranging in scope, an important focus for the work was the implications of the three publishing models for UK higher education and for scholarly journal and book publishing – although other forms of publication and other stakeholders are included in the analysis.

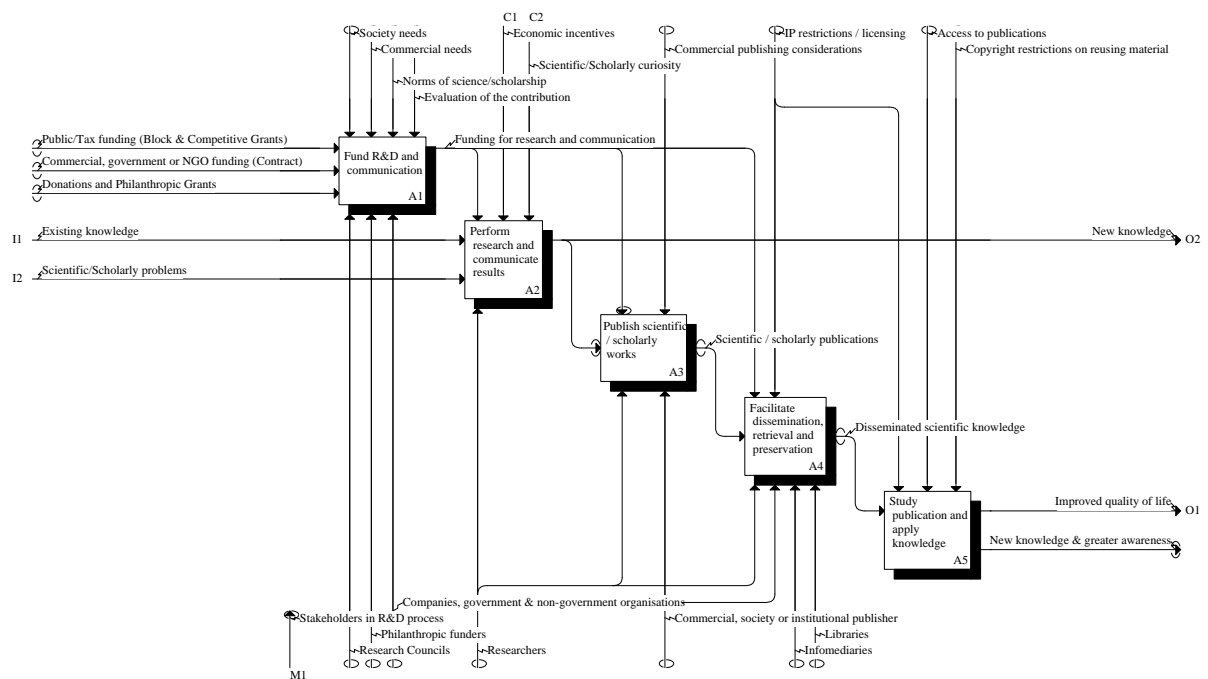
The scholarly communication process

In order to provide a solid foundation for analysis we have developed and extended the scholarly communication life-cycle model outlined by Björk (2007).

The scholarly communication process involves conducting research, communicating and applying the results, and in the model developed for this study there are five core activities:

- (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 S-I).

Figure S-I: Do research, communicate and apply results



Link: <http://www.cfses.com/EI-ASPM/SCLCM-V7/>

Source: Scholarly Communication Process Model: Authors' analysis.

This extended scholarly communication process model provides a foundation for a detailed identification of the actors, activities, objects and functions involved in the entire scholarly communication process. The model is based on that of Bo-Christer Björk (2007) and has

benefited from his very generous assistance in its development. In its current form, the model includes more than 50 diagrams and almost 200 activities (Version 7.0).¹

Scholarly communication system costs

Drawing on a wide range of data sources, activity surveys and tracking studies, as well as industry consultation, we estimated costs for activities throughout the scholarly communication process at the national level and for UK Higher Education. We found that these costs are substantial (Table S-I).

The reading of scholarly publications by UK-based researchers and academic staff is a major activity, perhaps costing around £7.7 billion annually, and reading by those actively publishing (*i.e.* approximating reading in order to write) cost around £2.8 billion during 2007.² We estimate that writing peer reviewed scholarly publications may have cost around £1.6 billion, and preparing and reviewing research grant applications for the UK Research Councils (RCUK), Wellcome and Leverhulme Trusts alone may have cost around £140 million.

Table S-I: Estimated annual UK national scholarly communication activity costs (GBP, circa 2007)

<i>UK National</i>	<i>Estimate</i>
Reading (Published Staff)	2,775,000,000
Reading (Research Staff)	7,729,200,000
Writing (ISI Web of Knowledge based estimate of UK published output)	1,599,700,000
Peer Review (Scaled to output counts)	202,800,000
Editorial Activities (Scaled to published staff)	63,600,000
Editorial Board activities (Scaled to published staff)	7,000,000
Preparing Grant Applications (RCUK, Wellcome & Leverhulme)	117,500,000
Reviewing Grant Applications (RCUK, Wellcome & Leverhulme)	18,600,000
Publisher Costs (Scaled to output counts)	573,900,000
Total National System	5,358,200,000

Source: EI-ASPM model: Authors' analysis.

The peer review of scholarly journal articles and books conducted by UK researchers on behalf of publishers (*i.e.* external peer review activities) probably cost around £200 million during 2007, and the external journal editorial and editorial board activities of researchers around £70 million. We estimate that publisher costs relating to UK-authored publications probably amounted to around £575 million (excluding the external costs noted above). Summing these costs suggests that ***core scholarly publishing system activities may have cost around £5.4 billion in the UK during 2007.***

¹ The entire model in 'browseable' form can be found at: <http://www.cfes.com/EI-ASPM/SCLCM-V7/>

² All costs are expressed in 2007 UK pounds and, where necessary, have been converted to pounds using OECD published annual average exchange rates and adjusted to 2007 using the UK consumer price index published by the National Statistical Office. Publisher costs include commercial margins.

