

Activities, costs and funding flows in the scholarly communications system in the UK

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Foreword

Communicating the results of research is an integral and vital part of the process through which research expands the frontiers of knowledge and understanding. The scholarly communications system has changed fundamentally over the past decade, as researchers, publishers and librarians have embraced new technologies; and the pace of change continues to increase. Such changes have brought tensions, as different groups debate how best to exploit the opportunities presented by new technologies to maximise access to the information resources that researchers create. The debates have sometimes generated more heat than light, however, and have often been limited by lack of reliable evidence about key features of the scholarly communications system.

It is in this context that the RIN joined together with the Publishing Research Consortium (PRC), the Society of College, National and University Libraries (SCONUL), and Research Libraries UK (RLUK) to commission a study to investigate the costs incurred by key agents in the various stages of the scholarly communications process, from the production of research outputs to the reading of those outputs; and the sources, nature and scale of the funding and other resources provided to meet those costs.

We commissioned Cambridge Economic Policy Associates (CEPA) – an economics and finance policy consultancy (www.cepa.co.uk) - to undertake the study; and we are most grateful to the CEPA team – Daniel Hulls, Alan Rennison and Stefan Rattensperger – for all the work they have done in gathering and analysing the evidence and in building a sophisticated model that enables us not only to present a picture of the current situation, but to analyse the effects of possible changes. CEPA has also benefited from input from John Cox Associates and from the advice of an Expert Panel, including Mayur Amin (Elsevier), Frank Fishwick (formerly Cranfield School of Management), Michael Jubb (RIN), Tony Kidd (University of Glasgow), and Professor Donald King (University of North Carolina at Chapel Hill). We are very grateful to them also for all that they have contributed to the project.

We believe that this summary and the full report available on the RIN's website present interesting and important findings that give for the first time an overall picture of the costs that are involved in the scholarly communications system, and how they are met. The findings and the modelling are based of course on input assumptions and data that may be subject to change. One of the key outputs from the study, however, is the detailed model; and the RIN is working with CEPA to consider how best that can be made available to other researchers who may wish to test it with other data.

Important Notice

It is important to stress that this report and the modelling carried out by CEPA relies on input assumptions and data that have not been independently verified. CEPA and the RIN make no warranty and accept no liability as to the accuracy of the information used, or for the use of the report by any third party.

Executive Summary

Nature and scope of this study

The purpose of this study has been to enhance understanding of the scholarly communications process by

- identifying the cash and non-cash costs incurred by the key agents in the various stages of the process;
- analysing the sources, nature and scale of the funding and other resources provided to meet those costs; and
- developing and analysing the impact of possible changes.

The study covers all stages of the scholarly communications process, from the production of research outputs to the reading of those outputs. Detailed modelling focuses on the publication, distribution, and provision of access to articles in English-language scholarly journals. Such articles are by far the most important information outputs produced and read by researchers in most subject areas, and they account for over half the acquisitions budgets of UK academic libraries. We recognise that other forms of scholarly communications, including monographs and conference proceedings, are important in some areas; but we do not cover them in this study. Nor do we consider the costs and revenue flows associated with secondary publishing, republication, or the provision of e-print repositories.

Key findings: global

We estimate that the global cost each year of undertaking and communicating the results of research reported in journal articles is £175bn, made up of £116bn for the costs of the research itself; £25bn for publication, distribution and access to the articles; and £34bn for reading them.

- *Publishing and distribution.* The global costs of publishing and distributing articles is £6.4bn:
 - £3.7bn in fixed first copy costs, including £1.9bn in non-cash costs for peer review; and
 - £2.7bn in variable and indirect costs, and the generation of surpluses by publishers.

Academic institutions meet about 53% of global publishing and distribution costs in the form of library subscriptions, and a further 23% in the form of the unpaid costs of peer review.

Non-academic subscriptions meet about 11% of global publishing and distribution costs.

The average total publishing and distribution costs per article amount to about £4,000, and we provide estimates in the full report about variations for different kinds of journal.

Key findings: UK contribution

We estimate that UK researchers constitute 3.3% of the global research base, and that they produce 6.6% of the global supply of journal articles.

- The UK is a net contributor to the global provision of peer review, contributing £165m a year in non-cash costs, which is 8.7% of the global peer review cost. On average, 7.1% of all published articles are peer reviewed in the UK.
- The total UK contribution to all stages of the scholarly communications process from peer review through to the provision of access in libraries amounts to £408m. Its contribution is

less than the proportion of articles it produces, but significantly greater than its proportion of all the researchers in the global research base.

- UK libraries spend £163m on journal subscriptions, and a further £72m on the provision of access facilities, making a total of £235m. Academic libraries account for £173m (74%) of that expenditure.
- The average annual access costs for UK libraries (excluding journal subscriptions) range from £715k for RLUK libraries to £242k for higher education colleges, and £156k for special libraries.
- Annual costs of journal subscriptions vary from £1386k for RLUK libraries to £208k for special libraries.

Possible changes and their impact

We have modelled the impact of four possible changes to the scholarly communications system. The results are instructive, but clearly reflect the range of assumptions in the model.

1. Electronic-only publishing.

Currently, most journals are published in both print and electronic formats. If 90% of all journals were to be published in electronic format only, the global costs of publishing, distribution and access would fall by £1.08bn (12%), offset by a rise of £93m in user costs for printing.

- By far the largest part of that reduction in costs would be accounted for by a fall of £758m (36%) in libraries' costs in providing access to journal articles.
- Global publication and distribution costs would fall by c£318m (7% of total costs excluding peer review).
- Falls in advertising revenues, membership fees and personal subscriptions would mean that less than two-fifths of the publication and distribution savings would be passed on to libraries through a reduction in subscriptions.
- UK academic libraries' costs in providing access to articles would fall by £23m. Within this total, the fall of £4m in subscription prices for academic libraries would be more than offset by an increase of £5m in VAT payments.

2. Author-Side Publication Fees

There have been moves in recent years to change the traditional journal business model, in order to make journal articles open access; that is, available to anyone who wants to read them, free of charge immediately upon publication. The models vary, but some journals now (especially in biological and medical sciences), instead of charging a subscription for access by readers, charge a publication fee to authors so that their articles can be open access. Currently, about 2% of articles are published in open access or "hybrid" journals (where most articles are available for reading only if a subscription has been paid, but authors have a choice to make their articles open access by paying a fee).

If 90% of all articles were made open access upon payment of a publication fee in this way, we estimate that the total saving in the global costs of publishing, distribution and access would be £561m, split almost equally between savings to publishers and to libraries. These savings would be on top of the savings from a move to e-only publishing. Our modelling assumes that there will be some costs to publishers in administering author-side payments; but any time and administrative costs to authors, their institutions and funders have not been modelled here. Some of these savings could therefore be offset if the costs to publishers, authors, institutions and funders are higher than we have modelled.

The key results of our modelling are that:

- The subscriptions paid by academic libraries globally would fall by £2.91bn. But these savings would be offset by an increase of £2.92bn in the charges that the academic and research institutions of which they are a part (or their funders) would have to meet in author-side publication fees.
- The costs and benefits would be unevenly distributed across institutions: research-intensive institutions would tend to pay more in publication fees than they currently do for library subscriptions, while institutions where research constitutes a lower proportion of activity and expenditure would tend to see reductions in overall expenditure.
- In the UK, libraries in the HE sector as a whole would benefit by c£128m. But the UK's contribution to publication fees would amount to c£213m. The UK's share of funding to meet the costs of publication, distribution and access would rise from 5.2% to 7.0%.
- The main beneficiaries would be other institutions that currently purchase journal subscriptions, but are not major producers of research outputs.

3. Cash for peer review

We have estimated the unpaid non-cash costs of peer review undertaken in the main by academics at £1.9bn globally each year. If payment were to be made in cash to meet these costs, there would be a significant transfer of funds to academics and the HE sector globally. If universities were able to capture the payments made to peer reviewers, it might be possible to make these payments neutral in terms of university budgets. But our assumption is that the majority of payments would in effect form additions to salaries. Since the estimated breakeven price of a major discipline journal would increase by 43%, the result would be an increase in the costs of subscriptions to academic institutions globally of the order of £1.4bn. The estimated increase in the costs of subscriptions to UK libraries in the HE sector would be of the order of £53m, a rise of 45% compared with their current subscription expenditure.

4. Increases in research funding

In recent years, the global increase in research funding has been of the order of 2.5% a year in real terms, with related increases in the number of journals and articles published. Our fourth scenario looks at the impact of sustained increases of this order over the next ten years, with a rise of 11% in the number of journals published, and of 28% in the number of articles (hence, in line with experience over the past decade, the number of articles published per journal will increase by c1.5% a year).

Such a rise in the production of articles will clearly have an impact on costs. Global publication and distribution costs will rise by £1.6bn (26%) in real terms, resulting in increases in breakeven subscription prices of around 12-13% over 10 years. Time spent by researchers in searching for articles will increase substantially. In the UK, the total cost to academic libraries will be of the order of £36m in real terms, or 21% of their current budgets for acquiring and providing access to scholarly journals.

Glossary of Terms

Acquisition price: the price paid by UK libraries and other organisations (special libraries, corporate users, etc) buying journals / articles. (See section 3.1.2)

Average cost: the total cost (of producing a journal) divided by the number of units produced (number of copies circulated). The publishers of a journal will break-even if they set the price equal to the average cost of producing the journal. The break-even price of a journal is equal to the average fixed cost plus the variable unit cost.

Contextual analysis: relatively basic analysis and spreadsheet modelling of the scholarly communications process in the context of the wider research value chain. Contextual modelling in this study includes the modelling of the cost and volumes of research production; the consumption (or readership) or peer reviewed articles; and estimates of the contribution of UK academic institutions to the cost and funding of the global publication and distribution of peer-reviewed articles.

Core modelling: detailed spreadsheet modelling of the volumes and unit costs of activities associated with the publication, distribution (at a global level) and access of peer-reviewed journals (at the UK level). Core modelling allows the user flexibly to specify alternative assumptions at a relatively disaggregated level (e.g. the cost structures of different elements of the process for different categories of journal, subject and publisher).

Direct cost: Costs relating directly to the publication and distribution of, and access to articles or journals. Examples of direct costs include the non-cash cost of peer reviewing an article, or the cost of hosting a journal using a third party web-hosting service. Direct costs exclude marketing, finance, HR and other costs not directly relating to the physical production of the article or journal.

First copy cost: The combination of unit costs and activities that generate a fixed (first copy) cost of each article and, once multiplied with the average number of articles per journal type, fixed (first copy) cost of a journal. While most of the first copy activity costs are cash costs incurred by publishers, some first copy costs are incurred by peer reviewers and will therefore be non-cash costs.

Fixed cost: Costs that do not change as output increases or decreases. In the context of the scholarly communications process, we consider there to be per article fixed costs, and per journal fixed costs – i.e. costs which are incurred regardless of the number of times an article or a journal is recreated (circulation). Per article fixed costs are most likely to relate to the publication component of the value chain, namely the cost of receiving each article, editing each article and (usually non-cash) peer-review costs. Further per journal fixed costs are incurred in producing the journal, such as cover editing and journal marketing.

Indirect cost: Indirect costs are the fixed, often company wide, cost of overheads, which are not attributable directly to the production of either an individual article or journal. Examples of indirect cost include management and administration cost, or depreciation of assets.

Marginal cost: The marginal cost of an additional unit of output (an additional copy of a journal) is the cost of the additional inputs (paper, printing and distribution costs in the case of hardcopies of journals) needed to produce that output.

Non-cash cost: costs incurred (typically by academics) which are not directly remunerated as part of the scholarly communications cost.

Peer review: the process by which an author's scholarly research output (article) undergoes qualitative assessment and review by experts in the same field.

Publisher's return / surplus: The return required by publishers is an average mark-up by article type on the total fixed and variable cost. We recognise that this is a simplification of the real world in which returns on journals vary according to their maturity, but believe that it is not unreasonable.

Scholarly communications process: the combination of the publishing and distribution of peer-reviewed scholarly research articles in scholarly journals, and the provision of access to such journals by academic and non-academic libraries and other channels (including open

access journals). It is the final, essential stage in a piece of scholarship or research project that provides certification of the work, dates it, identifies the authors as originators and disseminates it.

Variable cost: Costs that change directly as output changes – in publishing per journal variable costs vary according to the circulation of the journal. Journals with a high circulation will have high total variable costs. Variable costs are incurred with each additional copy of a journal produced. For a print journal they include print and distribution cost (e.g. paper, packing, postage) – per journal variable costs are lower, but high circulation will imply higher server capacity costs.

1 Introduction

In August 2007, the Research Information Network (RIN) commissioned Cambridge Economic Policy Associates (CEPA)¹ to carry out a study to investigate the costs and funding flows of the scholarly communications process in the UK. This document is the final report of that study². The work has been carried out by CEPA with advice and input from John Cox Associates Ltd.

In addition to input from colleagues at the RIN, the work has benefited from significant contributions from an Expert Panel. The members of the Panel were Mayur Amin (Elsevier), Frank Fishwick (formerly Cranfield School of Management), Tony Kidd (Glasgow University Library) and Donald King (University of North Carolina at Chapel Hill).

1.1 *Background to the project*

The background to this project was set out clearly in the terms of reference³ as follows:

“In recent years, technological developments and the availability of information resources online have brought a sea-change in how research is done, and how its results are communicated to other researchers, and indeed to anyone else interested in those results. The roles and the activities undertaken by the key groups of players in the scholarly communications process have changed fundamentally, and will change further in the next few years. There is increasing interest from researchers, funders, publishers, librarians and others in finding ways more fully to exploit the opportunities created by new technologies. But debates about how to achieve this have often generated more heat than light; and we lack reliable evidence about key features of the scholarly communications system as a whole.”

This study builds on the UK Scholarly Journals: Baseline Report (2006) commissioned by RIN⁴.

1.2 *Study objectives*

The high-level aim of this study has been to “produce estimates, from a systems perspective, of the costs associated with the different parts of the scholarly communications process in the UK, and the sources and volumes of resources provided to meet those costs”.

As set out in the terms of reference this has involved two key objectives:

- to identify the cash and non-cash costs incurred by the key agents involved in the various stages of the scholarly communications process in the UK; and
- to identify the sources, nature and scale of the funding and other resources made available to meet those costs.

It is important to stress that our study concentrates on that part of the scholarly communications process that covers publicising, disseminating, providing access to and reading articles in scholarly journals. We recognise, of course, that there are other forms of scholarly communication (monographs, conference proceedings, secondary publication and repositories, for example): but they are not the subject of this report. Articles in scholarly journals are by far the most important information outputs produced and read by researchers in most subjects. They account for more than half of the global revenues of the academic and scientific information industry. Our estimates of the costs of the scholarly communications system therefore concentrate on journal articles and exclude all other kinds of outputs and the provision of access to them. Our findings should be read in that light.

¹ More information can be found at www.cepa.co.uk.

² A summary report is available separately.

³ <http://www.rin.ac.uk/taxonomy/term/26>.

⁴ <http://www.rin.ac.uk/files/UK%20Scholarly%20Journals%2006%20Baseline%20Report.pdf>.

As might be expected in a project of this type, the precise scope of the work has developed as the study has progressed. The scope of the modelling work in particular has developed throughout the project and is discussed in more detail in Section 3 and in Annex B. In addition to providing estimates of the current costs and funding flows in the scholarly communications process, we have used the system model to provide analysis of four scenarios based on relevant policy issues:

- The implications of the current level and composition of funding flows in the scholarly communications value chain (SCVC) associated with a shift towards or away from existing journal⁵ publishing business models (for example a movement towards an 'author-side payment' business model).
- The impact on funding flows arising from shifts in the supply and/or demand for different journal delivery formats (for example, a movement towards electronic- only journals).
- Changes in funding flows arising from a movement towards publishers (or other organisations apart from the university) paying academics cash for carrying out peer review activities.
- The impact of increases in the volume of research on journal break-even price (through increases in the number of journals and articles).

These issues are considered in detail in Section 5.

It is important to note that this study has focused only on the *costs and funding* of the current scholarly communications process and possible changes to it. It does not therefore seek to quantify or explain the *benefits* of any possible change (such as, for example, a greater proportion of journals or articles being made available on an open access basis).

1.3 Study methodology

CEPA has carried out the study in five (sometimes overlapping) stages as follows:

- **Stage 1:** Review of key literature and consultations. In the first stage of the work CEPA reviewed relevant literature and interviewed a range of participants in the scholarly communications process. During this stage we also had extensive discussions with RIN and with Expert Panel members.
- **Stage 2:** Development of model structure and approach. CEPA defined the value chains to be modelled and the key scope and functionality of the model. The structure of the model was agreed at the second meeting of the Expert Panel.
- **Stage 3:** The third stage involved building the model and refining the structure and functionality in the light of further comments from RIN and the expert panel
- **Stage 4:** Data collection. Data for the model has been collected from two main sources. The main source has been the relevant literature, including published survey results. We have also received information from a survey of a small number of publishers and libraries.
- **Stage 5:** Scenarios and report write up. In the last stage of the work we agreed and run a series of scenarios to explore the policy questions outlined above in Section 1.2.

A more detailed explanation of the methodology is set out in Annex A.

1.4 Structure of the report

The structure of the report is as follows:

- Section 2 sets the study into context and provides a number of key definitions.
- Section 3 provides an overview of the model scope and structure.

⁵ The focus of all our modelling is on articles published in scholarly journals. Therefore, the model does not capture the costs incurred in producing, publishing and providing access to monographs, conference proceedings, and other forms of scholarly output.

- Section 4 provides the key results of the ‘base’ case modelling of the system-wide costs and funding flows – which are our estimates of the current system. It also sets out some of the key inputs to the model.
- Section 5 presents the sensitivity analyses, including a description of the rationale for the inclusion and analysis of different scenarios. Sensitivity results are presented and interpreted with reference to the ‘base’ case presented in Section 4.

There are three main annexes to this report as follows:

- Annex A provides more detail on the process that we have used for the study.
- Annex B provides a more detailed description of the model structure, including the value chain diagrams upon which the model is based.
- Annex C is the model book which sets out in detail all of the assumptions used in the model to assess the costs and funding flows of the scholarly communications system in the UK.
- Annex D and E provide further details of the scenario results presented in Section 5.

1.5 Caution in relation to model assumptions and structure

The focus of CEPA’s work has been to build a model of the scholarly communications system (the ‘system’), which allows the user to specify a range of assumptions about the costs, volumes and activities of the scholarly communications process in a ‘base case’ and then run policy scenarios against that base case.

As with all models the outputs are only as good as the inputs. Our approach has been to seek to define and model both the structure and input assumptions for the ‘base’ case on the basis of a review of the literature and discussions with the Expert Panel and other industry professionals. The sources of the input assumptions are set out in a detailed ‘Modelling Assumptions Book’ (Annex C). Although we believe that the assumptions used in the model for this report are reasonable, there are a number of judgements made where there is an absence of firm evidence.

In addition, given the complexity of the system, we have made a number of simplifying assumptions. These are set out in detail in the Model Structure (Annex B). Our view is that none of these simplifications materially impact on overall estimates of the cost or the analysis of policy scenarios.

2 Context, Scope and Definitions

2.1 *Purpose of this section*

The purpose of this section of the report is to place this study in the context of the scholarly communications process, and to place both publishers and libraries in the chain of information distribution from research author to reader. It also seeks to define and explain our understanding of some of the key terms used in the report, and the scope of our modelling work.

2.2 *Key definitions*

We take the scholarly communications process to be the combination of the publishing and distribution of scholarly research articles in scholarly journals, and the provision of access to such journals by academic and non-academic libraries, and other channels.

This study is therefore concerned with peer-reviewed articles, which are the culmination of a piece of scholarship or a research project. Publication of peer-reviewed articles provides a form of certification of the work, dates the work, and identifies the author as the originator.

We define peer review as the process by which an author's scholarly research output (in the form of a journal article) undergoes a process of qualitative assessment by experts in the field.

2.3 *Journals and other elements of scholarly communication*

Most research is currently reported as papers published in scholarly and scientific journals; the role of the peer-reviewed journal article is central to the scholarly record as the “minutes of science and scholarship”. Indeed, there are about 23,700 ‘active’ peer-reviewed scholarly and scientific journals currently published in English⁶.

While the peer-reviewed journal article reporting primary research is the key “unit of currency” in the scholarly communication process (and is the focus of this Report), we recognise that it is not the only mechanism for scholarly communication. Scholars and researchers have always communicated with their peers both during the research process itself and after the publication of the article reporting that research. Other mechanisms for formal and informal communication include the following.