Table S-II summarises these same scholarly communication activity costs for UK higher education (HE). It shows that academic staff reading probably cost around £5 billion during 2007, and reading by those actively publishing around £2.5 billion. We estimate that writing peer reviewed scholarly publications in UK higher education cost around £1.5 billion, and preparing and reviewing research grant applications for the Research Councils (RCUK), Wellcome and Leverhulme Trusts alone may have cost around £130 million.

Table S-II: Estimated annual UK higher education scholarly communication activity costs (GBP, circa 2007)

<i>UK Higher Education</i>	<i>Estimate</i>
Reading (Published Staff)	2,446,000,000
Reading (Academic Staff)	5,097,500,000
Writing (ISI Web of Knowledge based estimate of HE output)	1,453,900,000
Peer Review (Scaled to output counts)	178,600,000
Editorial Activities (Scaled to published staff)	54,900,000
Editorial Board Activities (Scaled to published staff)	6,100,000
Preparing Grant Applications (RCUK, Wellcome & Leverhulme)	109,500,000
Reviewing Grant Applications (RCUK, Wellcome & Leverhulme)	17,300,000
Publisher Costs (Scaled to output counts)	517,300,000
Total Higher Education System	4,783,800,000

Source: EI-ASPM model: Authors' analysis.

The peer review of scholarly journal articles and books conducted on behalf of publishers by UK academic staff (*i.e.* external peer review activities) probably cost around £180 million during 2007, and their external journal editorial and editorial board activities around £60 million. We estimate that higher education output-related publisher costs probably amounted to around £515 million (excluding the external costs noted above). Summing these costs suggests that *scholarly publishing system activities may have cost UK higher education around £4.8 billion during 2007.*

The cost of alternative models

This study focuses on three alternative models for scholarly publishing, namely: subscription publishing, open access publishing and self-archiving.

- *Subscription or toll access publishing* refers primarily to academic journal publishing, but includes any publishing business model that imposes reader access charges and use restrictions.
- *Open access publishing* refers primarily to journal publishing where access is free of charge to readers, and the authors, their employing or funding organizations pay for publication. Use restrictions can be minimal as no access toll is imposed.³

³ Open access book publishing is also now emerging, but is still at a rather embryonic stage.

- *Open access self-archiving* refers to the situation where academic authors deposit their work in on-line open access repositories, making it freely available to anyone with internet access. Again, use restrictions can be minimal.

Table S-III summarises a range of scholarly publishing costs relating to each of these publishing models. It shows that for UK higher education, *SCONUL library expenditures amounted to almost £600 million during 2006-07, including £205 million for acquisitions* (i.e. for subscription or toll access payments).

Table S-III: Estimated annual UK higher education scholarly communication infrastructure-related costs (GBP, circa 2007)

<i>UK Higher Education</i>	<i>Estimate</i>
Library acquisition costs (Subscription or toll access publishing)	204,800,000
Library non-acquisition costs	392,600,000
Author-pays fees for all journal articles (Open access publishing)	147,500,000
Current estimated Repository Costs (Open access self-archiving)	10,700,000
ICT Infrastructure (Total expenditure)	1,178,700,000

Source: EI-ASPM model: Authors' analysis.

Open access publishing all UK higher education journal article output in 2007 would have cost around £150 million. Given that it is said that no more than half of open access journals actually charge author fees, perhaps £75 million would have been required for author-side payments. However, if the UK supported open access publishing in proportion to output, the remaining £75 million would have been paid in other forms of institutional support.

Open access self-archiving costs are based on estimated repository costs, which are necessarily no more than approximate. Nevertheless, we estimate that the open access repositories in operation in the UK as of August 2008 may have involved annual costs of around £10 million, and that *a system of institutional repositories in UK higher education in which every institution had one publications-oriented repository and all publications were self-archived once would cost around £20 million per annum* (at 2007 prices and levels of publication output).

Costing activities, objects and functions

The matrix approach to costing lying behind these activity costs enables their presentation in various forms, including as costs for actors, objects and functions (Section 4.5.3).

For example, combining activity costs to estimate object costs we find that *journal articles cost an estimated average of around £9,600 to produce in the UK circa 2007*, of which around £5,300 related to the direct cost of writing (excluding input research activities, such as reading), £2,900 related to publisher costs and £1,400 to external peer review costs (per article published) (Figure S-II and Table S-IV).

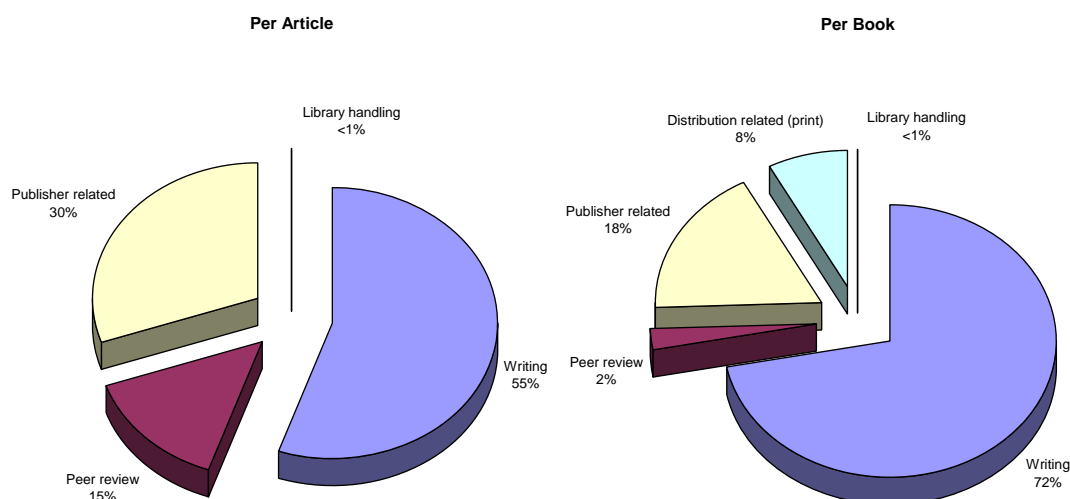
Table S-IV: Estimated per item object costs (GBP, circa 2007)

	<i>Estimate</i>
Cost per journal article (per article)	
Writing	5,300
Peer review (per published)	1,400
Publisher related	2,900
Library acquisition	0.68
Library handling	0.43
<i>Per article production</i>	9,600
Publisher share of production costs	30%
Cost per research monograph (per title)	
Writing	63,900
Peer review (per published)	2,100
Publisher related	15,800
Distribution related (print)	6,800
Library acquisition (books and pamphlets per item)	14
Library handling	74
<i>Per monograph production</i>	88,600
Publisher and distributor share of production costs	25%

Note: Writing costs include those items that are not published while all other costs are per item published. Acquisition costs are excluded from the totals to avoid double counting.

Source: EI-ASPM model: Authors' analysis.

Figure S-II: Estimated per item object cost shares (per cent)



Note: Writing costs include those items that are not published while all other costs are per item published.

Source: EI-ASPM Model: Authors' analysis.

Similarly, we estimate that *research monographs (i.e. authored and edited books)* cost an average of around £88,600 to produce in the UK circa 2007, of which around £63,900 related to the direct cost of writing (excluding input research activities, such as reading), £15,800

related to publisher costs and an estimated £6,800 to distribution costs, and £2,100 to external peer review costs (per title published) (Figure S-II and Table S-IV).

Activity costs can also be combined into the cost of specific functions, such as peer review and the functions of quality control and certification.⁴ The activity cost estimates outlined above include both internal publisher peer review handling and management related costs and external, largely non-cash, peer reviewer costs. Per article published, these amounted to an estimated £344 and £1,388, respectively, or a total function cost of £1,732 circa 2007. For books, these costs are estimated at £1,733 per title for publisher editorial activities and £2,082 for external peer review, or a total function cost of £3,815.

Publisher costs per journal article

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

For subscription or toll access publishing, we estimate an average publisher cost of around £3,247 per article for dual-mode production, £2,728 per article for print only production and £2,337 per article for e-only production (excluding the costs associated with external peer review and VAT) (Figure S-III).

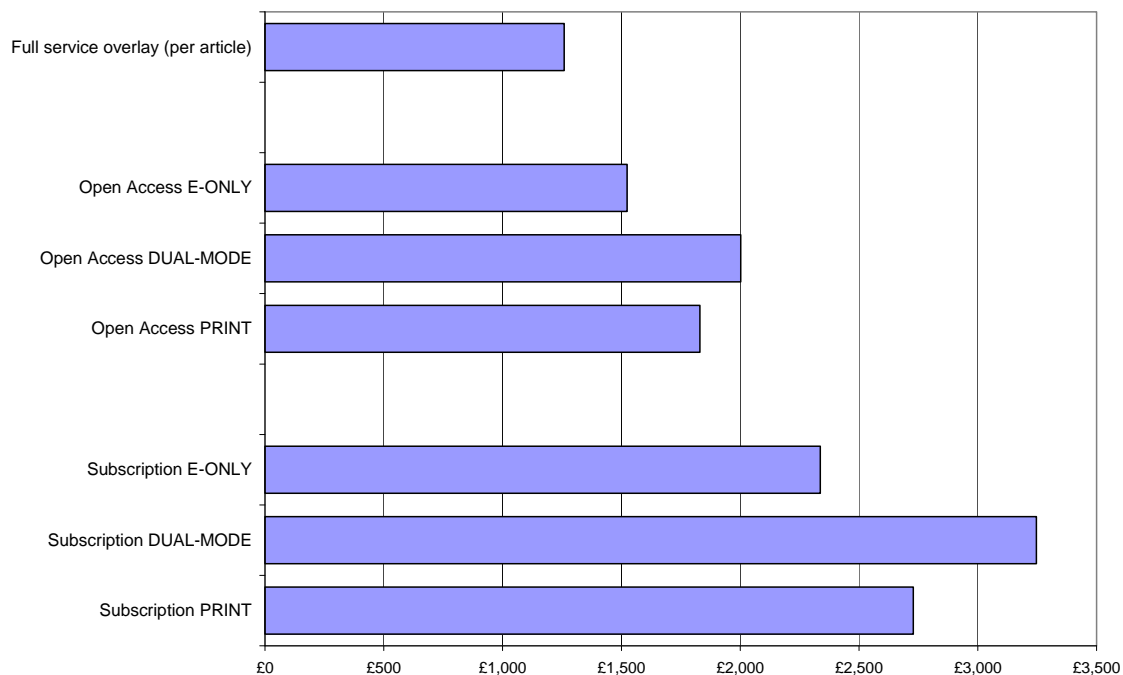
For open access publishing, we estimate average per article costs at £1,524 for e-only production. Excluding the costs of copy printing and delivery, we estimate the cost of dual-mode open access publishing at around £2,000 per article and print only open access publishing at £1,830 per article (Section 4.3.1).⁵ Indicatively, if printing and delivery costs were the same as they are for subscription publishing, they might add around £300 per article.

We have included the implied publisher costs of overlay services to open access self-archiving for completeness (*i.e.* elements of publisher activity that could provide value adding overlay services to open access repositories). The same commercial management, investment and profit margins are applied. This shows, for example, that ***operating peer review management, editing, production and proofing as an overlay service would cost around £1,125 per article*** excluding hosting, or £1,260 including hosting.