- **Monographs** represent the principal output medium for scholarship in the arts and humanities. University libraries' purchasing of monographs has declined steadily over the past twenty-five years, as more of the library acquisition budget has been allocated to journals. As a result, fewer monographs are being published, and there is a growing body of arts and humanities scholarship that is published in journals.
- **Conference proceedings** are an important adjunct to the journal literature. In some disciplines, notably computer science, they assume considerable importance as a record of the principal means of announcing and communicating research within that discipline's community.
- **Secondary publishing** is an important feature of scholarly communication. The published journal literature is considerable, with some 1.59 million new articles being published each year. Abstracting and indexing services form an integral part of the publishing industry and are an important adjunct to the communications process, providing navigation tools for scholars and scientists. In a number of cases, publishers include both primary research journals and indexes in their portfolios. Examples include the American Chemical Society (Chemical Abstracts), the American Psychological Association (PsycInfo) and Elsevier (Excerpta Medica, Ei Compendex, Scopus etc).
- Another form of secondary publishing is the **re-publication** of the full text of primary journals by “aggregators” in databases. This has, as far as journals are concerned, often

⁶ Source: Ulrichs Periodicals Directory: www.ulrichsweb.com, viewed 7 January 2008.

represented an extension of abstracting and indexing products to incorporate the full text of articles. Aggregated databases are marketed to a wide range of libraries, including those that do not serve researchers: public libraries, further education and school libraries. They extend the readership of scholarly literature.

- **Pre-print repositories** form part of the less-formal infrastructure that has been created within some disciplines. The most notable is ArXiv, based at Cornell University; it was created within the physics community as a mechanism to share research between physicists – and now mathematicians and computer scientists. Cogprints serves a similar function in cognitive science. Authors deposit manuscripts of papers for communication and comment. Some two-thirds of papers deposited in ArXiv are eventually published in peer-reviewed journals.
- A more recent development has been the establishment of **post-print repositories**, in which authors post their final manuscript, after peer-review and acceptance for publication but before processing into the final published form. Some large repositories have been established in broad disciplines, such as PubMed Central, an NIH-funded repository for research papers in medicine and the life sciences; a European mirror-site of PubMed Central has been set up by a consortium including the Wellcome Trust and the British Library. Many universities are establishing their own repositories as both a communications mechanism and a showcase for research originated by their own faculty. They are not limited to journal articles and may contain conference proceedings, book chapters or technical reports. At the end of 2007, there were 683 research-based repositories (institutional, cross-institutional or departmental) containing primarily contain e-journal content. Of these, 88 were in the UK⁷.

Whilst we recognise the importance of these elements of the system we have not sought explicitly to model the costs and funding flows associated with them⁸.

2.4 *Agents in the scholarly communications process*

The supply chain from author to reader is characterised by two principal types of player.

- **Publishers** are responsible for organising the certification of research through peer-review, presenting the work in an accessible and useable form, and for disseminating the published work. The term ‘publishers’ includes commercial businesses, university presses, and society publishers engaged in these activities. The types of publisher considered as part of the modelling work are discussed in more detail in Section 3 and Annex B.
- **Libraries** organise and provide navigation and access to works from many thousands of publishers for their readers, and ensure the long-term preservation of the scholarly record. Again the types of libraries considered as part of the modelling work are discussed in more detail in Annex B.

However, it is important to note that there are other players in the information supply chain who provide products and services that complement and support publishers’ and libraries’ activities. The most relevant here are subscription agents, providing transaction processing services, organising the supply of journals from publishers to libraries, and compiling and providing product and holdings management information for their customers. Subscription agents also cater for the very varied administrative and financial requirements of their library customers, and play an important financial role, both in covering the gap between paying the publisher and being paid by the library, and in managing foreign exchange so that the library pays in its local currency, and the publisher receives payment in its currency of choice.

The importance of the subscription agent in the supply chain is diminishing in the online environment. Online distribution has enabled libraries to make use of purchasing consortia, pooling their collective purchasing power in order to obtain better value for money – i.e. more

⁷ Source: <http://roar.eprints.org>, viewed 20 November 2007.

⁸ Although the modelling allows for the possibility of ‘post-print’ repositories to the extent that they become a substitute for more formally peer-reviewed, we have not used this element of the functionality in this paper.

content for the same or less money. It has also allowed publishers to develop and manage relationships directly with their customers.

The result is that publishers and libraries (and their consortia) have tended to trade directly, cutting out the subscription agent, if only because the collective licence under negotiation involves complex pricing models, access conditions and performance standards that simply did not apply to the individual printed journal.

In our modelling work we have not sought to model subscription agents explicitly. Rather the costs associated with their activities are included with the assumed costs of the publishers for journals distributed in print. There are different costs associated with distribution of journals in electronic format.

2.5 *The characteristics of scholarly journal publishing*

While their missions may vary, most publishers, whether commercial companies or non-profit society and university press publishers, operate and structure their publishing activities in similar ways. Primary journal publishing is focused on the author and the reader. Journal publishing exists to serve the interests of the scholarly and research community in publishing the results of research.

2.5.1 *Origins – supply driven nature*

The scholarly journal has its origins in the seventeenth century. In 1665 the Royal Society Council voted to allow Henry Oldenburg, the Secretary of the Society, to commence publication of *Philosophical Transactions*, “the first Monday of every month, ... licensed under the charter by the Council of the Society, being first reviewed by some of the members of the same.” It is noteworthy that this resolution established the periodicity of the journal and the need for its contents to be filtered, by peer review.

Philosophical Transactions set out the criteria by which new discoveries could be reviewed and published as the “minutes of science”:

- registration: the establishment of the priority and ownership of research work by a particular author;
- evaluation and certification: quality control through peer review and rejection, so that only the better papers are published. The publication of a paper in a particular journal marks that paper and by implication its author as being of the same quality level as the journal;
- dissemination: the broadcasting of authors’ claims to like-minded peers around the world through the channel that the journal represents; and
- archiving: the establishment of a permanent record in the scientific literature for the work that was undertaken.

These criteria are embedded in the practice of scientific research and scholarship, and still drive journal publishing. In this sense, it is a supply-driven business.

2.5.2 *Other market characteristics*

Other key characteristics are as follows:

- The journal market is, in economic terms, unusual in that the reader in the faculty or corporation may select or recommend the titles that are acquired, without having to bear directly the cost of acquisition. So the purchase is made by the library, which has the budget, but is driven by the requirements of its readers. Price signals do not reach the ultimate consumer – the reader. In such an environment, pricing is generally geared closely to the cost of producing the journal.

- The number of papers published each year has increased by approximately 3 per cent per year⁹. This continued growth in publication closely mirrors the increase in research and development investment in developed economies.
- Journal publishing is dominated by a few large commercial publishers. Nevertheless, the barriers to entry into journal publishing are relatively low, and there are thousands of smaller publishers, including learned societies with the leading journals in their fields. Publishers have always used freelance editors, printers and other “outsourced” suppliers; these suppliers now include a highly competitive range of technology suppliers catering for process automation and online publishing, thereby enabling small publishers to compete effectively with the large companies.
- The two principal factors that drive pricing decisions are the costs involved in publishing, and the circulation of the journal. These are crucial, as costs have to be recovered by amortising them across the circulation. Reduced circulation does not affect the number of papers published, but does drive up the cost of servicing each subscription.

The role of publishers draws considerable amounts of attention and criticism from some in the library community. The commonly held concern relates to a perception that the publishers are profiting from a product that is provided to them without cost, and peer-reviewed by reviewers who (generally) are not paid.

As part of this study we have not sought to do a detailed cost-benefit analysis of the most appropriate mechanisms for the publication of peer-reviewed articles. However, our analysis does seek to bring together the available evidence on the functions and costs of publishers' activities. It also recognises that, notwithstanding the above concerns, publishing is designed to provide a service to authors – to make the author's manuscript polished and packaged for the reader, and marketed effectively to libraries and their readers internationally. We also recognise that publishers of all kinds make investments and bear financial risk associated with existing and new journals. For example, new journals serving new areas of research have to be funded from existing resources – i.e. from the revenues earned from existing titles. A new title in science can build up losses over five years, and not reach break-even until Volume 6 or 7.

It is important to realise that up to 80 per cent of the cost of publishing a journal is incurred in processes that are not dependent on the medium of output – paper or online. These include the cost of editorial offices and secretarial assistance that institutions may not be willing to pay for, preparing illustrations and typesetting/data capture, and indirect costs such as subscription maintenance, marketing and author administration.

Given this, whether or not online publishing reduces costs will depend on whether or not savings in paper, printing and distribution are more than offset by the costs of hosting, and of providing additional functionality (e.g. links to and from cited articles and A&I services, searching power and flexibility), 24-hour availability and customer service.

2.5.3 The global dimensions of scholarly journals

The journal publishing business is global. Irrespective of where a journal may be published, its authors will be international in origin, and its market will also be international.

- The academic and scientific information industry – books, journals and databases – generated revenues of just under \$16 billion (£8 billion¹⁰) in 2007, being around 5 per cent of the global information industry¹¹. Of this figure roughly half of revenues are generated by journals: \$8 billion (£4 billion)¹²
- The UK-based publishing industry occupies a major position within global academic and scientific publishing, and generates some £800 million of annual export revenues.

⁹ Mabe M. and Amin M., Growth Dynamics of Scholarly and Scientific Journals, *Scientometrics* 51 (1), 2001

¹⁰ A \$:£ exchange rate for 2007 of 2:1 has been assumed here and throughout the report.

¹¹ Source: Outsell Inc, Information Industry Market Size and Share Rankings: 2006 of \$362 billion (£180 billion)

¹² Expert estimate based on Outsell Inc and JP Morgan European Equity Research.

- UK academic libraries' acquisition of scholarly and scientific journals is worth over £110 million per year. According to a recent report, this represents 30-40 per cent of total UK publishers' revenue for journals, with 20-30 per cent attributable to corporate libraries, and the balance to government, individual and professional subscribers and to advertising¹³. These ranges are somewhat general, as such data is not systematically collected, but they indicate that significant revenue is generated by customers from outside the academic community. As we discuss in Section 5 this is a key factor in consideration of the funding flows in an author-pays versus a reader-pays publishing model.
- 40 per cent of the global market is in the USA. Nevertheless, much journal publishing is undertaken by organisations based in Europe, mainly in the UK, the Netherlands and Germany. The UK publishing industry is responsible for publishing over 20 per cent of scholarly journals. The UK is overwhelmingly a net exporter of journal literature.

2.5.4 The review process

The process from article submission to acceptance is handled by journal editor, reviewers and the publisher. Papers are submitted to the journal, usually using an automated submission system provided by the publisher. They are then considered by the editor, or by publishing staff. At this stage some may be rejected as falling outside the journal's scope, or simply because they are manifestly poor work. The remaining papers are sent to experts (or "peers") for review. The result may be a recommendation for acceptance, rejection, or an invitation to the author to make amendments. The final decision to accept or reject lies with the editor. This process involves a mixture of cash and non-cash costs.

- The publisher incurs cash costs in providing the submission system, payments of honoraria and office expenses to the editor, and sometimes staff to undertake some of the review functions in-house.
- While the editor may be paid an honorarium, this is unlikely to cover the full cost of his/her time; this constitutes a non-cash cost.
- Reviewers generally undertake their reviewing work as part of their job, without any direct remuneration. This constitutes a significant non-cash cost in the process.

2.5.5 The post-review functions of the publisher

Once the article has been reviewed and accepted for publication, the publisher undertakes a range of functions to produce the final published product and bring it to the attention of readers:

- copy-editing the manuscript, typesetting and data-capture, and proof-reading designed to re-check and correct the accuracy of the information and make the work grammatically-correct and stylistically consistent with the journal house style;
- marketing the journal to readers and libraries both to attract subscriptions and to attract authors to submit papers through direct mail to libraries, society membership and conference lists; advertising; inclusion in all appropriate abstracting and indexing services; journal web pages and e-marketing; setting up mandates with the local Reproduction Rights Organisation (e.g. CLA in the UK); and licensing re-publication and distribution rights to document delivery services and aggregators to extend readership to institutions that would not normally maintain research journal collections;
- warehousing, shipping, customer service and subscription management via subscription agents and direct to customer; and
- online hosting of electronic journals, including the provision of functions such as citation linking via CrossRef, the industry's own linking mechanism, improved metadata and indexing, and tools to make the article and underlying data useful to the reader.

¹³ Source: UK Scholarly Journals: baseline report, RIN, RCUK and DTI, 2006.

2.5.6 The publication cycle

The publication cycle from acceptance of a paper for publication to dispatch of printed issue is typically much shorter than for books. Publishers have automated their processes so that an article is processed in digital form from submission. Online submission and peer-review management systems have become commonplace; authors submit their work online and the circulation and review of papers is now automated. Text and data are processed electronically, so that the first time an article manifests itself in printed form is when proofs are read and corrected, and then the printed issue is published. As a result, typical publishing cycles have been shortened from 16 to 10-12 weeks. As the print production component of that cycle may be three weeks, many publishers have taken the opportunity to post articles online as soon as the final proofs have been approved and the issue 'passed for press' (i.e. authorized for printing). This has reduced the production cycle further, and improved the timeliness of publication.

2.6 Academic and research libraries

Research by Andrew Odlyzko¹⁴ in the late 1990s identified libraries as one of the significant costs in the scholarly communication process. Confirmation from an unusual source came in 2002; an investment analyst's report indicated that while academic libraries spend 41 per cent on acquisitions (serials, monographs, databases etc), 46 per cent of costs were staff related, with 13 per cent attributable to other costs¹⁵. (This broad distribution is confirmed by SCONUL statistics). This is hardly surprising given the range of functions librarians undertake in relation to scholarly information, while additionally serving all their users including students, and given the impact of online information on the use of library facilities and on the role of library staff:

- the selection and acquisition of books, journals and databases to meet the needs of faculty and students, together with indexing tools to enable readers to locate and retrieve the information they need;
- the maintenance of a catalogue of library holdings that provides important navigation facilities to information in the collection;
- the creation and maintenance of the intranet that seamlessly organizes and presents the range of information from many sources that the library acquires. This may include the creation and management of institutional repositories;
- training readers in the use of electronic resources; and
- the long-term preservation of the scholarly record in its archive.

The academic library is changing as scholarly publications migrate from print to an online environment. Examples in corporate research, for instance in the pharmaceutical industry, show that library services are changing from being a 'place' to being a virtual service meeting the needs of researchers wherever they may be. Moreover, traditional role demarcation within the library, and between libraries and publishers, is changing:

- the differing roles of book and journal acquisitions librarians is ceasing to make sense in respect of information acquired online, where it is all "content";
- the creation of catalogue records used to be the sole province of the library, carried out via library co-operative services such as OCLC. This is still the norm, although metadata is becoming available via other intermediary services, or sometimes from the publisher as part of a service to libraries; and
- Libraries have traditionally seen archiving as one of their key responsibilities, but they have been looking to publishers to make appropriate arrangements for archiving electronic publications. Archiving in the online environment has become a joint effort, with publishers and libraries entering into collaborative arrangements for archiving online content, often

¹⁴ www.firstmonday.org/issues/issue2_8/odlyzko/index.html

¹⁵ Scientific Publishing: Knowledge is Power, Morgan Stanley Equity Research Europe, 2002

between a publisher and the national library or a non-profit archiving service such as Portico.

Details of how we have modelled libraries and the access component of the scholarly communications process are set out in Section 3. However, it is important to emphasise that that this element of our work has focused on the UK exclusively, and academic libraries particularly.

2.7 *Technology-related policy issues*

Research and development underpins the stability and continued growth of developed economies. The scholarly communications process lies at the heart of this activity, and consumes significant amounts of public funding. The impacts of internet-based technologies, some such as open access already apparent, and some not yet fully clear, raise policy considerations across and beyond the academic community, including the Higher Education Funding Councils; Research Councils UK; and the Departments for Business, Enterprise and Regulatory Reform (DBERR) and for Innovation, Universities and Skills (DIUS) and their equivalents in other parts of the UK.

In this section we briefly refer to two key policy issues that have arisen as a result of the potential for online access. The first relates to 'big deals' and library purchasing consortia. The second concerns the arguably more significant debate relating to open access.

2.7.1 *Big deals and purchasing consortia*

The market for journals has been changed fundamentally by the adoption of online distribution of journals by most publishers from the mid-1990s onwards. The use of the internet has grown exponentially. The scientific journal that is not available online is a rarity:

- 90 per cent of the journals published are now available online, an increase from 75 per cent in 2003;
- 84 per cent of humanities and social sciences and 93 per cent of STM titles are now published in online versions¹⁶.

Most important, technology has changed how university faculty and other researchers choose to work; they demand access to the literature at the desktop.

Overall access to journals has increased, as library consortia and major publishers have negotiated "big deals" by which all libraries within a consortium have online access to all of the publisher's output.

Despite some scepticism in libraries about the benefits of the 'big deal', most academic libraries in the UK, as elsewhere, now make use of this approach to journal access. The evidence from organisations such as OhioLINK, reported in the early 2000s, is that there is a great deal of usage of journals that were not previously held on subscription at the user's campus¹⁷. This has been repeatedly affirmed by universities as diverse as Toronto, Warwick, Glasgow, and Macquarie and ANU in Australia.

A notable feature of the market has been the development of library consortia, in which libraries pool their resources and use their combined buying power to negotiate better deals from publishers. The development of library consortia is important; there are now over 300 world-wide that actively buy scientific literature for their constituent libraries. JISC Collections and NESLi2 negotiate consortia deals for the higher education sector in the UK, with libraries choosing to opt-in or opt-out of the deals.

¹⁶ Cox J and Cox L, *Scholarly Publishing Practice, a Second Survey*, ALPSP, Worthing, 2006.

¹⁷ Sanville T, *A Method out of the Madness: OhioLINK's Collaborative response to the Serials Crisis – a Progress Report*, UK Serials Group Conference, April 2001

2.7.2 Open access

Open access is a term used to describe a number of publishing models, all of which challenge the traditional journal business model, based on subscriptions. The open access model transfers the cost of publishing from the subscriber (the market in which the reader operates) to the supplier (the community in which the author/ researcher operates).

It should be noted that open access does not of itself affect the processes of submission, peer review, preparation, publication, marketing and delivery, or the costs involved in operating those processes. Open access publishing models fall into two general categories:

- **Open access journals**, in which the costs of publishing are met from author-side payments for publication, from institutional “membership” payments that grant a discounted publication fee to institutional faculty and staff, or from grants from external sources such as charitable foundations, or via institutional support for overheads and salaries for e.g. university-based staff. Open access publishers range from Hindawi, Public Library of Science and BioMed Central to society publishers with experimental open access journals to individuals, groups and departments based in universities. Publishers are also introducing hybrid models in which there is a mixture of author and reader (‘subscription’) payments. Such journals form as yet a relatively small part of current scientific journal literature.¹⁸
- **Open access archives (repositories)** comprise institutional and subject-based repositories where authors make their work freely available, sometimes following a publisher embargo period¹⁹. Thomson Scientific estimates that 65% of articles published in journals indexed by it for citation analysis are openly accessible via such repositories. This is a much more significant segment of the published literature, and appears to complement existing publishing practice. Nevertheless, it should be noted that many institutional repositories are as yet very small, and there is clearly difficulty in persuading academic authors to populate such repositories with their work. However, funders such as the Wellcome Trust and, most recently, the National Institutes of Health in the US, are beginning to require that researchers place copies of their articles in subject-based or institutional repositories.

There is considerable pressure for open access from some parts of Government, the research funding community, and universities– reflecting the presumption that there are benefits associated with making research outputs available free at the point of use. This study has not sought to investigate the benefits of a move toward open access; nor do we seek to explore what would be necessary for open access to become sustainable as a publishing business model in the longer term. Rather, the focus of the study and this report has been to develop a model that allows us to explore how changes in publishing approaches might impact on the costs of the system as a whole and the funding flows within it. But by way of context we note the following.

- To the extent that journal publishing has (ever since the founding of *Philosophical Transactions*) been driven by the needs of scholars to publish the results of their research, the move to transfer the costs of the system to the point of supply appears logical.
- Open access makes journal articles available to all at no charge to the reader; hence it can eliminate the restrictions on access that disenfranchise readers who cannot afford to subscribe or whose library budgets restrict the journals to which they can have immediate access. On the other hand, it may affect the ability of researchers in less-well-funded subject areas or in less-developed countries to publish in journals which levy an author-side fee²⁰. The presumption may be made that there would be significant positive benefits for society

¹⁸ The RIN (2006) baseline report estimates about 2,000 author-side payment journals based on Ulrich’s Periodicals Directory. However a significant share of listed author-side payment journals do not publish regularly and the average number of articles published per year is lower. Sally Morris (in *Learned Publishing* 19(1) January 2006) estimates that author-side payment journals publish on average 42 articles per year only. Overall we based our modelling on estimates suggesting that only about 2% of articles are published in author-side payment journals.

¹⁹ Scholarly articles may be available in open access repositories after a period of time (normally 6-12 months) following publication in a subscription journal.

²⁰ These researchers are currently subsidised through preferential subscription rates.

associated with a move to open access since all researchers and the public would be able freely to access all scientific articles. However, we have not reviewed the literature on this subject.