⁴ A number of publisher activities relating to the proofing, checking and editing of manuscripts might also be included in the function of quality control, but have been excluded from this example for the sake of simplicity.

⁵ 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.

Figure S-III: 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.

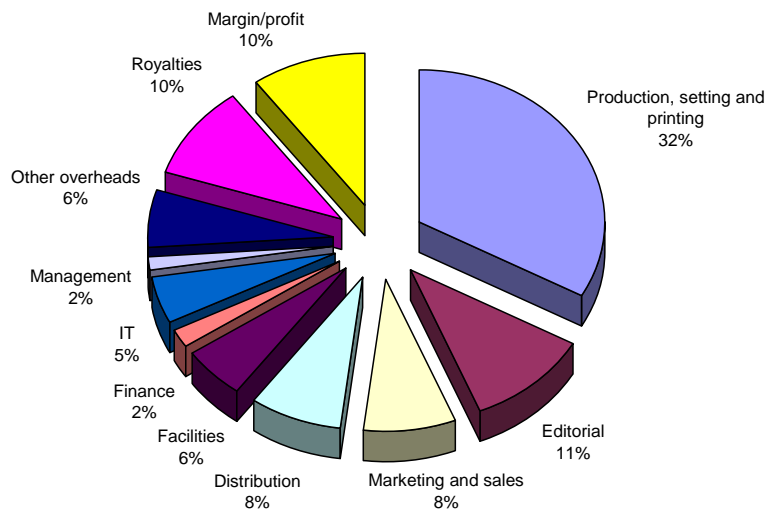
Source: EI-ASPM model: Authors' analysis.

Publisher costs per book title

Costs relating to academic book publishing are less widely discussed in the literature, although there a number of sources on book publishing costs, publisher management and pricing issues that provide a foundation. It is clear from these sources that book publishing costs vary widely, even within scholarly monograph publishing, between soft and hard backs, with production quality, print runs, sales and so on.

Based on proportions derived from industry consultation and those reported in the literature (Figure S-IV), we estimate average UK publisher Net Sales Revenue at £10,000 to £20,000 in 2007 prices (excluding external peer review costs). Average costs can be summed by format and publishing model, with the cost of toll access book publishing in print form at an estimated average of £15,750 per title. In electronic or e-only format, we estimate toll access publishing costs at an average of around £11,320 per title, and open access publishing around £7,380 per title (Section 4.3.2). These average costs are no more than approximate, but differences between the modes and models are indicative.

Figure S-IV: Approximate academic book publisher cost shares (per cent)



Note: Cost shares of estimated Net Sales Revenue per title, print.

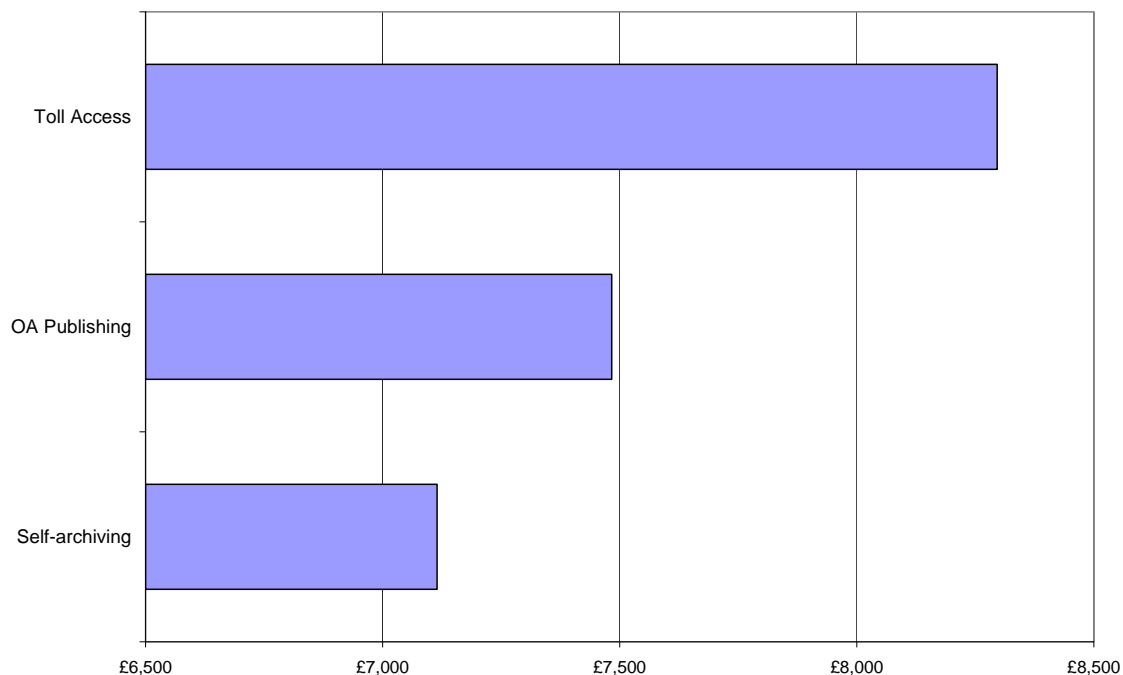
Sources: Industry consultation and Clark (2001). EI-ASPM model: Authors' analysis.

Those difference are accentuated when distributor discounts are taken into account. Academic book publisher discounts to distributors can be substantial, often ranging in the region of 30% to 40%. These discounts should not simply be included in publisher costs, but rather separately identified as distribution or channel costs. For example, if a book sold 500 copies at £45 per copy, a 30% distributor's discount would be worth £13.50 per item or £6,750 per title. Adjusting publisher costs to include distributor discounts brings our estimated average costs per title to £22,500 for print, £14,715 for toll access e-books and an unchanged £7,380 for open access e-books – substantially increasing the difference between publishing models.