- As noted above, it is uncertain as yet whether and how an open access model might be financially sustainable (for commercial or not-for-profit publishers alike). Research continues into the sustainability of open access and its acceptability to research authors, which falls outside the scope of this report. As yet, no consensus has been reached on this issue.
- A further consideration is that corporate and government library purchases comprise a significant proportion of journal revenues while non-academic authors are much less significant as a proportion of total authorship. If open access journals establish themselves, the academic research community and its funders will have to bear almost the entire burden of financing the publishing cycle.
- Open access may have unintended impacts on the financial underpinning of many learned societies which are dependent on publishing revenues to subsidise their other activities.

3 Model Structure

3.1 Overview of model

We set out here a summary of how the model is structured. A more detailed description of the structure is set out in the model structure (see Annex B).

3.1.1 Value chain scope

Figure 3.1 shows what we consider to be the five components that are common to the *research value chain* (regardless of business model), and the extent to which each has been modelled. They are as follows.

- *Research production* captures the set of activities carried out by researchers to create a research article and to submit it for peer review and publication.
- *Publication* involves the peer review and editing of articles submitted, and the composition of approved articles into journals.
- *Distribution* covers the logistical activities required to transport (either physically or electronically) copies of journals to libraries and other buyers. It also includes the activities involved in the marketing of journals.
- *Access* captures the set of activities carried out mainly by libraries with the purpose of making journals accessible to end-users, both now and in perpetuity.
- *Consumption* captures the set of activities undertaken by researchers in identifying, searching for, accessing and reading articles, mainly online and/or in libraries.

Because the study is specifically on the scholarly communications process, the focus of our detailed modelling work has been the *publication*, *distribution* and *access* components of the research value chain. *Research production* activities which precede the publication component, and research *consumption or usage* activities which come after the access component of the value chain, are modelled in less detail (referred to as ‘contextual analysis’). That is, the modelling is based on only a small number of assumptions drawn from the literature; and although these can be changed they are not dynamic (i.e. they do not vary automatically as part of any model runs).

Figure 3.1: Model scope



3.1.2. Costs and prices

One important point to be clear about at the outset is the distinction between costs incurred in the scholarly communication process (which includes all aspects of publication, distribution and access) and the prices that libraries and others incur in acquiring journals (in print and / or electronic form). In what follows, we use the following definitions:

- The journal / article **‘acquisition price’** is the price paid by UK libraries and other organisations (special libraries, corporate users, etc) buying journals / articles.
- **‘Incurred costs’** are the total costs of publishing, distribution and access activities incurred by value chain participants, excluding the acquisition price.

A clear distinction between these two concepts is essential, in order to avoid ‘double counting’ in calculating the costs of the scholarly communications process.

Incurred costs can be either **'cash' or 'non-cash' costs**. For the purposes of modelling we define the latter as costs incurred (typically by academics) which are not directly remunerated. Non-cash costs include the costs of the time spent by referees in peer-review²¹ and by readers in searching for articles relevant to their work.

3.1.3 Model structure

At the highest level, the model is organised around:

- the grouping of activities in the value chain as illustrated in Figure 3.2, i.e. the publication and distribution²² of published articles²³ and providing access to them; and
- the two main features of the model requirements, i.e. the incurred costs of the value chain as a whole and the sources and volumes of funding.

Figure 3.2: Article allocation versus article access



The model is divided into three **modules**, each comprising a number of **input components** generating sets of **outputs**, shown in separate *input* and *results* worksheets. Figure 3.3 at the end of this Section provides a summary of the model structure, including the main input components and outputs of each module (in the form of a two by two table). A detailed explanation of each of the three modules is presented in the model structure document in Annex B. We provide a high-level summary here.

All costs and activities are reported in GBP£ and are annual costs and activity flows. The model seeks to capture a single year 'steady state', but has the functionality to compare how a 'base case' varies with a range of scenarios.

Module 1 – Production and distribution (global)

Module 1 calculates the costs incurred in carrying out the activities within the publication and distribution components in the scholarly communication process value chain. The global nature of the scholarly communications industry means that this module considers the publication and distribution of all (English language) journals.

In producing these estimates the model allows disaggregation of costs of article production by:

- **Type of costs** (direct and indirect, fixed and variable costs, cash and non-cash and taxation²⁴).
- **The stage in the value chain** (i.e. publication, distribution and access).
- **Different journal types** which vary by:

²¹ In the model 'base case' (Section 4) peer review of articles is defined as non-cash, but a number of activities related to the initial screening, processing and management of articles for peer review are picked up as direct cash cost incurred by publishers.

²² We consider the provision of electronic journals through publishers' servers or through online portals (either open access or subscription-based) as simultaneous distribution and access. In order to allow for ease of analysis of costs by UK libraries under the access component, we classify electronic journal provision under the distribution component of the value chain.

²³ The model is structured around flows of *published* articles (and journals) to ensure a degree of definitional precision in our approach.

²⁴ We recognise that from a broader economic perspective taxes are a transfer rather than a 'resource cost'. However, we include tax in order to allow for the differential tax treatment of publishers and journal formats on acquisition prices. It is also particularly relevant from the perspective of changes in library budgets in our analysis of scenarios.

- business model (traditional print publisher ‘reader-pays’ model and open access ‘author-pays’ model);
 - subject (science/technology, medical, arts and humanities);
 - journal category (popular hybrid journals, major discipline journals, niche journals);
 - quality, as measured by the article rejection rate.
- Alternative production **formats** (print-only, print and electronic, electronic-only)

The *final* outputs of Module 1 include calculations of:

- fixed (first copy) costs by journal type (cash and non-cash);
- variable costs by journal type (cash and non-cash);
- total, average and marginal costs of publication and distribution activities. and
- estimates of a notional ‘break-even’ prices by journal type and volume of circulation. It is important to recognise that these ‘break-even’ prices assume that publishers make an average return on all journals. In practice, the return for different types of journals (including whether they are new or mature titles) will vary.

Module 1 also generates *intermediate* outputs that feed in as inputs to the calculation of the outputs presented above. Intermediate outputs include counts of articles flowing through the publication and distribution components of the value chain; and counts of circulation of different journal types. These have been calibrated to give a reasonable approximation of the current scholarly communications process.

The model also allocates articles and journals to three different **publisher types** to capture different average rates of return (or surplus) after accounting for tax treatment, and different sources of revenues by journal²⁵. It also allows the model to consider ‘big deals’ at a simplified level.

The model does not seek to allocate journal publication to specific countries. We recognise that there may be certain perceived advantages for the host countries arising from the location of publishers, but this issue is beyond the scope of this report.

Module 2 – Access (local)

The access component is local. This module therefore focuses on the costs incurred in the UK to provide access. It seeks to capture the volumes of activity carried out, and the associated costs incurred, by different types of university and other libraries in providing access to journals and articles in the UK. The library types are as follows²⁶:

- **RLUK**: Members of the Research Libraries UK²⁷. These are the libraries of 22 large UK universities plus the British Library, National Libraries of Wales and Scotland, the Victoria and Albert Museum, and the Wellcome Library for the History and Understanding of Medicine;
- **Old**: Those universities founded or chartered before the Education Reform Act 1992, but excluding RLUK members;

²⁵ The three publisher types are as follows: (i) **Commercial publishers** capture the large players in the scholarly journal industry. These are for-profit, tax-paying private-sector companies publishing a broad range of titles across subject areas, all typically offering ‘big deal’ packages of titles to libraries; (ii) **University press** publishers capture Oxford and Cambridge University Presses, as well as equivalently large organisations in the US. These are not-for-profit organisations although they do aim to generate a surplus which is redistributed back into publishing and/or other activities carried out by the university; and (iii) **Society** publishers capture the high count of smaller, membership-based publishers, and include smaller university presses not captured above (e.g. Liverpool University Press). Publishers in this category redistribute any surplus generated back into the publishing and other activities of the society to which they are affiliated. Society publishers exclude the large American societies.

²⁶ The allocation of academic libraries into different categories was carried out using SCONUL’s classifications in mid-2007. Some institutions have acquired or changed university status since then, but for the purposes of the study we consider them to remain in their classification in 2006.

²⁷ The former Consortium of Research Libraries (CURL) changed its name to Research Libraries UK (RLUK) on 1 April 2008.

- **new:** Universities incorporated between 1992 and 2005. These include the former polytechnics, and some former HE colleges;
- **HEC:** Higher education colleges which did not by 2005 have formal university status. This group covers large general colleges (e.g. University College Plymouth St Mark and St John,) to small specialist institutions (e.g. Royal College of Music).
- **other:** includes special libraries (public and corporate) with a significant collection of research journals.

The key *final* outputs that Module 2 generates are:

- the total incurred fixed costs of providing journal access by different university library types. These costs vary with the number of journals that a library has;
- the variable costs (i.e. the costs per user; as opposed to the cost per journal) of providing access to different journal type; and
- the average user cost of article access (cost per use).

Module 3 – Funding allocation module

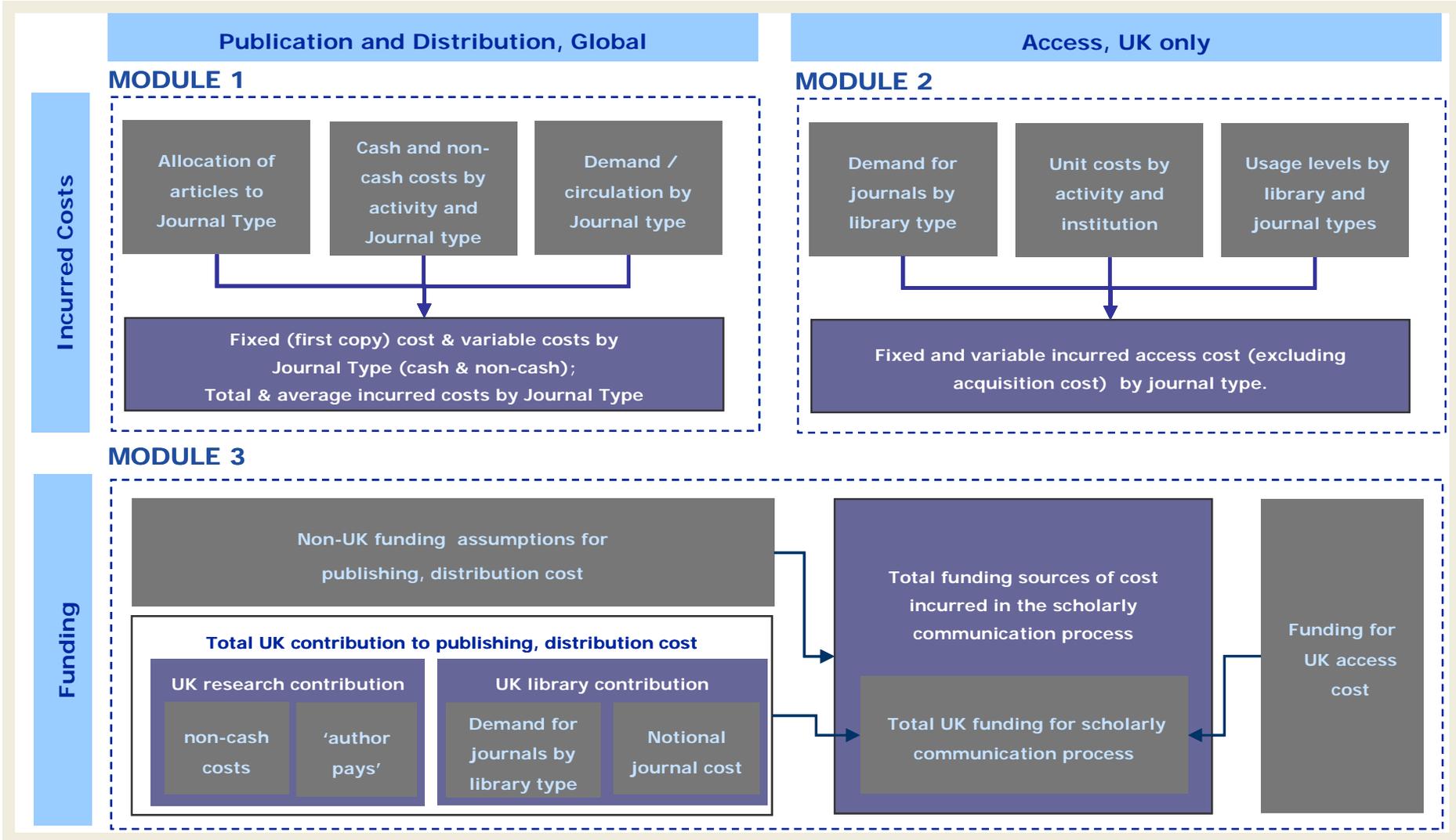
The objectives of Module 3 are:

- to allocate the total publication and distribution costs of the scholarly communications process (i.e. not access costs) to different sources of funding; and
- to identify the proportion of total funding for both 'cash' and 'non-cash' incurred costs that are borne by UK academic institutions (i.e. 'geographic funding allocation').

The *final* outputs generated by Module 3 include:

- the proportion of cash and 'non-costs' funded by different sources in the value chain;
- the proportion of funding of 'non-cash' and cash costs associated with the publication and distribution by the UK; and
- an estimate of the actual costs incurred by the UK academic libraries and academic research funders.

Figure 3.3: Scholarly Communications Process Model Modules



4 Model 'base' case

4.1 Introduction

In this section we set out the results generated from the spreadsheet model of the scholarly communications process ('the model') developed, populated and run during the study.

Results presented in this section are estimates of the **current** levels and shares of incurred costs and funding in the scholarly communications process, and in the broader research system value chain. The UK's contribution to incurred costs and funding is identified throughout this section. As already noted in Section 1, the results presented here reflect a range of assumptions which have been discussed and agreed with the Expert Panel and cross-checked against various sources. However, it is important to recognise that there is a significant element of judgement involved and many assumptions could be refined to improve accuracy.

Possible **future** levels and shares of costs and funding in various alternative states of the world are presented in the next section. We use the term '**base case**' to describe the set of results presented in this section, and '**scenarios**' to describe variations from the base case presented in Section 5.

This section is organised to reflect the focus of our work – i.e. the scholarly communications process covering global publishing costs and funding, and UK access costs:

- Section 4.2 provides details of a small number of key volume assumptions that feed into the model.
- Section 4.3 puts the scholarly communication process in the context of the wider research value chain and provides high-level estimates for the costs of the global system. As noted in Section 3, parts of these estimates draw on the less detailed contextual analysis that has been carried out as part of the study.
- Section 4.4 provides results of the total incurred costs of the production and distribution component of the scholarly communications process. These costs are global costs. We also present estimates of the proportion of these costs that are estimated to be funded by the UK and measures of whether the UK is a net contributor or beneficiary of funds provided from elsewhere in the scholarly communication process.
- Section 4.5 presents the results of the modelling work on UK access costs.

4.2 Key assumptions and intermediate outputs

The detailed input assumptions used to derive the modelling results set out in this section are presented in Model Assumptions Book at Annex C. For ease of reference, Table 4.1 sets out a number of key volume assumptions that drive the model estimates.

Table 4.1: Summary of key modelling volume assumptions

Volume driver	Units	Assumption	Source
Average number of researchers producing articles in a year	Number of researchers	1.92m	Thomson Scientific, UNESCO It is assumed that about 30-40% of global R&D researchers are regular authors or co-authors.
Global volume of articles published in a year	Number of articles	1.59m	The number of articles has been calibrated to match: (1) the global number of published scholarly journals of 23,700 per year; and (2) the assumed input assumptions of published articles per journal per year (between 30 – 120 articles per journal per year depending on journal type).
Average number of journals (titles) available in a year	Number of titles	~ 23,700	Model calculation based on average number of articles per journal per year.
UK number of research libraries	Number of libraries	RLUK – 29 ²⁸ OLD – 38 NEW – 51 HEC – 32 Special - 104	SCONUL library data Number of special libraries assumes a total of 47,000 non-academic researchers. On average 450 researchers equal one special library ²⁹ .

²⁸ As outlined in Section 2.8.3 (Module 2) the number of RLUK libraries includes a number of large research libraries from outside the higher education sector including the British Library. The model makes the simplifying assumptions that the total number of researchers is distributed across all libraries. However, this does not have any bearing on the cost of research production, publication, distribution or any non-cash costs incurred by researchers.

²⁹ There are no official estimates for the number of special libraries. Non-academic researchers' use of academic libraries has not been modelled. Therefore, non-academic researchers' access and usage costs are incurred at special libraries (the cost structure of a special library currently based on 'small' HEC library).

Volume driver	Units	Assumption	Source
UK FTE academic / scientific researchers per institution	Number of researchers per university/ library type	RLUK – 2,000 OLD – 700 NEW – 650 HEC – 500 Special – 450	HESA and SCOUNL data was used to estimate FTE academic staff. For the base case, the model assumes a total of 133,000 academic researchers which is broadly in line with HESA data 2001 suggesting a total of 116,000 full time and 23,500 part time academic staff ³⁰ .
UK number of articles read per year	Number of scholarly articles read per year per researchers	<ul style="list-style-type: none"> • RLUK – 258 • OLD – 258 • NEW – 258 • HEC – 258 • Special – 197 	Based on Tenopir and King (2002-2006) studies, weighted average of total readings based on different subjects. Input assumptions do not distinguish between subject types. No varying levels of readings for different academic researchers, but lower estimate for non-academic researchers.

4.3 Scholarly communications process in context

Figure 4.1 shows the system-wide incurred cost across the four research value chain components. This is the highest-level aggregation of costs presented in the report, with costs captured on a global level, excluding the bulk of non-academic research and development costs (e.g. research carried out by industry) for article production, but including the reading cost for all researchers.

We estimate that the total annual cost of research system activities is £175bn³¹: £115bn for production of research articles; £25 billion for the scholarly communications process (or 14% of the total research system cost); and £34bn for reading costs. The key components of the scholarly communication process are publication and distribution; access provision; and user search and printing.

The key points of contextual analysis are as follows. (The components of the scholarly communication process are discussed in more detail in the rest of this section.)

Research Production

Research production costs account for by far the largest share of the research system-wide cost: £115.8bn (66%) of the total. These costs include those incurred by researchers in carrying out field and lab research activities and in consolidating and writing-up the results of their research. There was some debate during the course of the study about whether reading should be considered as part of research production or as part of consumption activities. The latter approach was chosen in order to distinguish between the ‘input’ and ‘output’ components of research activity.

Therefore, the cost of researchers reading scholarly articles, which might feed into his research production activities is not captured in *research production*, but is instead captured as reading cost in the *usage* component.

³⁰ Note that we do not explicitly exclude research students as part of these estimates. This may have an impact on reading time costs discussed later in this section.

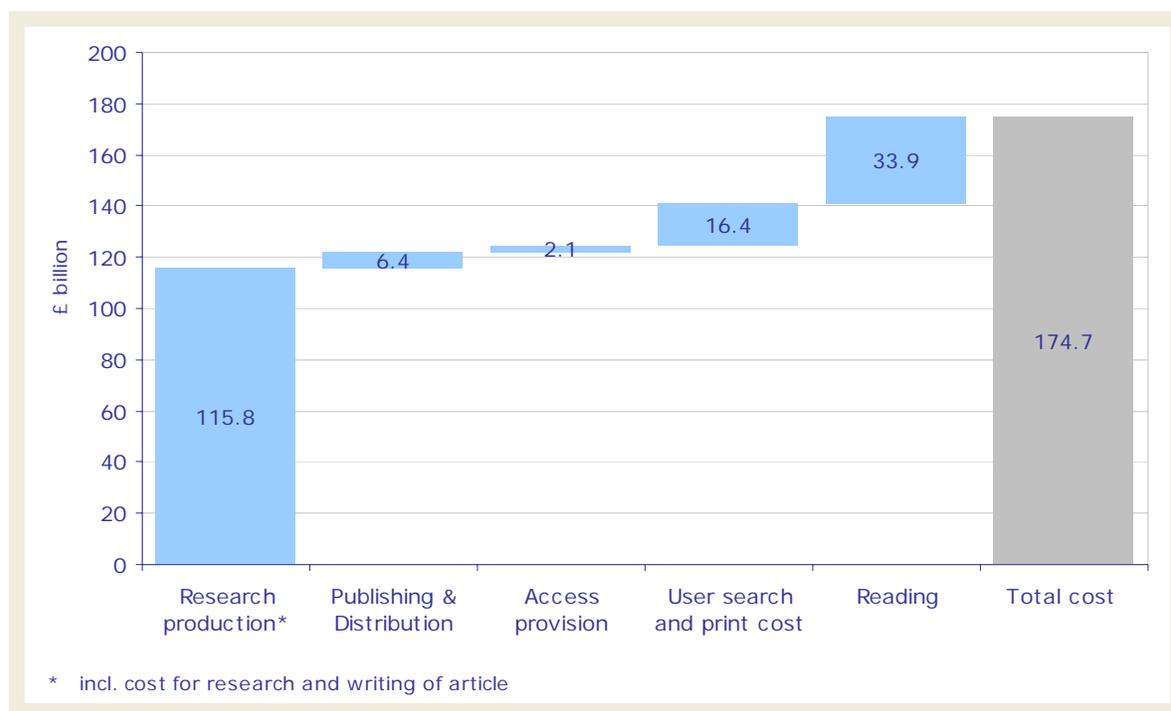
³¹ The estimates rely on detailed modelling of global publication and distribution cost estimates in the model. However, the access costs in the model are for UK only – so the global access cost estimates in this section are therefore extrapolations from UK calculations.