The impact of alternative scholarly publishing models

Summing the costs of production, publishing and dissemination *per article* in electronic-only format suggests that average toll access publishing system costs would amount to around £8,296 per article (excluding VAT), average open access publishing costs would amount to £7,483 per article and average open access self-archiving costs £7,115 per article (including overlay review and production services with commercial margins) (Section 4.5). At these costs, ***open access publishing would be around £813 per article cheaper than toll access publishing, and open access self-archiving with overlay services around £1,180 per article cheaper*** (Figure S-V).

Figure S-V: 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: EI-ASPM model: Authors' analysis.

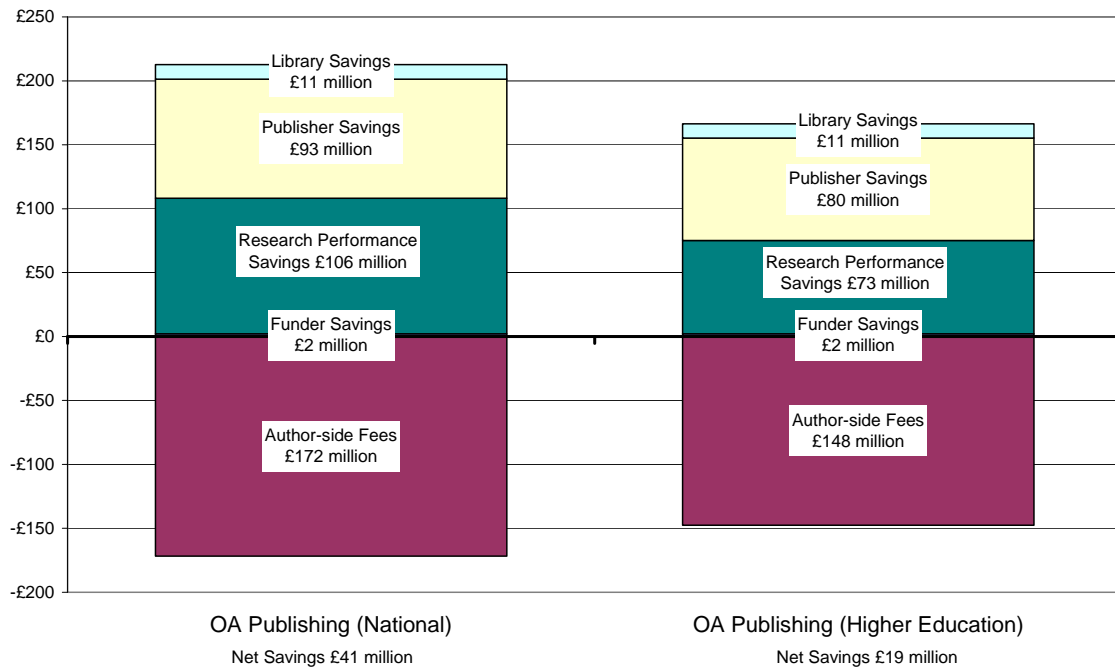
For UK higher education, these journal article cost differences would have amounted to savings of around £80 million per annum circa 2007 from a shift from subscription access to open access publishing, and £116 million from a shift from subscription access to open access self-archiving with overlay services. While alternative publishing models for scholarly books are much less developed and costings more speculative as a result, similar savings would appear to be available from shifting to open access book publishing.

In addition to direct cost differences, there are potential system cost savings. Based on the cases and scenarios explored in this study we estimate that ***open access publishing for journal articles might bring system savings of around £215 million per annum nationally in the UK (at 2007 prices and levels of publishing activity), of which around £165 million would accrue in higher education.*** The open access self-archiving with overlay services model explored in this study is necessarily speculative, but a repositories and overlay services model may well produce greater cost savings than open access publishing – with our estimates suggesting system savings of perhaps £260 million nationally, of which around £205 might accrue in higher education.

These savings can be set against the cost of open access publishing, which if all journal articles produced encountered author fees would have been around £170 million nationally in 2007, of which £150 million would have been faced by higher education institutions. Showing net savings from open access publishing of around £40 million nationally and £20 million in higher

education (Figure S-VI). Similarly, with estimated repository costs at around £22 million nationally and £18 million for higher education, the potential net savings might be around £200 million per annum.

Figure S-VI: Estimated annual costs and cost savings: OA publishing (GBP millions, 2007)



Note: Includes estimated e-only cost savings, and excludes acquisition costs (to avoid double counting). Research performance savings exclude the impacts of accessibility and efficiency on returns to R&D. National library handling cost savings are those relating to SCONUL libraries only and include handling of all library journal acquisitions.

Source: EI-ASPM model: Authors' analysis.

Thus the cost savings alone are likely to be sufficient to pay for open access journal publishing or self-archiving, independent of any possible increase in returns to R&D that might arise from enhanced access. Thus, it seems possible that open access publishing alternatives could be supported from within existing budgetary allocations.

Nevertheless, *the increase in returns to R&D resulting from enhanced access may be substantial.* To explore the impacts of enhanced access on returns to R&D we modify a basic Solow-Swan model, by introducing 'accessibility' and 'efficiency' as negative or friction variables, and then calculate the impact on returns to R&D of reducing the friction by increasing accessibility and efficiency (Section 5.1).

We find that with a 20% return to publicly funded R&D, for the major categories of research expenditure in the UK in 2006 a 5% increase in accessibility and efficiency would have been worth:

- £172 million per annum in increased returns to public sector R&D (*i.e.* government and higher education);
- £124 million per annum in increased returns to Higher Education R&D (HERD);
- £109 million per annum in increased returns to Government R&D (GovERD); and
- Around £33 million per annum in increased returns to research councils (RCUK) competitive grants funded R&D.