The estimates here are calculated using an assumed per article cost of research production (including writing cost) of around £73,000³². This is based on non-industrial research funding, the number of researchers (unique authors publishing scholarly articles) and an assumed annual productivity. The cost per article of research production is multiplied by an assumed number of research articles generated by the global research system in a year.

Reading

The final block in Figure 4.1 shows the estimate of the cost of reading of around £34bn, or 19% of the total research system. These estimates reflect the total global researcher base, a total number of readings per researcher by institution and an average reading time by subject. The model calculates the UK's and global researchers' share of reading separately.

Figure 4.1: Total (system-wide) annual cost incurred in the global scholarly communications process, by value chain component



4.4 Publication and distribution

This section presents key cost and funding flow results specifically relating to the *publication and distribution* component of the scholarly communications value chain. These have been modelled on a global basis – i.e. to cover the total costs of all peer-reviewed articles.

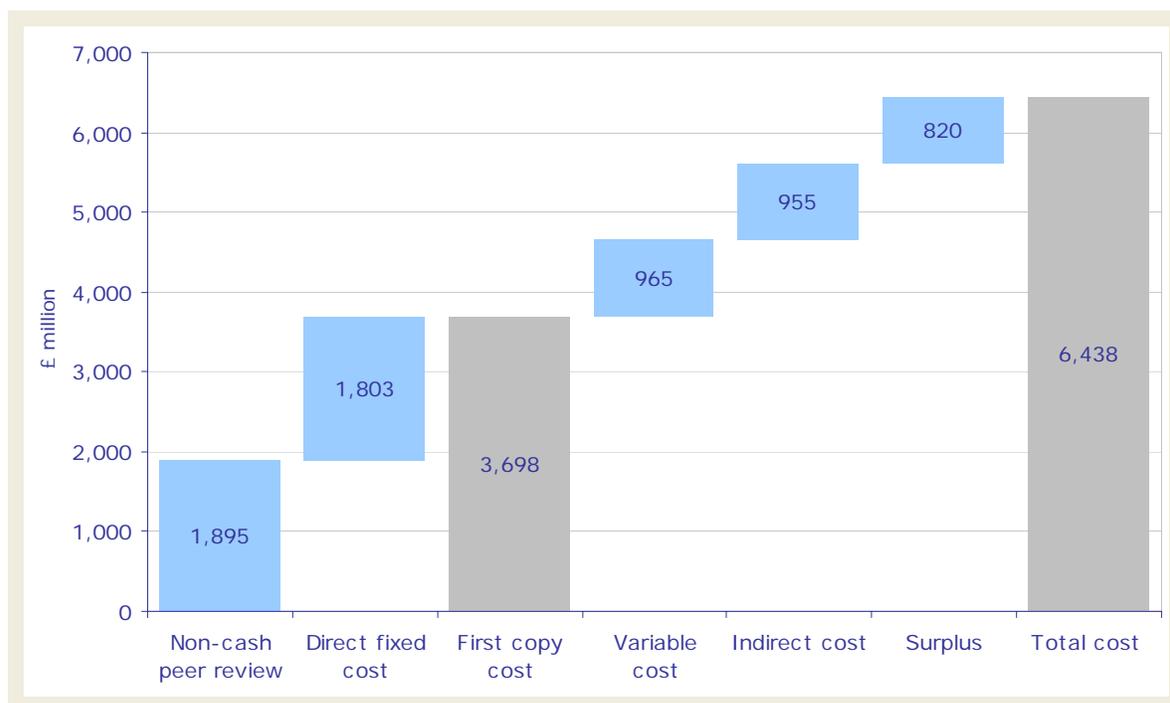
4.4.3 Publication and distribution: incurred costs (global)

Total costs

Figure 4.2 shows the global cost of publication and distribution activities incurred in a year disaggregated by first copy, direct, indirect, fixed, variable and surplus costs.

³² Based on UNESCO, OECD and UK government statistics on research expenditures, as well as Thomson ISI statistics on article production, the model estimates that the cost per article in the UK (at around £45,000 is lower than the global average of around £75,000 per article). This difference is generally taken to be indicative of higher levels of productivity per researcher in the UK. (as measured by peer-reviewed article production). We use the global average for our analysis. As with all of the modelling, this assumption can be varied.

Figure 4.2: Total publishing and distribution cost incurred in the global scholarly communication process, by activity



Key points to note are as follows:

- Our estimate of the cost of the global publication and distribution elements of the scholarly communication process is around £6.4bn. Excluding non-cash peer review costs from that estimate suggests a total incurred cash cost of £4.5bn. This is broadly consistent with the annual global scholarly publishing market revenue estimate reported early in Section 2.
- The first block in Figure 4.2 shows peer-review costs of £1.9bn. These are assumed to be the only non-cash cost in the publication and distribution element of the value chain³³. The time cost incurred in peer review activity is the main non-cash cost incurred in the research system. It is calculated by multiplying an assumed number of articles undergoing peer review in a year, by an assumed average number of peer reviewers per article, at an average length of time spent reviewing each article per reviewer, and a notional hourly fee rate. Assumptions are also applied about the ratio of rejected articles (after peer review) to published articles (which differs across different journal categories³⁴). Details of these calculations are set out in Table 4.2 below.
- Fixed first copy costs, including the non-cash cost of peer review, account for approximately £3.7bn (57%) of the total publishing and distribution cost.
- Total variable costs relate to the costs associated primarily with distribution. These vary according to subscription rates and the formats in which the articles are assumed to be available (electronic only, print only, and electronic and print). Variable costs further include subscription-related costs (e.g. sales administration, online user management, etc.). We estimate these costs to amount to be around £0.97bn.

³³ As stated in the model overview, for the purposes of modelling we define non-cash costs as costs incurred (typically by academics) which are not directly remunerated as part of the scholarly communications cost.

³⁴ Table 4.2 sets out some key inputs on article allocation and levels of rejection rate. Overall the share of articles allocated to different journal types (high/medium/low rejection rates) and the applied rejection rate result in a weighted average rejection rate of 90% rejected articles for Popular Hybrid journals, 57% for Major Discipline journals and 45% for Niche journals.

- Indirect costs are the overheads incurred by publishers, and cover marketing, online hosting, customer service, management, other administration, and investments. As noted in Annex C, we have assumed that on average there are constant returns to scale in relation to overhead costs³⁵. This allows us to make what we believe is a realistic simplifying assumption, that indirect costs are fixed per journal.³⁶ We estimate these costs to amount to around £0.96bn.
- 'Surplus' is profit (in the case of commercial publishers) or surplus (in the case of society / non-profit publishers), and is estimated at £0.82bn. This amount can be varied according to publisher type and also takes account of differential tax treatment of publisher types.

Table 4.2: Summary of key inputs and intermediate outputs to calculate global non-cash peer-review costs

Model input	Units	Assumption	Source / Comment
Share of articles rejected outright or during peer review in HIGH rejection rate journals ³⁷	% share	90%	Expert Panel estimates; and Publishing Research Consortium 2007 (PRC 2007)
Share of articles rejected outright or during peer review in MEDIUM rejection rate journals	% share	35%	
Share of articles rejected outright or during peer review in LOW rejection rate journals	% share	30%	
Share of articles published in HIGH rejection rate journals ³⁸	% share	27%	Expert Panel estimates; Publishing Research Consortium 2007 (PRC 2007); and ALPSP 2000 study
Share of articles published in MEDIUM rejection rate journals	% share	57%	
Share of articles published in LOW rejection rate journals	% share	17%	

³⁵ This simplifying modelling assumption is discussed in Annex B. In practice we understand that the overhead costs per journal tend to fall for the first 100 journals, but then flatten out. However, because many society publishers with a small number of titles contract out the publishing activity we believe that the assumption is not unreasonable.

³⁶ For a more detailed discussion of assumptions on cost structures see Annex C.

³⁷ Articles for publication are submitted to different journal types, for which different rejection rates are applied. A proportion of articles are rejected upfront and a further proportion of articles are rejected during/after the peer review process. These percentage shares of rejection determine the peer review cost per 'successful' article.

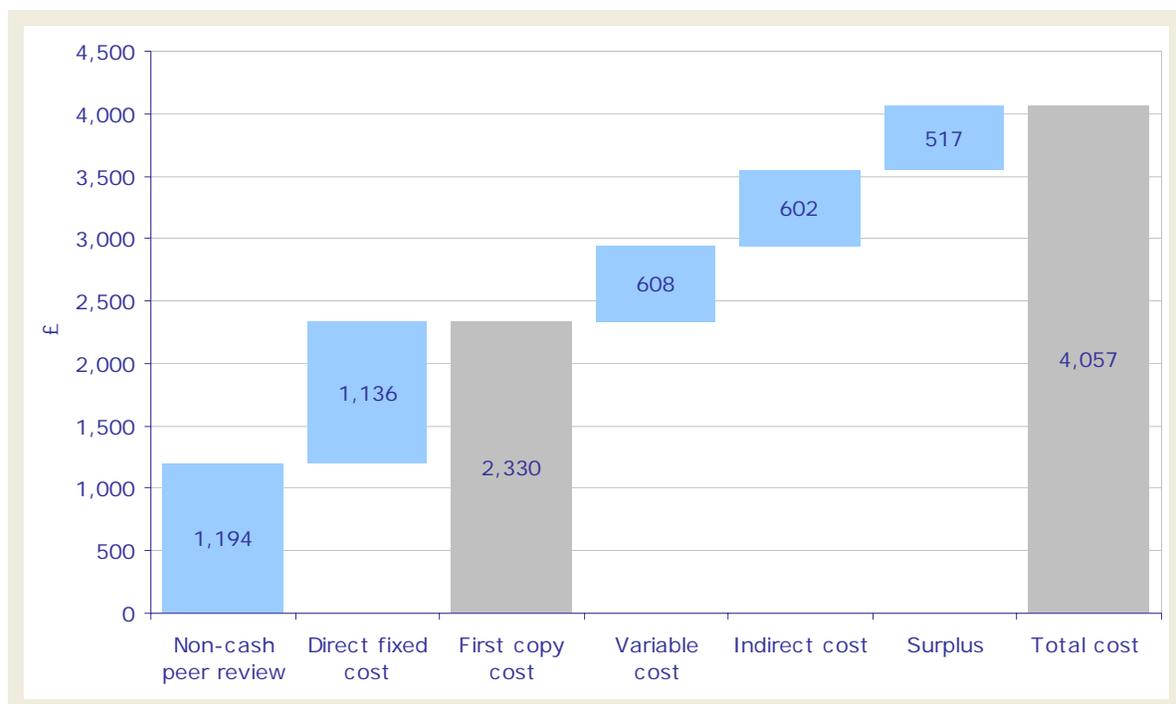
³⁸ Depending on which journal category articles are published in, a different overall rejection rate is applied. This indicates the overall proportion of articles that is published in either high, medium or low rejection rate journals. This is not an input assumptions but a weighted average across different journal categories (see model assumption book for detailed input assumptions of rejections rates for different journal categories).

Model input	Units	Assumption	Source / Comment
Average hours of peer review per article	hours	4	PRC 2007 suggests a median of 5 hours spent on the peer review per article. The UK median is 3 hours, the mean 3.9 hours. Tenopir and King 2000 and King 1997 estimate 3-6 hours per reviewer per article spent on peer review
Average number of peer reviewers per article	number of peer reviewers	2.5	Tenopir and King 2000
Global average hourly non-cash cost of peer review	£ / hour	£40.4	Weighted average of UK and non-UK peer reviewers based on hourly wages
Share of peer review conducted at/or affiliated with academic institutions	% share	80%	Expert Panel estimates

Cost per article

Dividing these totals by the number of articles published in a year gives an average total (cash and non-cash) cost of £4,057 per published article. Figure 4.3 below provides a breakdown of these per-article costs.

Figure 4.3: Average per article publishing and distribution cost incurred in the global scholarly communication process



Excluding peer review non-cash costs of £1,194 per article from this estimate results in a per article total cost of £2,863. Tenopir and King (1998, 2000) estimate a first copy publishing cost, excluding non-cash peer review cost, of \$2,000-\$4,000 (£1,000-£2,000³⁹), which is consistent with the estimate of £1,136 shown in Figure 4.3.

The estimates above are averages which reflect the assumed article allocation to different notional journal types, which have different cost structures. Table 4.3 shows per article cost estimates for different journal types. The different assumed cost structures reflect our review of the literature, input from the Expert Panel, and a very limited number of responses from publishers.

A number of the key points arising from this table are discussed below. But it is important to note that the estimates are illustrative only and should be treated with an appropriate degree of caution⁴⁰. The model is defined in a way to allow the user to change any of the activity cost assumptions that determine the cost structures.

Table 4.3: Average per article costs by journal type

Journal type	% total articles ⁴¹	Peer review	First copy ⁴²	Total Variable cost ⁴³	Indirect costs	Surplus	Total
Popular hybrid	<1%	£2,664	£4,116	£7,067	£714	£641	£12,539
Major discipline	34%	£1,458	£2,678	£777	£650	£555	£4,661
Niche	66%	£1,056	£2,148	£511	£577	£497	£3,733
Print only	5%	£1,193	£2,304	£464	£394	£445	£3,608
Electronic only	5%	£1,193	£2,334	£275	£613	£522	£3,745
Print and electronic	90%	£1,194	£2,331	£640	£612	£521	£4,105
High rejection rate	27%	£2,664	£4,091	£670	£676	£622	£6,058
Low rejection rate	17%	£647	£1,670	£566	£570	£475	£3,281
Commercial	60%	£1,194	£2,324	£608	£705	£642	£4,279
University press	5%	£1,194	£2,324	£608	£576	£426	£3,934
Society publisher	35%	£1,194	£2,343 ⁴⁴	£608	£428	£315	£3,695

³⁹ On current GBP£:US\$ exchange rates, around 0.5.

⁴⁰ The results are presented to the nearest £ for transparency, but in practice this is almost certainly spurious accuracy.

⁴¹ Note that the percentages in this column do not sum to 100% - since the row categories are not mutually exclusive. For example, it is possible to have a hybrid journal which is print only and is produced by a commercial publisher. Also, these are high-level assumptions in the article allocation of the model, which are partly refined at a lower level in the article allocation module. For example, it is assumed that all Popular Hybrid journals have a high rejection rate.

⁴² We assume first copy cost to include all direct cash and non-cash cost of article publishing.

⁴³ This is the variable cost per subscription multiplied by the assumed numbers of subscriptions.

⁴⁴ The total first copy cost of the average article published by society publishers is assumed to be marginally higher because we assume society publishers to be less able to redirect submitted articles during the selection/peer-review process, which saves some cash admin cost for larger (mostly commercial) publishers.

The results in Table 4.3 reflect many assumptions. However, points to note for the average cost per article published are as follows:

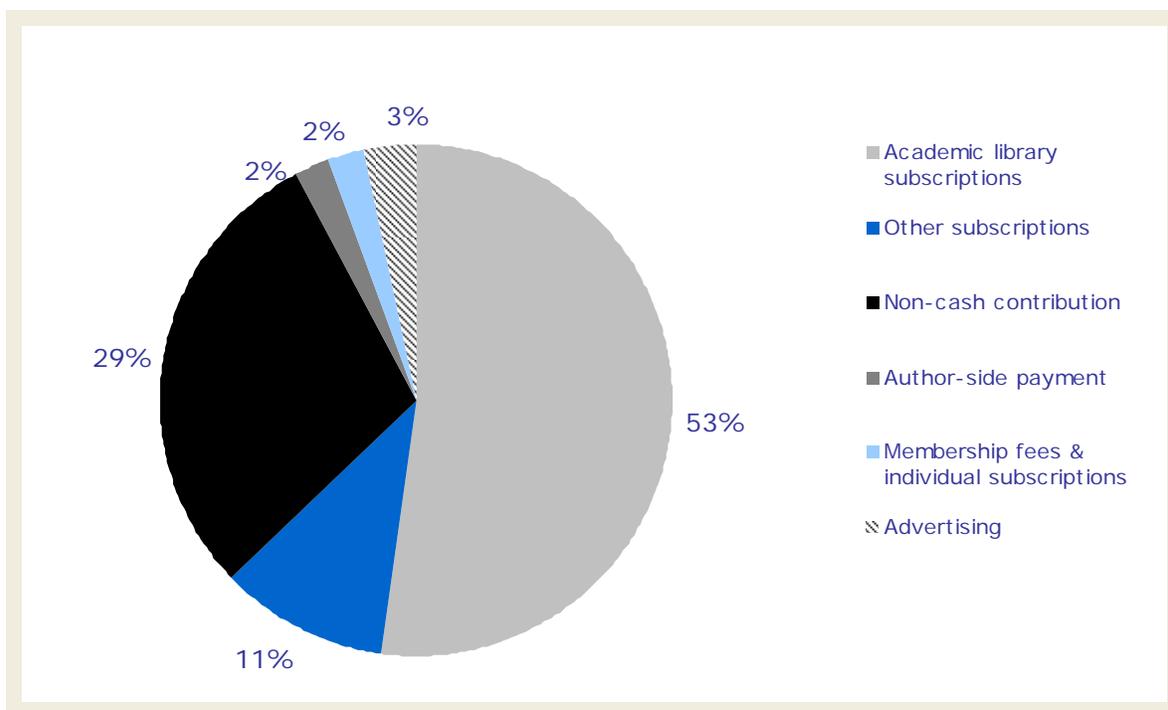
- The peer review process is markedly more expensive for journals with high rejection rates. The total cost of peer review for such a journal, at £2,664 per article, is estimated to be about five times higher than that of a journal with a low rejection rate. This is of particular relevance for popular hybrid journals with a uniformly high rejection rate of more than 90%.
- Journal circulation numbers are the main cost driver of variable cost per article across journal categories. The average total variable cost of an article published in a high-circulation, popular hybrid journal is estimated to be £7,067. The average variable cost for an article published in major discipline journal is £777, and £511 in a niche journal.
- Journal delivery format is a key driver of variable publishing costs. Articles published in electronic- only journals incur significantly lower variable costs, £275, as opposed to print journals with an average variable cost of £464 per article. Journals published in both formats (in print and electronically) incur the highest variable costs, at £640.
- Indirect cost structures and surpluses vary across different publisher types. The estimates for commercial publishers are £705 per article for indirect cost, and £642 per article for surplus. In comparison, an article published by a society publisher is estimated to incur indirect costs of £428, and generate a surplus of £315.

4.4.2 Publication and distribution: funding

Funding sources

Figure 4.4 below provides estimates of the sources of funding for the total estimated system cost of global publication and distribution of journals, equal to £6.4bn. It reflects assumptions made about the sources of funding for each of the different journal types specified in the model; together with the assumed article allocation.

Figure 4.4: Funding contribution to meet global publication and distribution incurred cost (all journal types)



Key points to note on the funding flows are as follows:

- Subscriptions (academic and other) account for the largest share (64%) of funding for publication and distribution. This percentage increases to 89% if non-cash peer review costs are excluded from the costs to be funded. Within this 89%, our modelling estimates that 83% of subscriptions funding is from academic institutions and 17% are from other subscriptions including individual subscriptions.
- Funding obtained through author-side payments, including page charges, for open access journals and open access articles in hybrid journals, accounts for around £130m (1.5%) of the total publication and distribution funding⁴⁵.
- Membership fees account for £145m (2%) of publication and distribution funding and are confined to journals published by society publishers only.
- Funding from advertising accounts for £219m (3%) of funding. This is a rather small contribution since it is assumed to be largely for popular hybrid journals and makes only a small funding contribution for major discipline and niche journals.⁴⁶

In order to provide an illustration of how the funding sources are assumed to vary by journal type, Table 4.4 below shows the assumptions for three types of journals in the model.

Table 4.4: Illustrative funding source assumptions for three types of journal categories used in the model

Funding source	Popular Hybrid (e.g. The Lancet)		Major Discipline (e.g. Physical Review)		Niche journal (e.g. Canadian Journal of Botany)	
	£ per journal pa	% of total	£ per journal pa	% of total	£ per journal pa	% of total
Academic subscriptions	188,621	14%	211,479	47%	120,336	56%
Other subscriptions	188,621	14%	52,870	12%	21,236	10%
Non-cash contribution	282,741	21%	140,621	31%	60,983	28%
Author-side payments	0	0%	10,437	2.3%	3,968	1.8%
Membership fees	199,100	15.0%	15,442	3.4%	3,093	1.4%
Advertising	471,552	35.4%	18,606	4.1%	6,003	2.8%
Total	1,330,634	100%	449,455	100%	215,619	100%

⁴⁵ This is higher than the share of open access articles in total published articles because it is assumed that some subscription journals obtain a small proportion of their funding from authors who want to make their articles available through open access channels.