These are recurring annual gains from the effect of one year's R&D expenditure, so if the change that brings the increases in accessibility and efficiency is permanent they can be converted to growth rate effects.

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 outweigh the costs.

First, we explore 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 explore the implications of open access publishing and self-archiving as alternatives to current activities, by adding the estimated system savings to estimated returns (*i.e.* net cost scenarios) (Sections 6.1 and 6.2). 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 allowed under the copyright demands of subscription publishing.

Our 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 (*i.e.* Gold OA and Green OA) the benefits exceed the costs, even in transition. 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 the benefits from increased returns to R&D resulting from open access publishing all journal articles produced in UK higher education would be around 1.5 times the costs, and the benefits from open access self-archiving with overlay editorial and peer review services would be more than 14 times the costs. Indicative modelling of post-transition 'steady-state' alternative systems returns benefits of 5 times costs for open access publishing and more than 45 times the costs for open access self-archiving with overlay services (See Table S-V and Sections 5 and 6).

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

<i>Scenario</i>	<i>Costs</i>	<i>Savings</i>	<i>Benefits</i>	<i>Benefit/Cost Ratio</i>
Ceteris Paribus Scenarios				
<i>Transitional Model:</i>				
OA Publishing in HE (unrealistic)	1,787	..	615	0.3
OA Publishing Nationally (unrealistic)	2,079	..	2,353	1.1
OA Repositories in HE	189	..	615	3.2
OA Repositories Nationally	237	..	2,353	9.9
<i>Simulated Steady State Model:</i>				
OA Publishing in HE (unrealistic)	1,787	..	6,876	3.8
OA Publishing Nationally (unrealistic)	2,079	..	26,318	12.7
OA Repositories in HE	189	..	6,876	36.3
OA Repositories Nationally	237	..	26,318	110.8
Net Cost Scenarios				
<i>Transitional Model:</i>				
OA Publishing in HE with direct and indirect savings	1,787	2,016	615	1.5
OA Repositories in HE with direct and indirect savings	189	2,148	615	14.6
OA Publishing Nationally with direct and indirect savings	2,079	2,575	2,353	2.4
OA Repositories Nationally with direct and indirect savings	237	2,697	2,353	21.3
<i>Simulated Steady State Model:</i>				
OA Publishing in HE with direct and indirect savings	1,787	2,016	6,876	5.0
OA Repositories in HE with direct and indirect savings	189	2,148	6,876	47.7
OA Publishing Nationally with direct and indirect savings	2,079	2,575	26,318	13.9
OA Repositories Nationally with direct and indirect savings	237	2,697	26,318	122.2

Note: Costs, savings and benefits are expressed in Net Present Value over 20 years, in GBP millions. See the modelling assumptions outlined in Section 5 and modelling results in Section 6.

Source: EI-ASPM model: Authors' analysis.

Exploring topical issues

We also examine a number of topical issues, beginning with that of diverting research funds to author-side payments for open access publishing, and then exploring the possible impacts of delayed open access embargo periods and of speeding up the research and discovery process (*e.g.* through self-archiving *pre*-prints) (Section 6.3).

Our analysis suggests that under the rather conservative modelling assumptions, funding agencies or institutions might be able to divert up to 3.5% of research funding to author-side payments before net benefits were exhausted – a level that is much higher than is commonly reported and one-and-a-half times that required (on estimated costs). Of course, this is dependent on the returns characteristic for the field of research, and returns are typically higher in medical research than elsewhere and might be expected to be lower in some areas of Humanities and the Arts. Hence, the percentage of funds at which breakeven might be reached would likely be higher for the Medical Research Council or Wellcome Trust than for the Arts and Humanities Research Council, for example.

Simulating the impact of a one year ‘delayed open access’ embargo on all journal articles, we find that over 20 years such delays would reduce the estimated increase in returns to R&D by around 2% (in the transitional model) – costing the equivalent of around £120 million in lost returns to UK higher education research spending.

Simulating the impact of the potential for enhanced and/or earlier access to speed up the research and discovery process (*e.g.* through self-archiving *pre*-prints), we find that over 20 years speeding up the process by one year increases the estimated increase in returns to R&D by around 3.6% (in the transitional model) – worth around £220 million in additional returns to Higher Education R&D expenditure.

Conclusions

The costs, benefits and impacts of alternative scholarly publishing models revealed in this study demonstrate that research and research communication are major activities and the costs involved are substantial. Preliminary analysis of the potential benefits of more open access to research findings suggests that returns to research can also be substantial, and that ***different scholarly publishing models can make a material difference to the returns 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). This suggests that there are gains to be realised from moving towards open access publishing models and, despite the lag between the costs and the realisation of benefits, the transition may be affordable within existing system-wide budgetary allocations.

Implications for scholarly communication in the UK

Open access publishing and self-archiving (with overlay services) appear to be more cost-effective systems for scholarly publishing, with cost savings available throughout the scholarly communication process – in funding, performing, publishing, disseminating and preserving research. However, a shift from a user-side to producer-side system for funding publishing implies a greater concentration of costs and diffusion of benefits, with costs concentrated among the most intensive producers of scholarly content and benefits diffused across many users. Nevertheless, the most intensive producers of scholarly content are also among its most intensive consumers, and the system cost savings available from open access publishing and self-archiving alternatives are likely to be realised most by the most intensive users, through, for example, reduced library acquisition and handling costs, research time and cost savings, and so on.

Many analysts have compared institutional library journal acquisition expenditure with likely institutional open access publishing fees, and for the more research intensive universities they have noted that the latter may exceed the former. But such comparisons overlook the implied

library handling cost savings from an alternative open access publishing system, which would be greatest in institutions with the most extensive research collections and active researcher use. The time and cost savings available in the performance, reporting and management of research would also be greatest in those institutions performing most research. Hence, a fuller accounting of costs, cost differences between the alternative publishing models, and potential cost savings is required than has hitherto been typical.