⁴⁶ It is also assumed that electronic only journals manage to attract only half of the advertisement funding of a similar print journal. This is further discussed in Scenario 1, where a move towards electronic only journal has a negative impact on overall advertisement funding of journals.

4.4.3 UK share

A key part of the study has been to estimate the contribution that the UK makes to the costs and funding of the global scholarly communications process. Table 4.5 below sets out some of the key assumptions used in estimating UK and global contributions. It suggests that the UK's research base is more productive than the international average⁴⁷: with a global share of 3.3% of researchers and 4.1% of total R&D expenditure, the UK produces some 6.6% of all articles.

Table 4.5: Key assumptions for contribution estimates

Volumes	Global total	UK total	UK % share
Number of researchers	5,475,282	180,550	3.3% ⁴⁸
Number of regular article authors	1,916,349	63,193	3.3%
Number of articles published (authorships)	1,586,792	104,268	6.6% ⁴⁹
Total modelled cost of publication and distribution ⁵⁰	£6.44bn	£428m	6.6%

Table 4.6 (a) and (b) uses the above information together with the modelling outputs to present a range of possible measures of contribution. We compare the following four measures⁵¹ of the UK's contribution:

- Measure A: the UK contribution to peer review. This is shown in Table 4.6(a).
- Measure B: the contribution that UK university / academic subscriptions make to the total global cost of publication and distribution.
- Measure C: total UK academic institution contribution (i.e. the combined contribution of A and B) as a proportion of the total global cost of publication and distribution.
- Measure D: the total contribution of all UK funding sources compared with the total global cost of publication and distribution.

With:

- The proportion of the global supply of journal articles accounted for by UK academics (estimated to be 6.6%). We refer to this as a 'supply-side' measure, since it seeks to illustrate

⁴⁷ Source: DTI OST 2005. These estimates need to be treated with caution as it is unclear which percentage of research funding can exactly be attributed to research article production.

⁴⁸ See OECD MSTI 2007 data for key figures on RandD expenditures and total count of researchers.

⁴⁹ The UK share of articles was calibrated to match the estimates based on Thomson Scientific data and US Science Board estimates. Our estimates are consistent with those of the US National Science Foundation, SandE Indicators 2008 that estimate a UK share of 6.4% of global article production (<http://www.nsf.gov/statistics/seind08/c5/c5s3.htm#c5s31>) and data published by SCImago (<http://www.scimagojr.com/countrysearch.php?country=GB>) which suggests a UK share of 6.6%. The 2005 report published by the OST "PSA target metrics for the UK research base" estimates a higher percentage of 8.8%. The difference is due to the methodology applied to account for article co-authorships.

⁵⁰ The total cost of publication/distribution caused by the UK article production as a share of global cost is not exactly equal to the UK's share of article production because the article distribution differs marginally. For example, the UK's share of article production among medical articles is higher than the average article production of 6.18% and medical journals incur a different cost from S/T/S and A/H journals.

⁵¹ The UK contribution to 'funding' the peer review (non-cash costs); the contribution that UK university / academic subscriptions make compared with other universities; and the total contribution of all UK funding sources compared with other countries' contribution.

whether the UK contributes to the funding of the publication and distribution elements of the process in proportion to the costs that it imposes.

- The proportion of global readings accounted for by the UK. We refer to this as a ‘demand-side’ measure. Balance would be assumed to occur if the proportion of publication and distribution costs covered by the UK is equal to the readings of articles by UK residents.

A value of 1 in Table 4.6 (a) and (b) for each indicator should be taken to mean ‘balance’ for the UK in terms of contribution. A value >1 suggests that the UK is a net contributor; and a value of <1 suggests that UK is a net beneficiary.

Table 4.6a: UK contribution to peer review costs

	Contribution indicators	UK as % of Global peer review costs	Supply Indicator (defined as UK funding contribution % / UK article contribution %)	Demand Indicator (defined as UK funding contribution % / UK reading %)
A	Contribution of UK to peer review costs	8.7%	8.7% / 6.6% = 1.3x	8.7% / 3.3% = 2.7x

Table 4.6b: UK contribution to total publication and distribution costs

	Contribution indicators	UK as % of total Global costs	Supply Indicator (defined as UK funding contribution % / UK article contribution %)	Demand Indicator (defined as UK funding contribution % / UK reading %)
B	UK academic library contribution to funding	1.8%	1.8% / 6.6% = 0.3x	1.8% / 3.3% = 0.5x
C	Total UK academic institution contribution to funding	4.0%	4.0% / 6.6% = 0.6x	4.0% / 3.3% = 1.2x
D	Total UK contribution to funding	5.2%	5.2% / 6.6% = 0.8x	5.2% / 3.3% = 1.6x

Key observations are as follows:

- UK academics appear to be significant net contributors in terms of peer review costs compared with both the proportion of articles originated from UK authors (supply-side measure, where the indicator is 1.3); and the estimate of total readings (demand-side measure, where the indicator is 2.7).
- The contribution from UK academic subscriptions, at less than 1.8%, is significantly lower than either (i) the UK contribution to global article production (so the supply side indicator is 0.3) or (ii) the UK contribution to global article reading (so the demand-side is 0.5)
- The full contribution from UK academic institutions (including both subscriptions and peer review contributions) is still, at 4% of global publication and distribution costs, significantly lower than the UK's contribution to article production (so the supply-side indicator is 0.6). But it is greater than the UK article readership (so the demand-side indicator is 1.2).
- Our estimates of the full UK contribution including corporate subscriptions as well as the contribution from HEIs suggest that the UK as whole is a net beneficiary compared with the supply of articles (thus the supply-side indicator is 0.8). Based on the comparison with reading, however, the UK is a net contributor (thus the demand-side indicator is 1.6).

4.5 Access provision and usage

This section presents key cost and funding flow estimates relating to the *access provision and usage* component of the scholarly communication process value chain. All costs reported in this section relate to the UK only.

4.5.1 Access provision: incurred costs (libraries and users)

Library types and journal portfolios

The costs incurred by libraries in providing access to scholarly journals are driven by assumptions about the demand for journals by different library 'types'. For simplicity, the definition and categorisation of UK academic library types follows SCONUL's classification, with the addition of a fifth category, special libraries – which include corporate, government departments, and public libraries. Assumptions about each library type's demand for different journal types are applied to define each library's portfolio of journals (by the library's preferred delivery format).

Table 4.7 provides summary information on the assumed journal portfolios of the five different library types, as percentages of each journal type that the library categories are assumed to subscribe to. The portfolios have been calibrated so that:

- The total cost of the modelled portfolio (at the breakeven prices) matches the actual SCONUL serial subscription budgets for each library type.
- The average modelled journal portfolio held by each library type in the model matches the actual print / electronic journal portfolios reported in SCONUL data for the library category.

Table 4.7: Assumed journal subscription holdings of academic libraries (by SCONUL classification) and special libraries, by journal categories and publisher type

Library portfolios	Popular Hybrid	Major Discipline	Niche Journal
RLUK			
Commercial	100%	85%	60%
University Press	100%	65%	50%

Library portfolios	Popular Hybrid	Major Discipline	Niche Journal
Society	100%	50%	30%
OLD			
Commercial	100%	60%	26%
University Press	100%	25%	20%
Society	100%	15%	10%
NEW			
Commercial	100%	60%	24%
University Press	100%	22%	20%
Society	100%	15%	10%
HEC			
Commercial	100%	15%	5%
University Press	100%	10%	5%
Society	100%	10%	5%
Special⁵²			
Commercial	50%	15%	10%
University Press	50%	10%	5%
Society	50%	10%	5%

Access provision/usage costs

Access costs incurred by libraries comprise:

- **fixed access costs**, which are assumed to be fixed in relation to each journal and relate to, for example, library and shelving space; staff time for acquisition registration and archiving etc. Access provision costs are therefore calculated by multiplying the article provision activity costs per journal, by the number of journals in the library's portfolio. There are assumed to be fundamentally different access provision cost structures between different delivery formats (i.e. print-only journals versus electronic-only journals); and
- **'variable access provision costs'** incurred by libraries, which are determined by the level of usage of library facilities. These are costs that would be incurred only when there is use of the library's scholarly journal portfolio.

The model assumes different elasticities for the cost structures of library access provision activities (fixed, semi-variable, variable). Any change to libraries' subscription portfolios changes the total access provision cost according to the underlying cost structures and the elasticities. For example, the activity costs of journal procurement, like subscription processing, are assumed to include semi-variable costs, while the costs for reference and assistance, depending on the number of library users, are assumed to be fully variable.

⁵² Special libraries are assumed to focus on certain subject areas, for which their subscription rates will be high, but across an average of all journal types subscription rates are estimated to be significantly lower than for other library types.

'Usage costs' are incurred by individual researchers in searching, requesting, copying and printing articles.⁵³ They are calculated by applying assumptions about the number of researchers using (requesting) articles held by different library types, multiplied by per article activity costs.⁵⁴

Table 4.8 summarises the assumptions for average fixed and variable costs (these are intermediate outputs of the model, in that they are the result of a series of other inputs and calculations).

Table 4.8: Summary of key intermediate cost outputs (access)

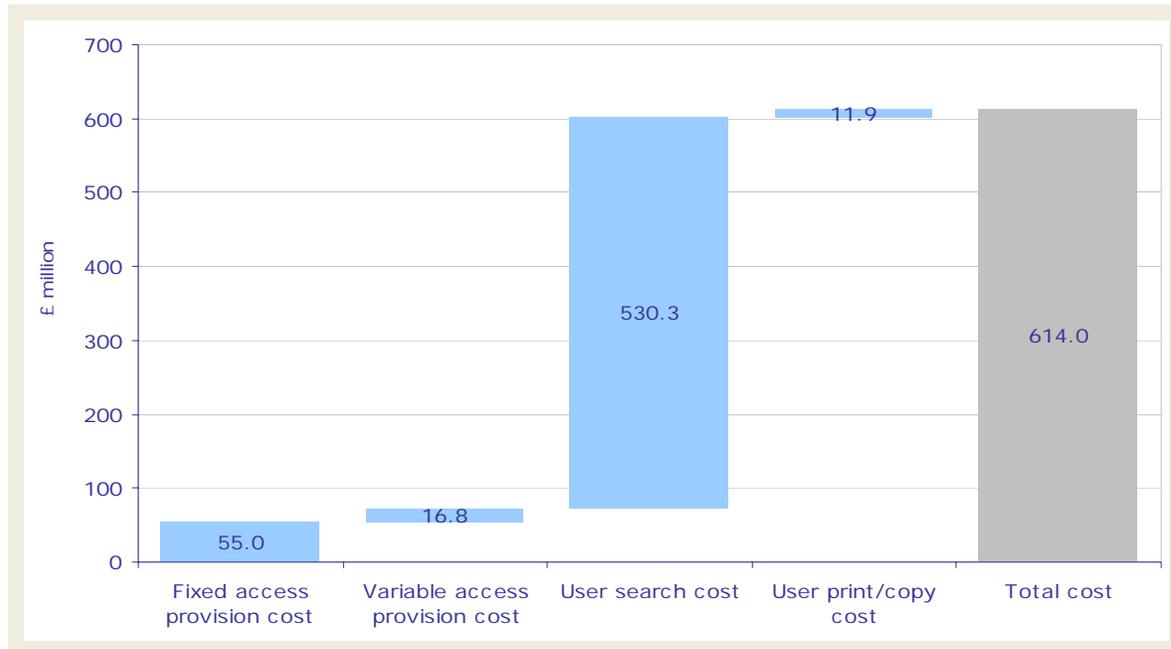
Intermediate cost output	Units	Assumption	Comment
Average library fixed access cost per journal	£/ article subscribed to	£57	This is the average cost of holding a journal for the average library, journal type and format.
Average library fixed access costs per reading	£/ article subscribed to read	£1.28	Fixed access costs are assumed to be fixed in relation to each journal subscription. The assumed unit cost is an estimate of the total fixed cost over the current number of readings. With a change in usage the unit cost would vary accordingly.
Average library variable access costs per reading	£/ article read	£0.39	Variable costs are the cost incurred by the library for each article that is read. The average is across all journals and library types.
Average user search and print / copy cost	£/ article requested	£8.86	Average across all research users, including the non-cash cost of search time for articles. The majority of these costs are accounted for the assumed 12.5 minutes search time per article.

Figure 4.5 shows: (i) the total annual cost incurred by UK libraries in providing access to their stock of journals; and (ii) the cost incurred by researchers in searching for and printing or photocopying articles.

⁵³ There is, of course, a close relationship between user search/print costs and reading costs (which are modelled as part of the contextual analysis of usage). For the purposes of this study, however, we have modelled search/print costs as part of access costs.

⁵⁴ The usage cost of accessing articles in author-side payment (open access) journals is modelled similarly.

Figure 4.5: Total annual access provision and usage cost incurred in the UK scholarly communication process



Key points to note are as follows:

- Access provision (the sum of fixed and variable access provision cost) accounts for £72m (12%) of the total cost in this component of the value chain. These are the costs that are borne by libraries.
- The bulk of access costs - £530m (86%) - are accounted for by the time spent by researchers in locating, displaying, downloading, and browsing articles before they read them.⁵⁵
- In addition, print costs incurred by researchers account for £12m (2%). A proportion of these costs may be expected to be revenue for libraries, but most will arise in printing from users' desktops.

4.5.2 Access provision: funding (libraries and users)

This section firstly sets out how the non-acquisition access costs in the UK (as set out above) are allocated between different library types. Secondly, it seeks to compare subscription amounts paid by each library type (with and without big deals) with journal portfolios and usage.

Allocation of access costs

Figure 4.6 illustrates the allocation of the above total access costs per library for each library type including special libraries. It reflects the number of libraries in each category, and the different journal portfolios and levels of usage for each library type.

⁵⁵ Search cost is equally applied to articles accessed via libraries and articles in open access journals.

Figure 4.6: Allocation of total access cost per library for different library types

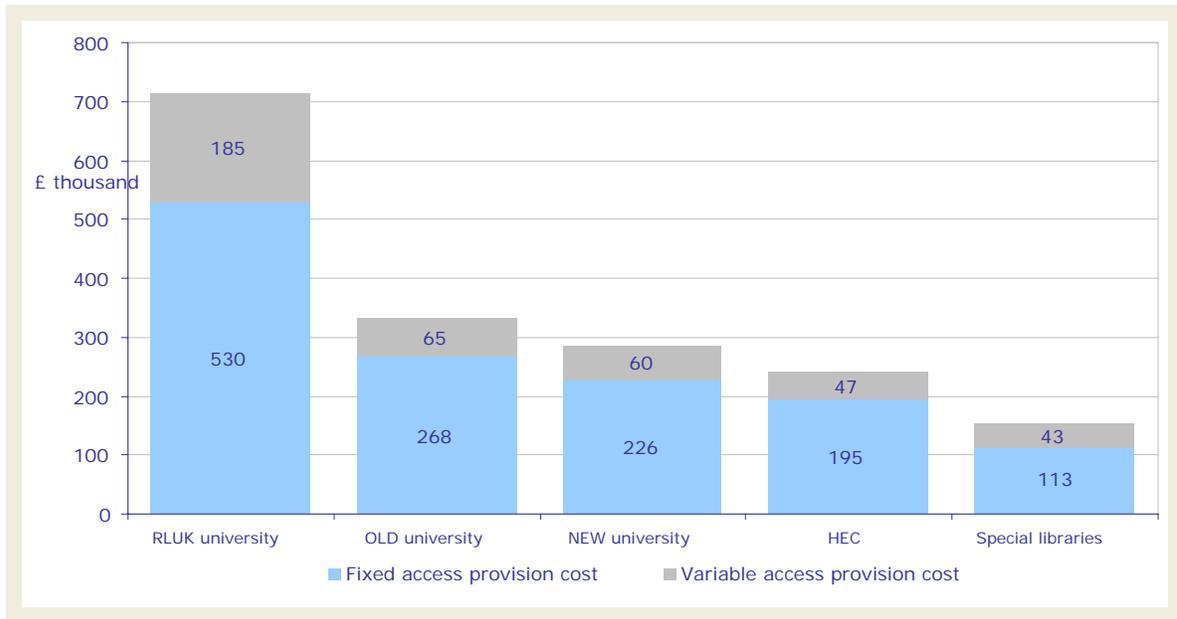


Figure 4.7 shows the total aggregated access costs of the different library types, which add up in total to £72m. Figure 4.8 provides an indication of the assumed access cost per researcher by library type. It shows that RLUK libraries have on average a lower fixed access provision cost than other library types, which implies some economies of scale.

Figure 4.7: Allocation of total access cost across different library types

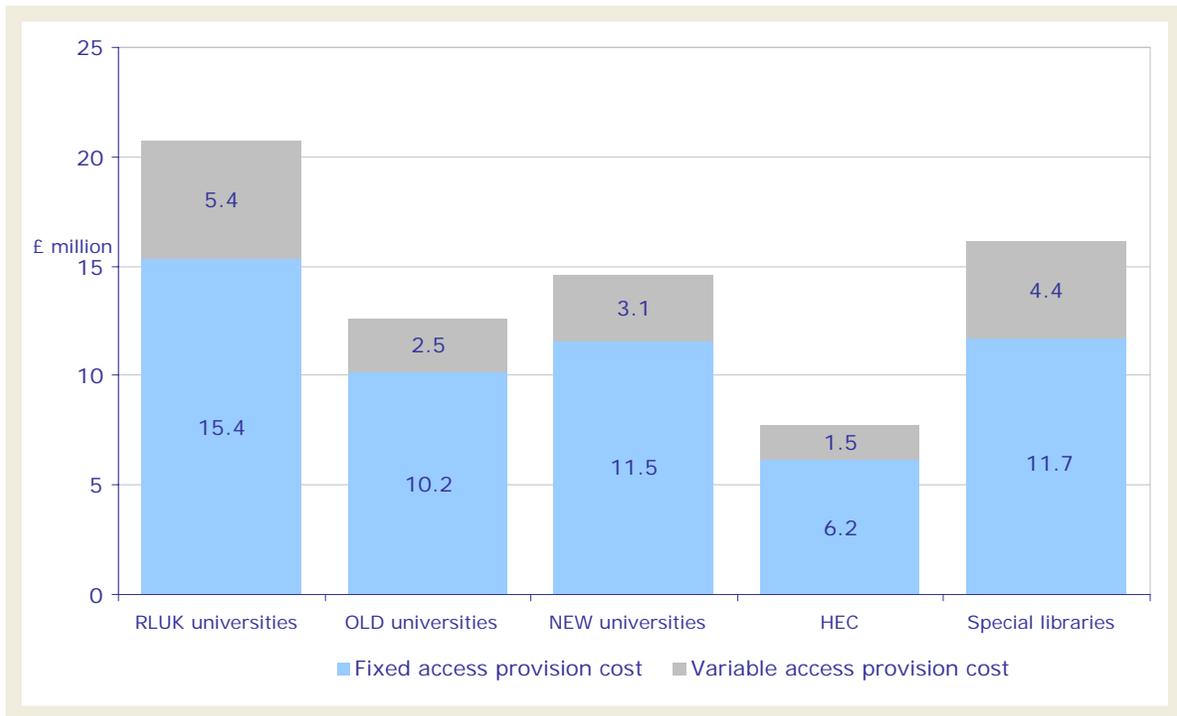
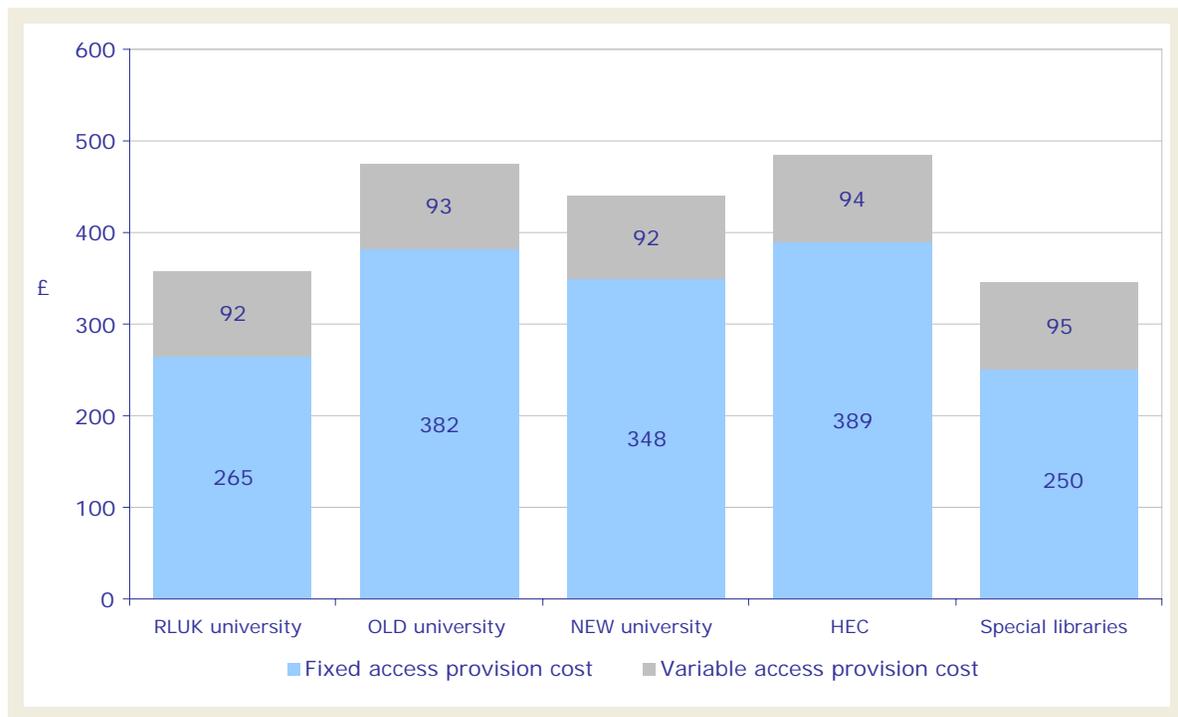


Figure 4.8: Library access provision cost per researcher by library type



Allocation of acquisition prices

In the base case, the burden of subscription fees is allocated to the different library types on the basis of subscription portfolios that have been calibrated to match SCOUNL data. Table 4.9 shows a breakdown of subscription costs for the different library types, per library, per journal subscription, per researcher (user) and reading.

Table 4.9: Library subscription costs

Library type	Total £, per library type	£ Per library	£ Per journal	£ Per researcher	£ Per reading
RLUK universities	40,194,490	1,386,017	111.14	693	2.74
OLD universities	30,656,218	806,743	138.57	1152	4.56
NEW universities	39,433,727	773,210	138.01	1190	4.70
HE colleges	7,183,981	224,499	141.29	449	1.78
Special libraries	21,658,720	208,257	98.71	463	2.40

The key points to note on libraries subscription costs are:

- RLUK universities have by far the most extensive serials subscription portfolios and hence highest total subscription expenditures. On a per journal basis their subscription expenditures are the lowest, on average, among all academic library types.

- On a per researcher basis, library expenditures are lower at RLUK universities than at OLD and NEW universities, mainly because of a higher average number of researchers using the libraries and the stock of journals.
- The average subscription cost per reading is largely driven by the size and cost of the subscription portfolios, as well as the number of researchers. Average costs per reading are lowest for HE colleges, which is not a result of lower average journal prices but simply of their limited journal portfolios.

4.5.3 *Scholarly Communication System: UK Funding*

The total global cost of the scholarly communication system (as defined) is estimated to be £25bn. Figure 4.9 below shows the UK funding contribution to that cost, through academic peer review, subscriptions, library access provision, and user non-cash costs for article search and printing. We also show an alternative presentation of the figures in Figure 4.10, excluding user search and print costs.

Key points to note are:

- The UK total funding contribution to the scholarly communication system cost is £951m, or about 3.8% of total global costs. Excluding user search and print costs, the total UK contribution is £408m, or 4.8% of total global costs (also excluding user search and print costs).
- UK academic institutions contribute a total of £314m in the form of academic peer review, author-side payment for article publications, academic library subscriptions and the fixed and variable access provision costs of university libraries.
- The total funding for user search and print activities is estimated at £542m, of which about £427m can be related to UK higher education institutions.

Figure 4.9: UK funding contribution to the total cost of scholarly communication

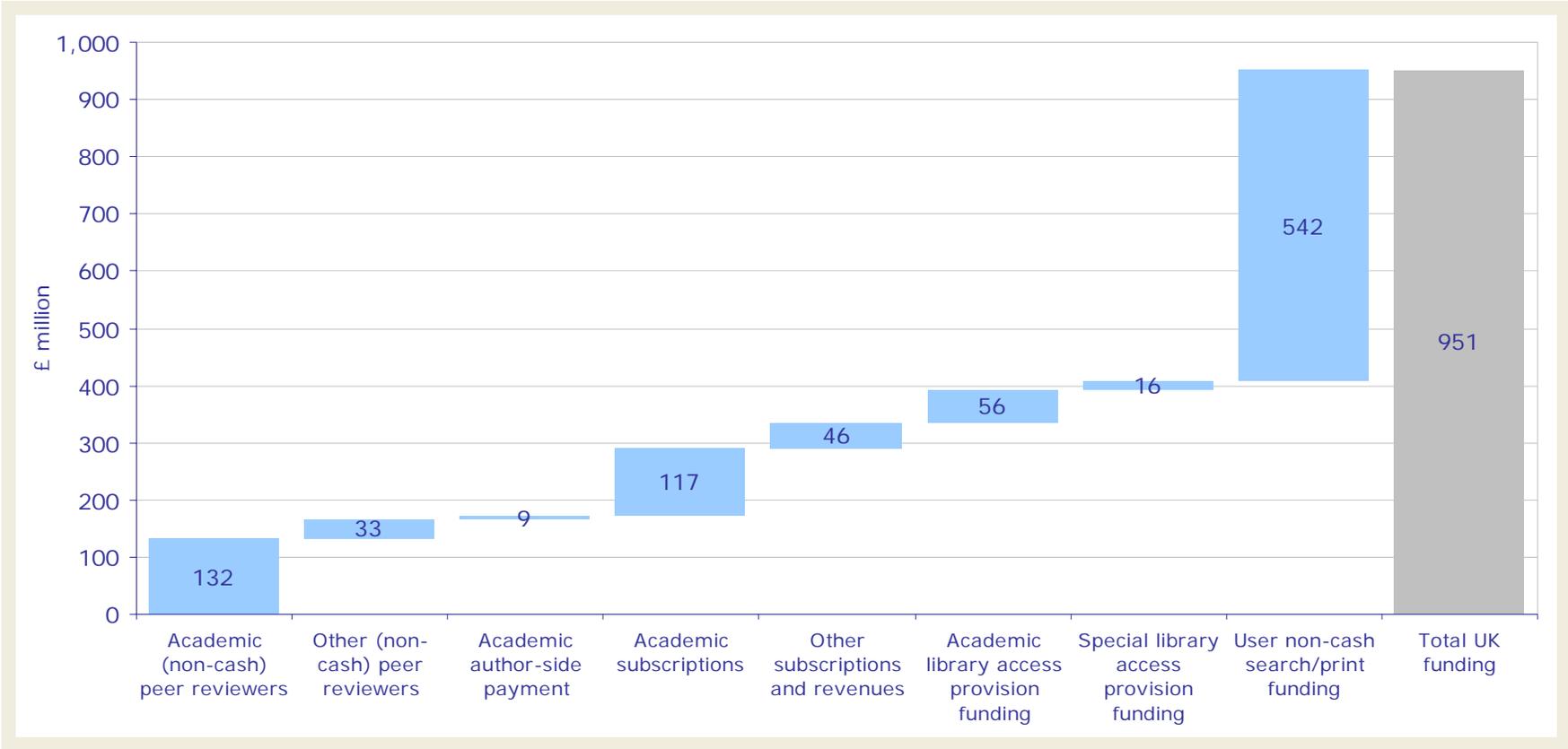
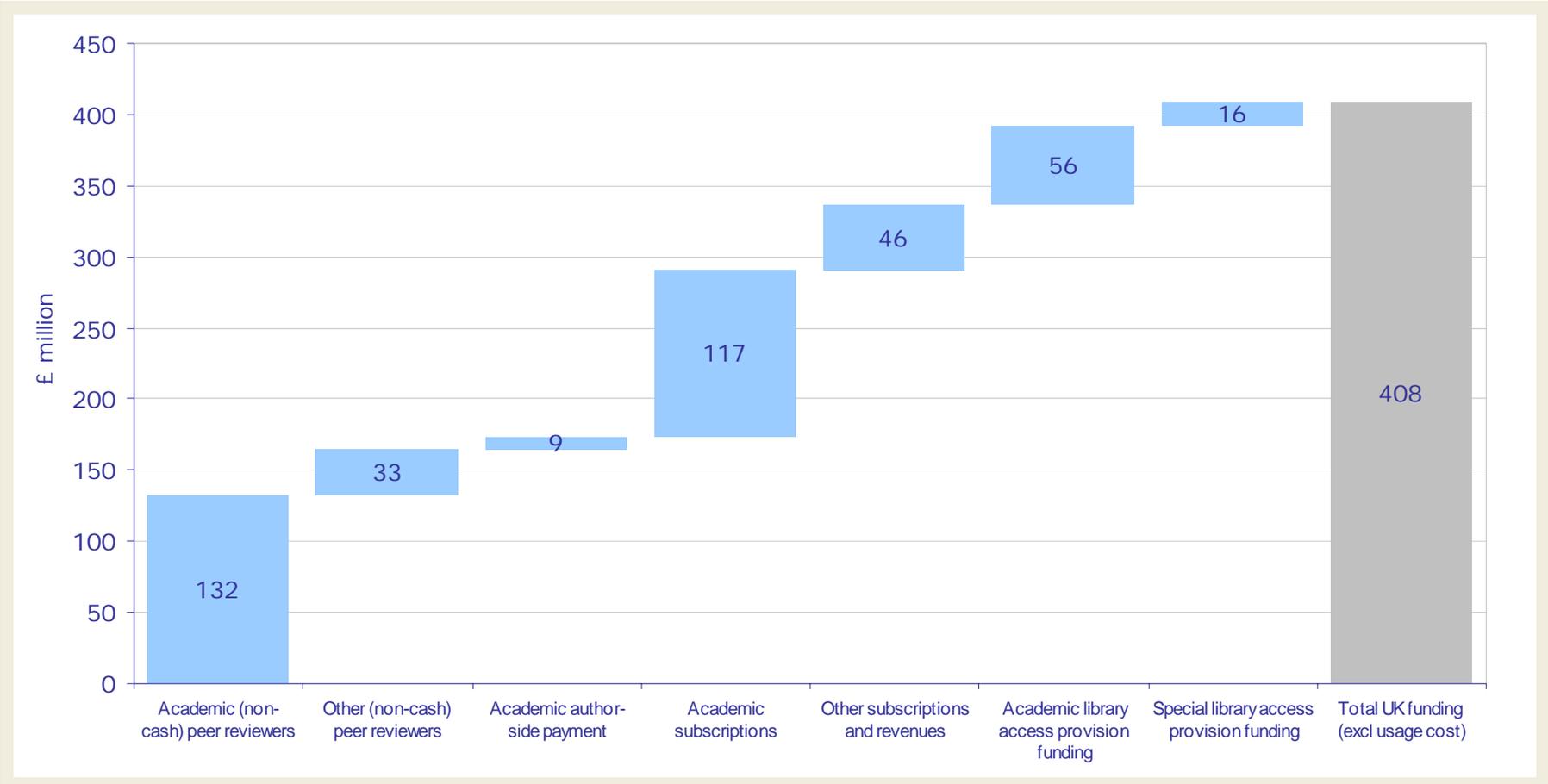


Figure 4.10: UK funding contribution to the total cost of scholarly communication (excl. user search and printing)



5 Scenario analysis

5.1 Purpose of this section

The purpose of this section is to compare the results presented in the previous section on the estimated current levels and shares of costs and funding in the scholarly communications process (the 'base case'), with possible cost and funding scenarios. In what follows, the scenarios modelled are firstly described before results are presented and interpreted.

The policy scenarios should not be taken to be our view of what will or should happen to the scholarly communications system. Rather they demonstrate that using the model provides indications of the likely magnitude of cost and funding impacts that result from defined changes.

5.2 Summary of scenarios

We have modelled four scenarios:

- **Scenario 1:** a move towards electronic-only publication.
- **Scenario 2:** a move towards an author-side payment business model, building on Scenario 1.
- **Scenario 3:** a move towards paying academics cash for carrying out peer review activities.
- **Scenario 4:** an increase in the level of global funding for researchers and resulting increases in the number of articles per journal and the number of journals.

The model input assumptions used to define each scenario are set out in each section. It is important to note that Scenarios 1 and 2 are linked, in that Scenario 2 looks at the effects of a change in business model for a world which will have already moved largely to electronic-only publishing. Scenarios 3 and 4 are considered in isolation from the other scenarios.

For each scenario we consider the results in three parts:

- the impact on the costs and funding of the **global publication and distribution** of the scholarly communications process;
- the impact on **UK access costs** (including the impact specifically on UK library budgets); and.
- the total impact on the **total costs of the global scholarly communications system**.⁵⁶

Appendix E provides additional charts showing the cost to the UK of the scholarly communication process for each of the scenarios as well as the base case.

5.3 Scenario 1: move towards electronic-only publication

This scenario considers the magnitude of possible savings resulting from a move toward electronic-only publication. They are expected to impact the costs of both publishers and libraries. Cost savings could be generated from reduced:

- printing, production and distribution costs incurred by publishers scaling back or no longer supplying print copies of journals;
- library staff input required to process newly-received print copies of journals, such as making changes to current issue display, spine labelling, bar coding, inserting and applying bookplates, binding, and initial shelving;

⁵⁶ The model uses a simplifying assumption of pro-rating the UK's access costs to get to global access costs, to estimate the impact on the total global cost of the scholarly communications system.

- library staff input required to carry out stack maintenance duties, such as shelf reading and maintenance, collection shifting, collection weeding and cleaning; and/or
- library space (rental) costs, arising from eliminating the need to store print journals.⁵⁷

However, any move towards electronic-only publication could also result in increased costs incurred by publishers, libraries, and users. Cost increases could arise from:

- IT hardware, online user management and maintenance costs incurred both by libraries and publishers;
- VAT charges incurred by libraries arising from a movement away from print journals (which incur VAT charges at less than 17.5%)⁵⁸; and/or
- printing costs incurred by users in libraries and/or at home.

In addition, eliminating print circulation can be expected to lead to a significant loss of advertising and other similar revenues which rely on the large print distributions of popular hybrid and several major discipline journals.⁵⁹

Analysing costs arising from a move to electronic-only publication provides information about required changes to library budgets. It is also possible to consider how the changes might affect the cost to the library of acquiring a given portfolio of journals.

5.3.1 Scenario 1: input assumptions

Table 5.1 defines the inputs that have been adjusted from the base case in order to generate this scenario. Both the delivery formats offered by publishers, and those required by libraries are relevant, since both impact on costs.

The input assumptions have been chosen to define a clear move to electronic-only publication. To demonstrate the impact of an extreme case of electronic-only publication, 90% of journals are assumed to be offered in electronic format only⁶⁰, and 10% in print and electronic format.

Table 5.1: Scenario 1 input assumptions

Parameter	Base case		Scenario	
Delivery format (supplied by publishers) for Popular Hybrid subscription journals	P and E	100%	P and E	10%
	P only	0%	P only	0%
	E only	0%	E only	90%
Delivery format (supplied by publishers) for Major Discipline subscription journals	P and E	90%	P and E	10%
	P only	5%	P only	0%
	E only	5%	E only	90%

⁵⁷ As set out in Table 5.1, a move toward an electronic publication is expected to result in a 50% reduction of library space used for the storage of print scholarly journals.

⁵⁸ VAT is in reality a transfer, but is included here as it is relevant to an analysis of library budgets.

⁵⁹ The model inputs assume that advertising funding is on average 50% lower for electronic-only journals.

⁶⁰ Although this might be unrealistic in the near term, Scenario 1 one chooses an extreme approach of 90% electronic only publication. Scenario 2, which builds on these input assumptions, will not show any effect of electronic only publication but only a change in the business model.

Parameter	Base case		Scenario	
Delivery format (supplied by publishers) for Niche subscription journals	P and E	90%	P and E	10%
	P only	5%	P only	0%
	E only	5%	E only	90%
Delivery format (supplied by publishers) for author-side payment journals	P and E	0%	P and E	10%
	P only	0%	P only	0%
	E only	100%	E only	90%
Delivery format (demanded by RLUK libraries)	P and E	11%	P and E	20%
	P only	28%	P only	0%
	E only	60%	E only	80%
Delivery format (demanded by 'Old' libraries)	P and E	18%	P and E	20%
	P only	15%	P only	0%
	E only	67%	E only	80%
Delivery format (demanded by 'New' libraries)	P and E	9.5%	P and E	20%
	P only	12.5%	P only	0%
	E only	78%	E only	80%
Delivery format (demanded by HEC libraries)	P and E	14%	P and E	20%
	P only	10%	P only	0%
	E only	76%	E only	80%
Delivery format (demanded by Special libraries)	P and E	20%	P and E	20%
	P only	15%	P only	0%
	E only	65%	E only	80%
Membership fees and other sources	Pop Hybrid	19%	Pop Hybrid	15%
	Major Discipline	5%	Major Discipline	3%
	Niche journal	2%	Niche journal	1%
Average share of library space used for scholarly journals	RLUK	10%	RLUK	5%
	OLD	10%	OLD	5%
	NEW	10%	NEW	5%
	HEC	10%	HEC	5%
	Special	50%	Special	25%

Note that the model already includes different assumptions about advertising revenues of e-only journals compared with print / electronic or print-only format. On average advertising revenues are assumed to be 50% lower for electronic-only journals than for print format journals.

5.3.2 Results – global publication and distribution

Changes in global publication and distribution costs and funding

Figure 5.1 shows that, based on the above input assumptions, electronic-only publishing of 90% of journals would result in the global publication and distribution incurred cost reducing by around £318m, (7% of current costs excluding peer review) mostly as a result of the reduction (of £342m) in the variable cost of printing and distributing hardcopies of journals to end users. Publishers' indirect costs would increase by a total of £17m, as a result of increased online hosting costs. Fixed

first copy costs would increase marginally because of the assumed higher cost of quality assurance of e-content required to make articles available online.