Implications for funders

The operational costs of funding agencies are unlikely to change very much as a result of alternative publishing models, but there is likely to be an impact on the implied effective level of research funding – primarily through the diversion of research funding into author-side fees.

Noting that only around half of all open access journals actually charge author fees but that support for open access publishing would nevertheless be coming from the producer side, we estimate that had all UK authored journal articles been published in an entirely producer-pays open access publishing model in 2007 it would have cost around £170 million nationally in the UK, of which around £150 million would have been from higher education.

Balancing the negative impacts of such a diversion of research funding on the level of research activity against the positive impacts of enhanced accessibility and efficiency on returns to that R&D still conducted and system cost savings, *we find that funders can feel comfortable diverting the required level of research funding to producer-side publication payments*. That is to say that, at the estimated costs, the benefits of enhanced accessibility and efficiency and potential system cost savings outweigh the costs of diverting research funds to author-side open access publishing fees (Section 6.3.1).

Implications for researchers

In addition to possible costs and cost savings, impacts on funding flows within research activities would be likely to revolve around possible differences in the use of researcher time and funding (*e.g.* in applying for and obtaining permissions versus self-archiving to a subject or institutional repository, etc.). Time and cost savings are likely to arise in such areas as: reduced search, discovery and access time through enhanced discoverability, greater accessibility and less use of authentication and access control and of proprietary silo access systems; and less time spent on seeking and obtaining permissions. In addition to these savings, there are opportunities for new forms of analysis when the findings and record of research are openly available, due to both their accessibility and usability (*e.g.* permission to use for any purpose, subject only to attribution). Independent scholars working outside mainstream institutions, as well as those from poorer institutions and poorer countries, could benefit enormously from open access to scholarly publications (Section 3.3.2).

Open access publishing may require author payments, and researchers in fields that are relatively poorly funded, those working without specific project funding, and independent *scholars may find it difficult to pay, unless there are specific funds made available to support publishing fees*. Self-archiving also takes some additional time, but the benefits from enhanced

accessibility, broader readership and, potentially, increased citation are likely to make the effort worthwhile.

Implications for research institutions

From the perspective of universities and research institutions, research library acquisition and handling cost savings should also be factored in. Because research intensive institutions are both major producers and users of scholarly publications, research and library cost savings will offset additional producer-side costs. Nevertheless, ***research intensive institutions might pay relatively more in a producer-pays system, and it would be preferable to cover the direct costs of producer-side open access publishing fees from competitive and block grant funding.*** This might be scaled to outputs in the previous year, and would be likely to cost of the order of £75 million to £150 million per annum to publish UK higher education journal article output in open access journals. Similar support mechanisms could be offered for the operation of institutional repositories and, perhaps, open access book publishing.

Enabling and ***supporting self-archiving through the operation of institutional repositories offers a number of potential benefits for universities and research institutions,*** not only through providing greater support to research, but also in providing a platform for hosting and showcasing the institutions research and maintaining a more complete record of it, which can assist the institution in research management and reporting functions. There are also potential benefits in hosting teaching and learning materials alongside research materials in integrated institutional repositories (Section 3.3).

Implications for publishers and the publishing industry

Savings relating to publishing are captured in the publisher cost differences between the publishing models. ***Clearly, reduced costs would result in reduced revenue flows from research users to publishers, although these reductions may well be offset by revenue gains from selling value-adding services to a larger number of readers and/or authors and from alternative revenue streams.***

There are taxation differences between alternative publishing models, as well as what are more significant differences between formats (e.g. VAT on electronic content but not on the same content in print form). Obviously, with no access charges levied in open access models there would be no VAT collected on subscriptions. However, VAT would be collected on the (domestic) provision of publisher services, including author-pays fees and fees for overlay services, depending on the domicile of content producers and the VAT registration status of institutions. Consequently, ***while one might expect lower publisher production costs to imply somewhat lower taxation revenue in open access publishing and self-archiving models, the net impact is unlikely to be significant and will depend on the methods of payment and level of international publishing*** (e.g. whether or not authors publish with domestic or overseas publishers).

A reduction of revenue to the publishing industry, should it arise, would imply a reduction of activity and employment in the industry. Such adjustments are difficult for those concerned, but

an economy is a dynamic system and, over the business cycle, is likely to achieve something close to ‘full employment’. As a result, the capital and labour no longer employed in publishing would be employed in an alternative activity. ***Given the relative size of the publishing industry and the rate at which alternative publishing models are being adopted, it is unlikely that the UK economy would have difficulty adjusting to such a change.***

The publishing industry in the UK is a major exporter, contributing as all exporters do to the balance of payments. However, scholarly publishing is a global activity with payments for scholarly content and services flowing both in and out. While it is impossible to predict how alternative publishing models would affect these payment flows, there is no obvious reason to expect the net effect to be large. For example, ***possible losses from reduced subscription payments inflows to the UK would be offset by reduced subscriptions payments outflows and increased author-pays fees and overlay services payments inflows to UK-based open access publishers.*** The impacts of a possible marginal reduction in publishing industry revenues and employment on the balance of payments would depend on whether the alternative application of the capital and labour was more or less export or import oriented. That is impossible to know, but there is no obvious reason to expect the net effect to be significant.

Implications for research libraries

Savings relating to facilitating dissemination, retrieval and preservation are largely captured in the research library acquisition and handling cost differences between the publishing models. There are also library-related savings in such areas as operating and supporting access and authentication systems, permissions and copyright fees, etc.