Figure 5.1: Key differences in global publication and distribution costs between the base case and Scenario 1

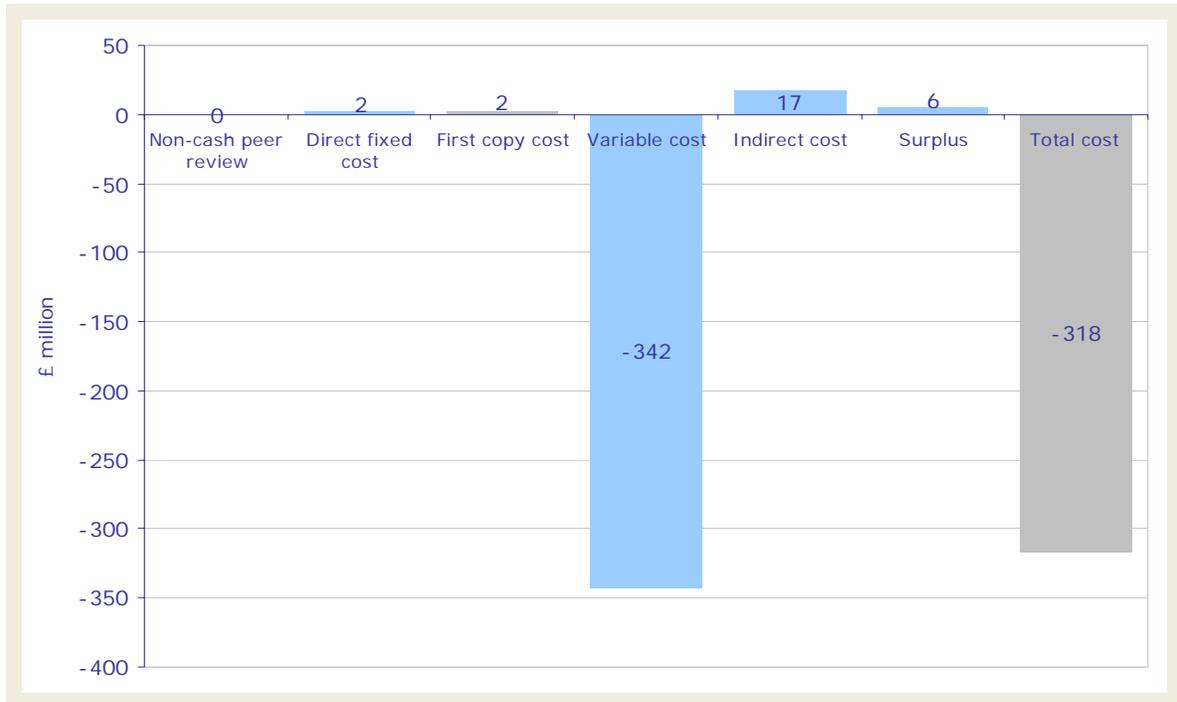
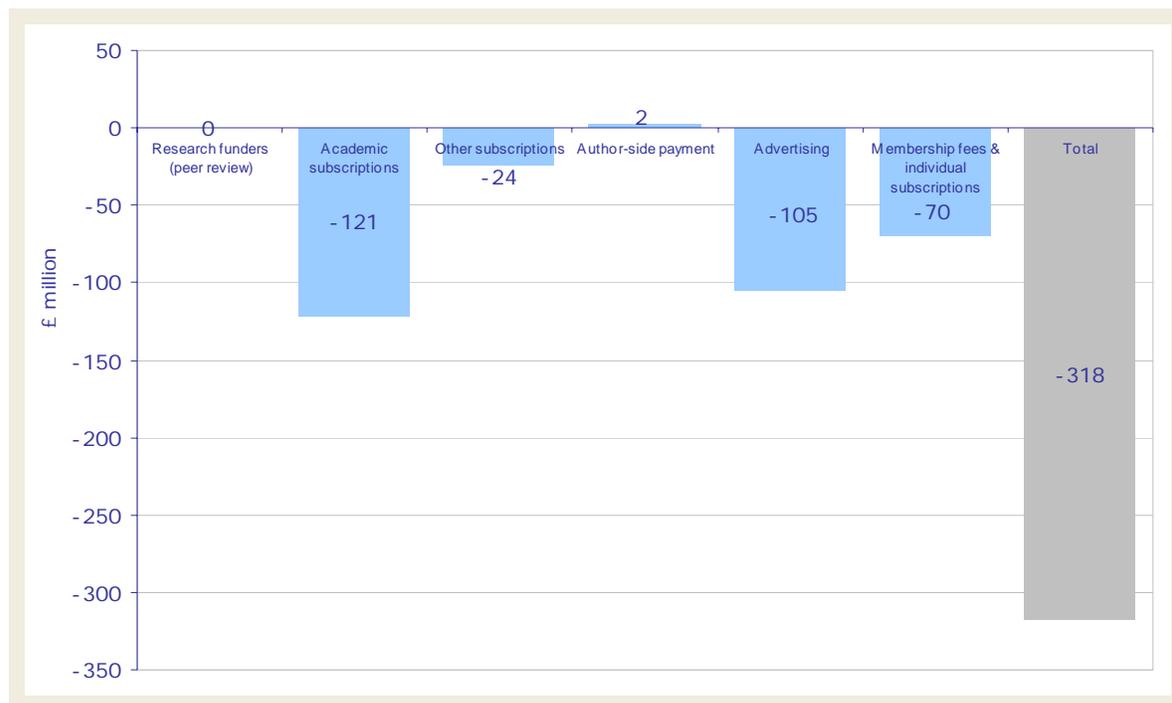


Figure 5.2 shows how these savings are allocated across the various different funding sources for the journals concerned at the global level. It shows that less than two-fifths (£121m) of the total savings of £318m get passed on to academic and other subscribers through reductions in subscription prices. This is because of the assumed reduction in advertising revenues and membership fees⁶¹.

⁶¹ This reflects the assumed reduction in membership fees which is as a result of electronic only publication. The model assumes that in an electronic only scenario fewer subscribers will be inclined to pay membership fees if they no longer receive a print copy. If membership fees remained unchanged then a greater proportion of the savings would be passed onto subscribers.

Figure 5.2: Key differences in global publication and distribution funding between the base case and Scenario 1



UK contribution to publication and distribution costs

Whilst this scenario results in a proportionate reduction of UK library subscription and access provision cost, (discussed in the following section), it is not expected to result in any changes in the UK’s contribution to the publication and distribution elements of the scholarly communications process⁶².

5.3.3 Results – Impact on UK access costs and library budgets

Impact on UK access costs

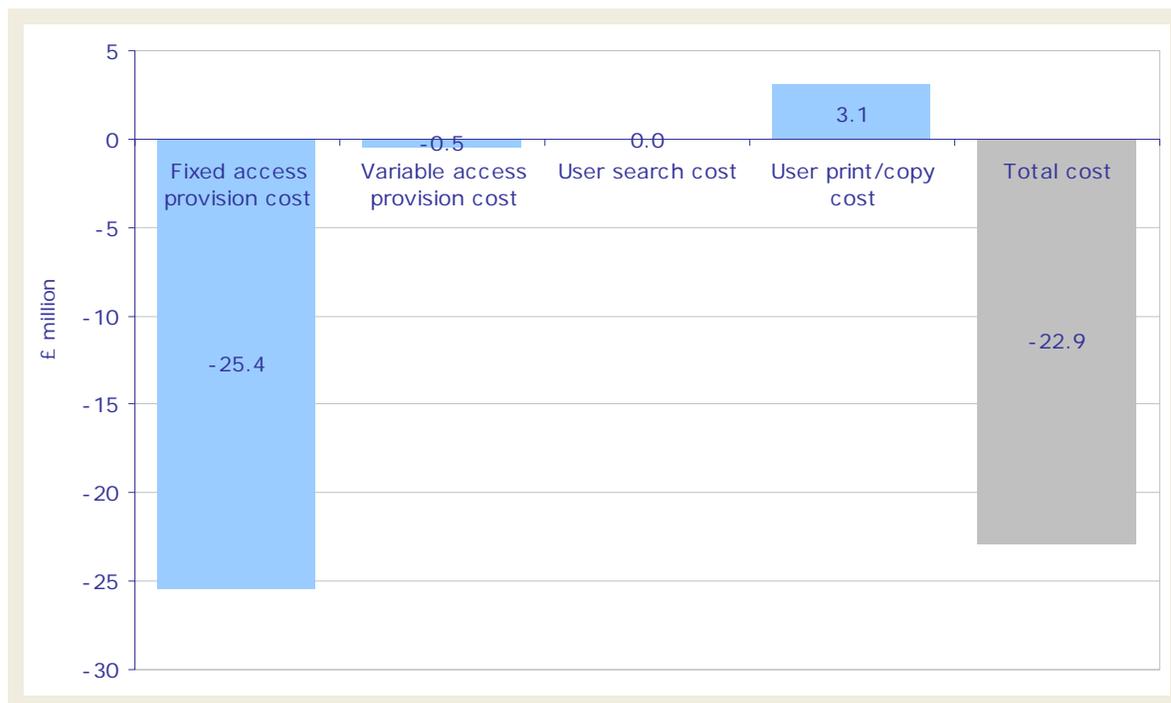
Figure 5.3 shows the reduction in access provision costs in the UK that might result in this scenario⁶³. Key points to note are as follows:

- Total savings are estimated to be around £23m (4% of total UK access costs) and arise mainly from reduced library access costs.
- Libraries’ fixed access costs are estimated to fall sharply by £25m as a result of lower subscription processing and archiving services required for print journals, as well as reduced storage space for print journals. Variable access costs are also assumed to fall because of reduced staff costs for journal usage (check in/out, reserves activities, etc.). In total the reduction in fixed and variable costs is around 36% of UK library access costs.
- Some of the saving is offset by an increase of £3.1m in search and print cost borne by researchers, since researchers are assumed to print a higher proportion of articles with electronic-only journal provision.

⁶² This is because there are no changes, for example in the proportion of articles peer reviewed by the UK researchers.

⁶³ The pro-rated savings in fixed and variable access costs at a global level are assumed to be £758m. This combines with a £318m savings on publication and distribution to suggest total savings of the order of £1076m.

Figure 5.3: Key differences in access provision and usage cost in the UK between the base case and Scenario 1



Impact on academic library budgets

In addition to reduced costs associated with access, UK academic libraries would expect to benefit from reductions in subscription prices (discussed above).⁶⁴ Figure 5.4 shows how total academic library budgets are expected to change as a result of the move towards electronic-only publication. It shows that the total expected benefit of this scenario for UK academic libraries is expected to be of the order of £18.5m (or 10 % of total library budgets for scholarly journals). However, within this the estimated savings in subscription costs are more than offset by VAT increases – the result of moving more to e- only format delivery, which incurs VAT at 17.5%.

⁶⁴ Special libraries (including corporate and individual subscribers) would also see price reduction. The following section, however, models the impact on the budgets only of academic libraries.

Figure 5.4: Changes in UK academic library budgets between the base case and Scenario 1.

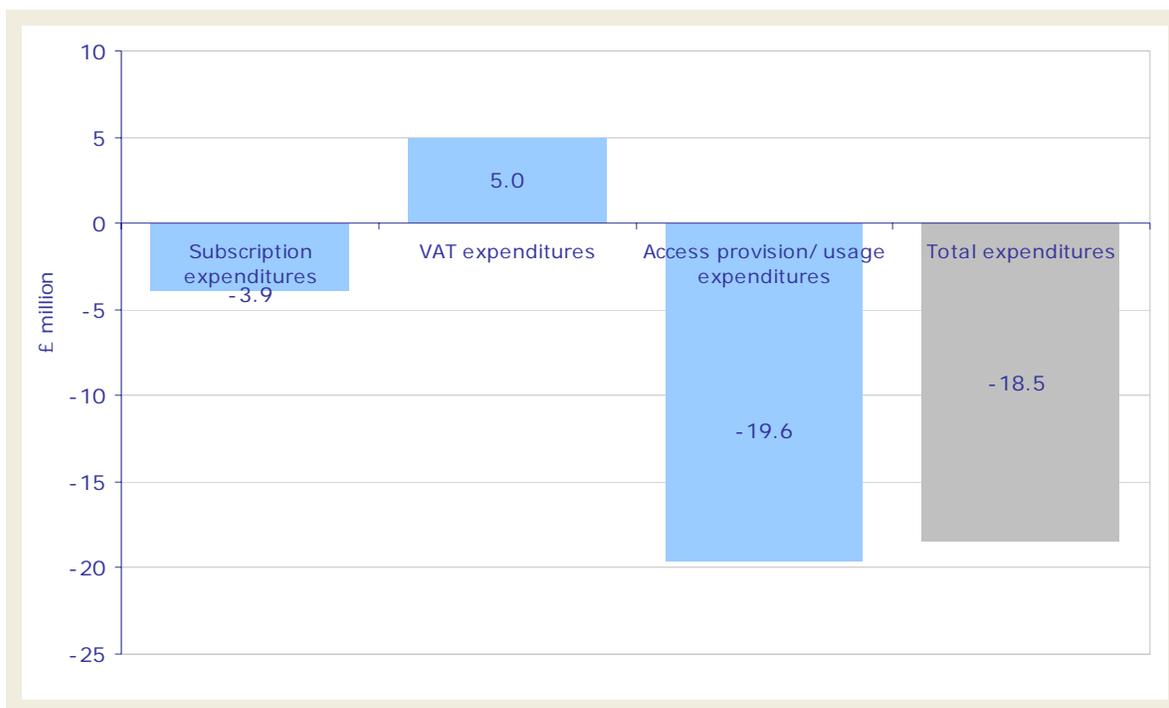
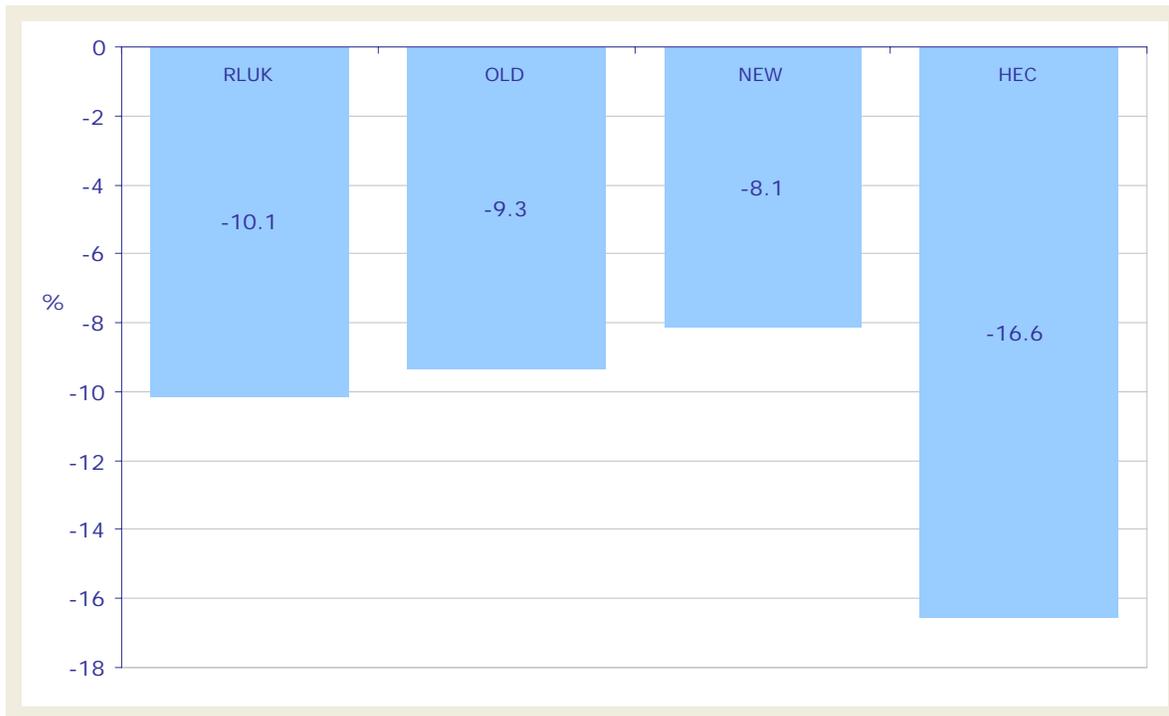


Figure 5.5 shows the percentage reduction in assumed costs for each of the academic library types. The extent of the reduction varies primarily according to the number of print and of print-and-electronic journals used in the base case compared with this scenario. Whilst all libraries benefit significantly from a reduction in library access costs and a reduction in subscription prices, this is offset by the impact of higher VAT payments. This effect is most dramatic for libraries switching from a large base of print or print/electronic portfolios to electronic-only journal subscriptions.

In relative terms it is estimated that the average HEC library would benefit the most from a move towards electronic-only publishing and subscriptions, which could result in an overall reduction of 17% of their library expenditures. Other library types will reduce their expenditures in the range of 8-10%.

Figure 5.5: Key differences in total access provision expenditures (subscriptions and access costs) in the UK between the base case and Scenario 1, by library type



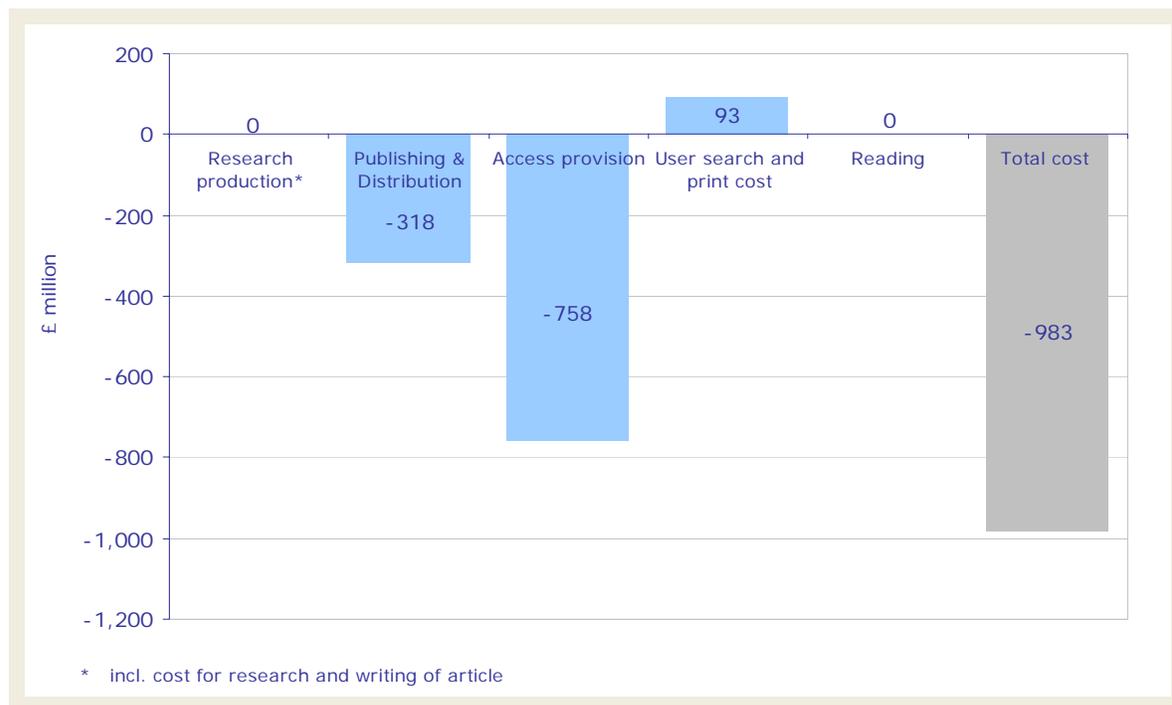
5.3.4 Scenario 1 results – impact on global scholarly communication value chain

Figure 5.6 sets the above analyses of a move towards electronic-only publication in the context of the global research system. As already noted, this analysis uses a simple pro-rating of UK access costs to estimate global access costs.

Total research production cost is assumed not to change. Estimated total cost savings of approximately £983m arise in the scholarly communication process. This occurs largely through a reduction in publication and distribution costs, and in library access costs. The total cost of publishing, distribution and access is reduced by £1,076 million (12%). Usage costs increase by £93m, on the assumption that users print more articles if they are accessed electronically, than they would if they accessed the same number of articles in a print journals⁶⁵.

⁶⁵ Assumption based on Tenopir and King (2007).

Figure 5.6: Key differences in global research system-wide incurred costs between the base case and Scenario 1



5.4 Scenario 2: move towards the author-side payment business model

Scenario 2 assumes that the share of articles funded through author-side payment increases from the current level of about 2% to 90%.⁶⁶

A move towards author-side payment is expected to result in minor changes in the incurred costs of getting to first copy, associated with the need to manage payment contracts with authors. At the same time, such a move would be likely to lead to substantive changes in journals' variable cost structure, particularly in relation to sales administration and online user management.

It is also clear that a move to author-side payment would have a significant impact on who funds the scholarly communication process. For example, we might expect to see:

- reductions in the levels of subscription paid by libraries as article publication costs are met mainly from author-side payments;
- significant increases in the costs that research institutions and funders bear, in order to pay for publication;
- the loss of the funding contribution of corporate and other non-university subscriptions – which will increase the proportion of the cost of the scholarly communications process that are borne by authors and their funders; and
- publishers incurring costs for the management of multiple payment contracts with authors, as distinct from subscription contracts.

⁶⁶ To account for a number of journals that will still be requested in print format by readers, the model makes the simplifying assumption that 10% of journals continue to be provided through a subscription model and are available in print and electronic format. Equally 10% of all author-side payment journals are assumed to offer a print delivery subject to a charge to the reader.

5.4.1 Scenario 2: input assumptions

The input assumptions used to define Scenario 2 are presented in Table 5.2. The key input used to define this scenario is the percentage of articles that are assumed to be published under a wholly ‘author-side payment’ business model. The model assumes that 90% of all author-side payment journals are published in electronic format only. A remaining small proportion of journals will continue to offer print copies under a subscription payment model. Further it is assumed that a move towards author-side payment goes hand in hand with an increase in the average number of articles per author-side payment journal. The total number of published journals will stay roughly around 23,700.

It is important to note that Scenario 2 builds on the results of Scenario 1, where 90% of all journals are assumed to be delivered in electronic format only. This scenario therefore reports only the changes in cost and funding flows shown that arise from a switch from a subscription business model to author-side payment business model.

The author-side payment scenario input assumptions are presented in Table 5.2 below:

Table 5.2: Scenario 2 input assumptions

Parameter	Base case		Scenario	
Payment model (% of articles allocated)	Subscription	98%	Subscription	10%
	Author-side payment	2%	Author-side payment	90%
Journal categories for author-side payment journals	Popular hybrid	0%	Popular hybrid	0.1%
	Major discipline	34%	Major discipline	34%
	Niche journals	66%	Niche journals	65.9%
Number of articles per author-side payment journal per year	42		67	

5.4.2 Scenario 2 results – global publication and distribution costs and funding

Global publication and distribution costs and funding

Figure 5.6 shows that reductions in the variable costs contribute the largest share of the total potential cost saving to the global publishing industry of around £273m with a shift to author-side payment. This is largely due to an estimated decrease in variable publishing cost of £385m related to a cut in sales administration (£ 267m) and online user management cost (£ 130m).⁶⁷ This cost saving is partly offset by an increase in direct fixed cost (per article) due to the management of payment contracts with authors.⁶⁸ As noted above, these changes are in addition to the changes arising from a move to e-only publication.