It is difficult to say exactly how open access publications will be treated by research libraries and what role libraries would play in dissemination and preservation in these alternative publishing models. Nevertheless, we suggest that ***research libraries may continue to play a key role in providing access to open access journals*** and have costed library handling activities accordingly. With little evidence to date that open access self-archiving leads to subscription cancellations, acquisition cost savings have not been included. However, should they arise in the future, there would be potential for significant additional savings.

Implications for government and central agencies

There is likely to be uncertainty during the coming years as to the direction and speed of a transition towards more open access to research findings through open access publishing and/or self-archiving, and there will be difficulties in shifting budgetary allocations around the system in such a context. Moreover, ***some of the savings and benefits resulting from alternative publishing models cannot be realised until some time after the costs have been met. Consequently, it seems inevitable that central allocations will be required at the funder, institutional and, perhaps, national levels.***

Estimated annual author-pays costs of around £170 million for the UK nationally (£150 million for higher education) and perhaps £23 million nationally (£18 million for higher education) for a basic system of publications-oriented institutional repositories are relatively modest in

comparison to UK gross expenditure on R&D of around £24,000 million per annum and higher education R&D expenditure of £6,000 million per annum. All the more so when system-wide cost savings as well as potential increases in the social returns to R&D resulting from more open access to research findings are likely to outweigh those costs.

Recommendations

Our analysis suggests that there is evidence to support a move towards more open access to research findings, and it provides some guidance as to where the gains may be most substantial, the potential levels of cost and cost savings involved, and the budgetary implications for various actors in the system.

Overcoming the barriers

Given the potential benefits, *there is scope to focus on reducing the barriers to transitioning to more cost-effective scholarly publishing models*. Key areas for attention are those of enabling innovation and aligning incentive and reward systems to create a level playing field, and raising awareness of the opportunities. This might involve:

- *Ensuring that research evaluation is not a barrier to innovation* (e.g. by developing and using metrics that support innovation in scholarly publishing, rather than relying on traditional evaluation metrics that reinforce and reward traditional publishing models and behaviours);
- *Ensuring that there is funding for author or producer side fees* (e.g. encouraging all research funders to make explicit provision for publication charges, and encouraging higher education and research institutions to establish funds to support publishing fees);
- *Encouraging and funding the further development of institutional and/or subject repositories* to enable author self-archiving; and
- *Supporting advocacy initiatives* to inform and educate funders, researchers and research managers about the potential impacts of alternative publishing models.

Realising the benefits

Cost savings can be realised more quickly than can increases in returns to R&D, so there is merit in making them an early focus. This might involve:

- *Focusing on areas where there are activity cost impacts* relating to the various publishing models (e.g. complexity and uncertainty in such areas as copyright and licensing conditions and permissions, purchasing and licensing negotiations, and the cost impacts of imposing access control and authentication systems); and
- *Focusing on areas where there are system cost impacts* relating to the various publishing models, especially where they are likely to be substantial (e.g. the implications of alternative publishing models for research costs, publishing costs,

research library handling and acquisitions costs, and research reporting and management costs).

Box S-I: Areas for further research

There are many areas in which more information and analysis might give stakeholders greater confidence to experiment with alternative publishing models. This might involve:

- ***Encouraging and supporting the collection of better data*** in such areas as: open access repository costs, impacts and operational statistics; operational information about special libraries and library related activities outside higher education; and information on the activities of users of scholarly publications in industry, government and non-government organisations and the community at large;
- ***Supporting or conducting more research into areas where the greatest benefits may be available*** (e.g. the possibilities for, and potential benefits of, convergence and the integration of more open access to publications, data curation and sharing, and education and learning that is possible through repositories);
- ***Supporting or conducting more research into alternative and emerging forms of scholarly communication***, in order to better understand their roles and interactions between them, and the systemic implications of alternative publishing models and new forms of research communication in what is a rapidly changing environment; and
- ***Encouraging greater integration of research relating to the conduct of R&D and operation of the S&T system with research on scholarly publishing and scholarly communication more broadly*** (e.g. research relating to Open Innovation).

Source: Authors' analysis.

Our analysis suggests that open access self-archiving, either in parallel with subscription publishing or with overlay services, may be more cost-effective, although more information is required on repository costs and the potential benefits of greater integration of publications with other forms of research output, their integration into learning materials, and the curation and sharing of research data (Box S-I). Hence, ***there is scope to focus greater attention on the development of repositories***. This might include:

- ***Encouraging and supporting the development of institutional and/or subject repositories***;
- ***Encouraging greater focus on the operational effectiveness of repositories*** (e.g. enhancing metadata standards and quality, effective federation, enhanced discoverability and searchability, and, perhaps most importantly, supporting the development and use of metrics and reporting suitable for research evaluation, etc.); and
- ***Encouraging greater sharing of information and experiences*** to enable stakeholders to better understand the costs and benefits involved and build more effective 'business cases' for repositories.

Our analysis also suggests that *there may be considerable benefits available from a shift to open access scholarly book publishing*. Hence, there is scope to further explore the possibilities. This might involve:

- *Supporting or conducting more research into the academic book publishing value chain*, where substantial costs savings and benefits appear to be available from shifts to electronic and open access publishing, but alternative publishing models are as yet more embryonic and relatively little is known about the longer term operational viability of open access scholarly book publishing; and
- *Encouraging greater sharing of information and experiences* of emerging open access book publishing initiatives to enable stakeholders to better understand the costs and benefits involved and build more effective ‘business cases’.

Sharing the gains

While a major contributor to the scholarly literature, the UK accounts for no more than 10% of the World’s scientific papers. Hence, *international developments are of great importance in realising the benefits of more open access* and much can be achieved by international efforts towards sharing the gains. This might involve:

- *Encouraging and supporting greater attention to the potential benefits of more open access to research findings in international fora* (e.g. European Commission, OECD, UNESCO, etc.); and
- *Encouraging international cooperation between agencies and supporting the activities of such cooperative efforts*.

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