⁶⁷ The total savings in sales administration and online user management of £ 397m are slightly offset by additional variable costs for production/print, management/inventory and delivery/fulfilment which are estimated to increase by £ 12m. This is related to a marginal change in the article allocation through a move to author-side payment journals (Scenario 2).

⁶⁸ Please see the model assumption book for details on activity cost assumptions. With a move toward author-side payment journals, publishers’ cost to administer author-side payments was uplifted by an extra £30 per article to account for this fundamental change in the business model of publishing. Also, online user management costs are only reduced by 50% since we assume that under this scenario, publishers will still incur some cost for user registration and management, even if access to journals is free. Note that the model assumption does not include any ‘non-cash’ cost potentially incurred by authors in the process of handling payments for article publication.

Figure 5.6: Additional differences in global publication and distribution cost between e-only publication (Scenario 1) and Scenario 2



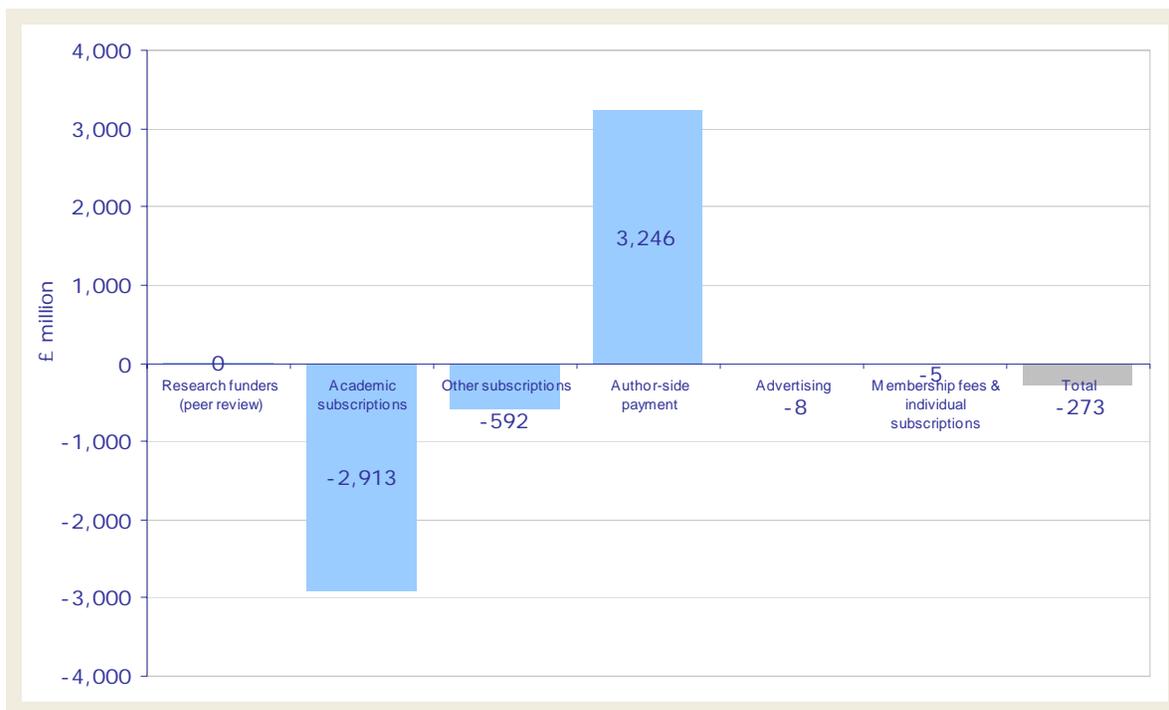
Figure 5.7 shows the changes in funding shares arising from the modelled move towards an author-side payment model. It indicates a shift in the burden of funding of the global scholarly communication system from academic and other libraries, and corporate subscribers, to academic authors (and/or their employing institutions, or their funders).

- Academic libraries are net beneficiaries, with their total subscription expenditures decreasing by almost £2.91bn at a global level.
- However, since academic libraries are part of the academic and research institutions that need to fund 'author-side payment' costs, these savings are expected to be largely offset. Assuming that around 90% of articles are published by academic researchers, their proportion of the increase in author-side payments would be about £2.92bn. As a result, the model suggests that academic institutions at a global level would need to fund an additional £10m from the move to author-side payment⁶⁹.
- Costs and benefits are unevenly distributed across institutions: research-intensive institutions would pay more in publication fees than they currently do for library subscriptions, while institutions where research constitutes a lower proportion of activity and expenditure would tend to see reductions in expenditure.
- The main beneficiaries of this move are thus 'other subscribers', to the extent that they are 'consumers' of published research outputs. They benefit by a cost reduction in subscription expenditures of £592m. If the remaining share of articles (10%) is assumed to be published by these other subscriber, the net benefit would fall to £267m.

⁶⁹ If we assumed that all articles were published by academic researchers, then academic / research institutions would in total bear a cost increase of £333m.

What is interesting about the results summarised in Figure 5.7 is that, based on the assumptions in the model, the ‘loss of revenues’ from ‘other subscribers’ has been largely offset by the assumed variable cost savings resulting from a move to author-side payment. The additional funding from academic institutions would otherwise have increased further.⁷⁰

Figure 5.7: Additional differences in global publication and distribution funding between e-only publication (Scenario 1) and Scenario 2



A discussion of the impact of UK libraries, including the impact on non-subscription price access costs is presented further below.

UK contribution to the global publication and distribution costs

Table 5.3(a) shows two of the measures of the UK’s contribution to the publication and distribution cost activities of the scholarly communications process (£6.4bn in the base case and £5.8bn in Scenario 2). The contribution of peer reviewers is not expected to change under this scenario. Table 5.3(b) shows how the supply and demand-side indicators change compared with the base case.

Key points to note from Table 5.3(a) and (b) are that:

- Table 5.3(a) shows an increase from 4.0% to 6.2% in the UK academic contribution to the costs of the global publication and distribution of articles. This reflects the fact that the current contribution (as a proportion of total costs) provided in the form of subscriptions from UK university libraries is less than the proportion of articles that originate from UK authors.
- The total UK contribution under Scenario 2 - taking account of further funding sources from remaining print subscriptions, author-side payments from non-academic researchers, and membership fees - would be 7% of the global cost of publication and distribution, as compared with 5.2% in the base case.

⁷⁰ One further point to note is that this analysis does not take account of the subsidy currently provided to academics in developing countries (through free or discounted access to academic journals). If this continued to be provided in an author-side payment model, the relative burden on academics would increase – in order to cover the cost of the publication of developing country academics.

- Table 5.3(b) shows the implications of these changes for the ‘contribution measures’ presented in Section 4.4.3. It shows the supply indicator moving from a position in which UK is a ‘net beneficiary’ to being broadly in balance. The impact on the ‘demand side’ indicator is to increase the extent to which the UK is a ‘net contributor’ compared with its levels of readership.

Table 5.3a: Change to UK contribution arising under Scenario 2

Measure	Base case	Scenario 2
UK Academic contribution of global total of funding for publication/distribution	4.0%	6.2%
Total UK contribution of global total of funding	5.2%	7.0%

Table 5.3b: UK contribution to total global indicators (publication and distribution) costs

	Measure	UK as % of total Global costs	Supply Indicator (defined as UK funding contribution % / UK article contribution %)	Demand Indicator (defined as UK Cost contribution %/ UK reading %)
C	Total UK academic institution contribution to funding	6.2%	6.2% / 6.6% = 0.9x (0.6x in Base case)	6.2% / 3.3% = 1.9x (1.2x in Base case)
D	Total UK contribution to funding	7.0%	7.0% / 6.6% = 1.1x (0.8x in Base case)	7.0% / 3.3% = 2.1x (1.6x in Base case)

5.4.3 Scenario 2 results – impact on UK access costs and library budgets

Impact on UK Access costs

Figure 5.8 shows how the assumed shift towards author-side payment could result in a saving to UK access costs (excluding subscription acquisition costs) of around £9.8m per annum. These savings arise from reductions in the non-subscription costs incurred by libraries, namely the fixed costs of processing, receiving and archiving of journals that would be available as open access. This is an additional cost reduction of 34% on top of the potential savings through a move to electronic journals shown in Scenario 1. The remaining £10m of fixed library costs would be used to ensure archiving of existing journal stocks and for user reference and assistance in relation to open access journals.

The savings in fixed and variable access cost provision are offset slightly by increases in costs borne by researchers in printing, reflecting the assumption that these costs are higher when articles are provided in electronic format.

The remaining costs are limited to management and administration, and a reduced share of the current storage cost. Journal usage among researchers is assumed only to relate to searches for older articles and use of inter-library article requests for subscription articles published prior to the move to a world of author-side payment.

Figure 5.8: Additional differences in access provision and usage cost in the UK between e-only publication (Scenario 1) and Scenario 2.



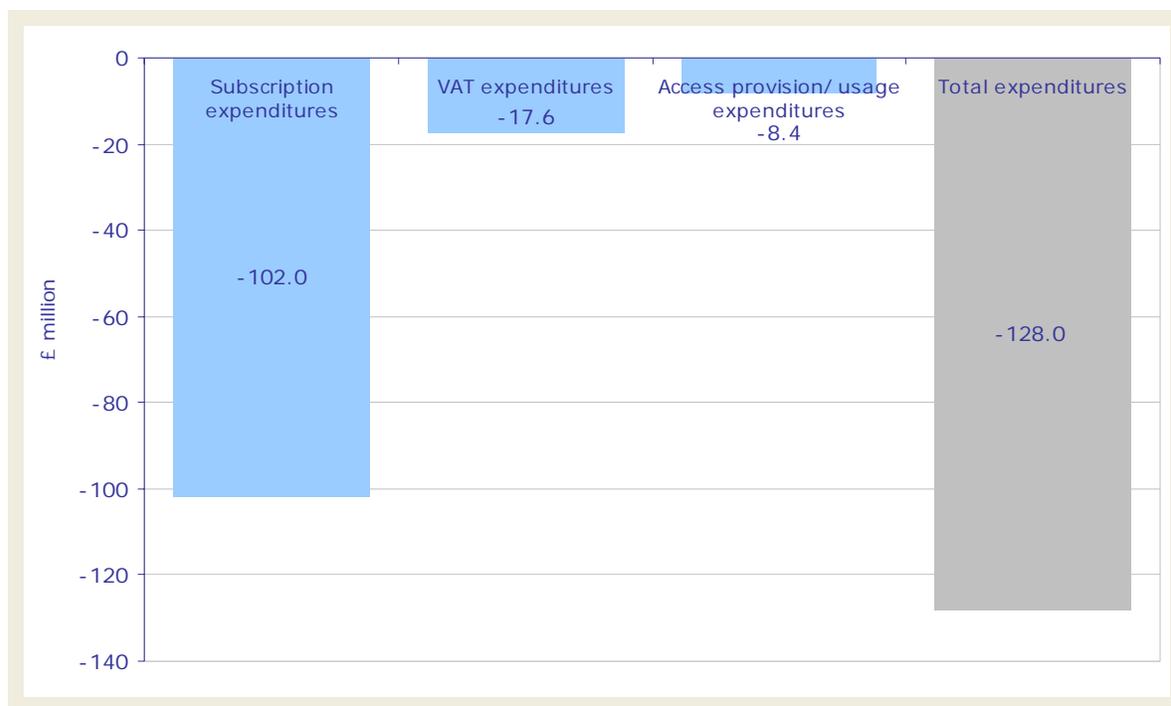
Change in UK academic library access costs

Figure 5.9 shows how a move to an author-side payment business model might impact total UK academic library budgets, including both the reduction in access costs and the reduction in subscription charges.

It shows that the total expected benefit of this scenario for UK academic libraries is expected to be of the order of £128m, or an additional 76% reduction of total academic library budgets compared to library expenditures in Scenario 1.

Library subscription budgets for journals are estimated to fall by £102m or 90%. The total reduction in the cost of access provision arising from a shift to an author-side payment business model is shared by the five library types, and expected relative cost reductions are in the range of 65% (HEC) to 78% (NEW universities).

Figure 5.9: Additional changes in UK academic library budgets between e-only publication (Scenario 1) and Scenario 2



5.4.4 Scenario 2 results – global scholarly communication process

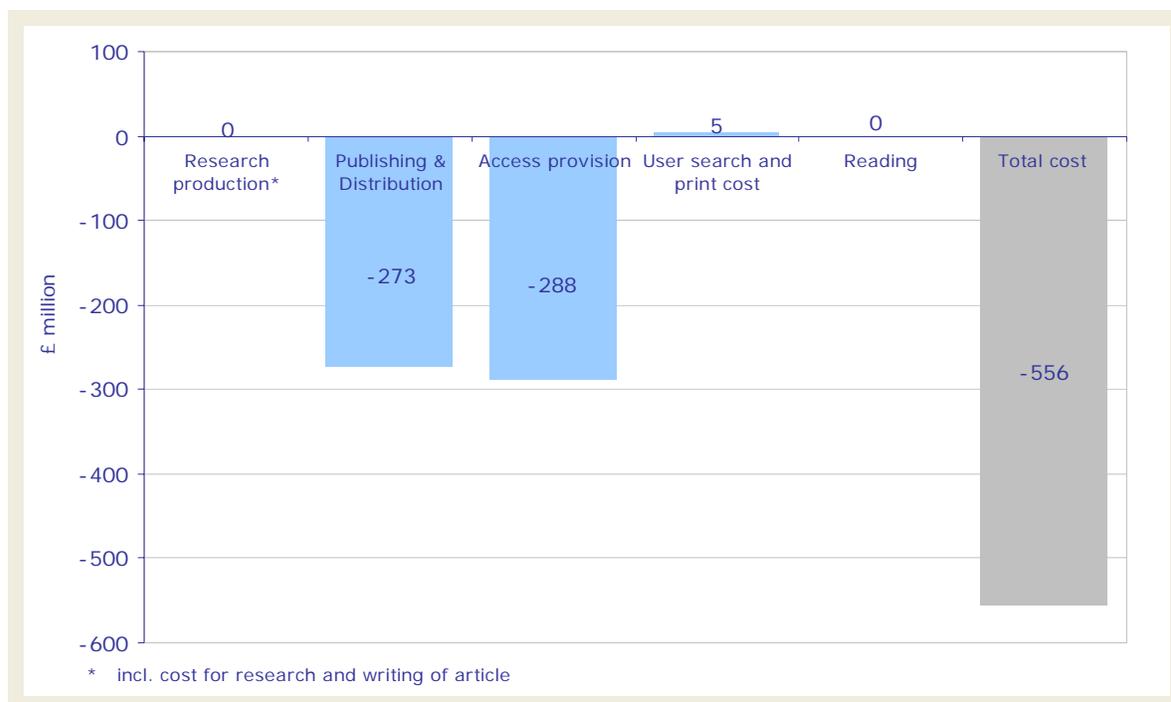
Figure 5.10 shows the impact of a move to author-side payment for the entire research value chain. It shows that, in addition to a move to electronic publishing in Scenario 1, this scenario generates an estimated annual cost saving to the global system of publishing, distribution and access of £561m (71%), offset only marginally by £5m increase in user search and printing costs. As with Scenario 1, a move towards author-side payment does not impact on the total cost and funding for research production, but is assumed marginally to increase research usage cost.⁷¹ It is important to note, however, that while our modelling assumes that there will be some costs to publishers in administering author-side payments, any time and administrative costs to authors, their institutions and funders have not been modelled. Some of the estimated savings could therefore be offset if the costs to publishers, authors, institutions and funders are higher than we have assumed and modelled.

The key differences in the funding flows, involving a shift of funding from library subscription budgets to other research institution budgets has been previously shown in Figure 5.7. In reality a move to author-side payment may also result in increases in research budgets to cover the need for authors to pay for publication, with some leakage of monies intended for publication payment into research activities.

Appendix D presents the combined impact of key figures on cost and funding flows used in Scenarios 1 and 2.

⁷¹ Usage cost increases marginally because of the assumption that users print more articles if they are accessed electronically, than they would if they accessed the same number of articles in print journals.

Figure 5.10: Additional differences in global research system-wide incurred costs between e-only publication (Scenario 1) and Scenario 2



5.5 Scenario 3: move towards cash payments for academic peer review

Scenario 3 is a relatively simple scenario involving a change in peer review costs (currently non-cash costs) into cash costs. The model generates the corresponding set of funding flows and allocations required to meet the additional cash cost (incurred by publishers, and passed on to libraries in the form of higher subscription charges). This scenario does not build on Scenarios 1 and 2.

5.5.1 Scenario 3: Input assumptions

Table 5.4 sets out the current approach to calculating peer review costs per article. The only difference between the base case and Scenario 3 is that the costs are assumed to be 100% cash costs.

Table 5.4: Scenario 3 input assumptions

Parameter	Base case	Scenario
Unit cost of peer review	Global hourly (100% non-cash) cost of peer review = £48 per hour. Average hours of review per article = 4 hours Average number of peer reviewers per article = 2.5 people	As base case; 100% cash costs

5.5.2 Scenario 3 results – publication and distribution (global)

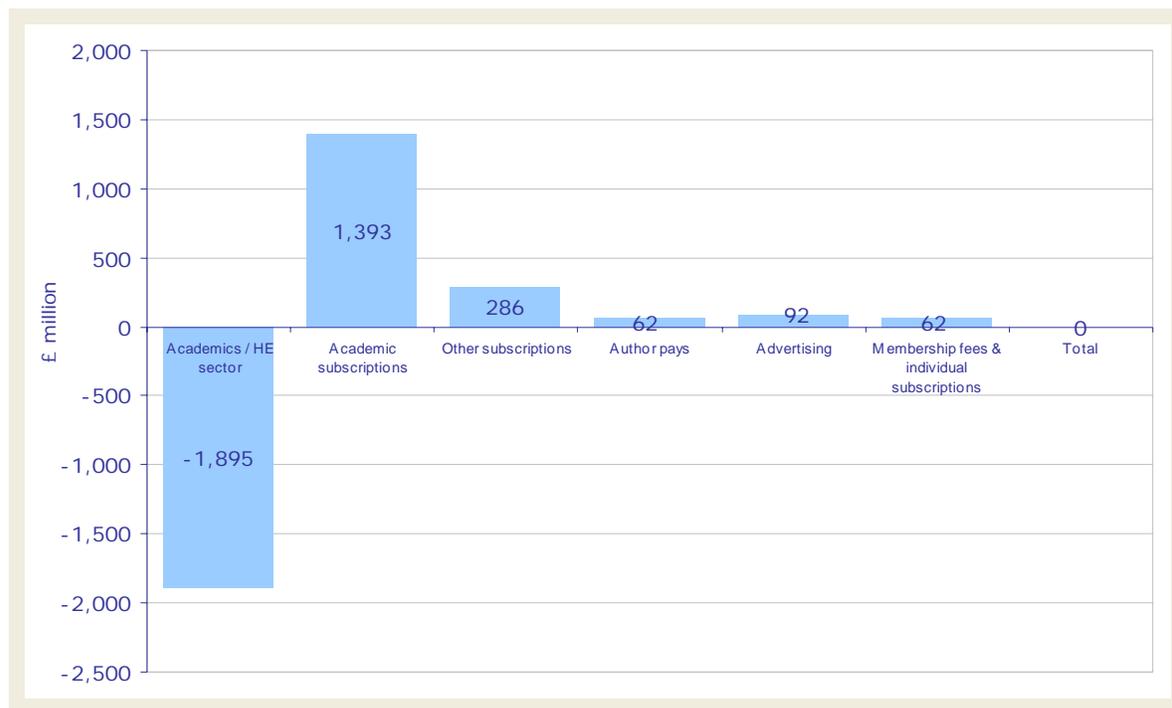
Global publication and distribution costs and funding

Because our measure of the costs of global publication and distribution costs associated with the scholarly communications process include both cash and non-cash costs, there are no changes in these totals. The only changes relate to funding flows as show in Figure 5.11 below. Key points to note are as follows:

- Payments for peer review would create a significant transfer (of the order of £1.9bn) to academics and/or the HE sector.
- This increase in first copy cash costs would result in increases in break-even prices and therefore subscription costs. For example the estimated breakeven price of an average major discipline journal would increase by 43%. The increases for the average hybrid and niche journal would be 24% and 44% respectively
- Figure 5.11 shows the impact of these changes in the form of very significant increases in subscription costs for academic libraries and others. It also shows increases in revenues from the other sources – e.g. author pays, advertising, membership fees and individual subscriptions - since the model assumes that in order to meet the increased first-copy costs funding for each would increase in proportion to their current contributions.

In the event that research universities are able to capture the payments received by peer reviewers (e.g. by reductions in salaries or by institutions adopting a charge-out policy); it might be possible for these changes to be neutral in terms of university budgets. However, our presumption is that the majority of these peer-review payments would be in addition to existing salary payments. At the limit, this would result in an increase in the cost to academic research institutions of acquiring journal subscriptions of around £1,393m globally.

Figure 5.11: Key differences in global publication and distribution funding between the base case and Scenario 3



UK contribution

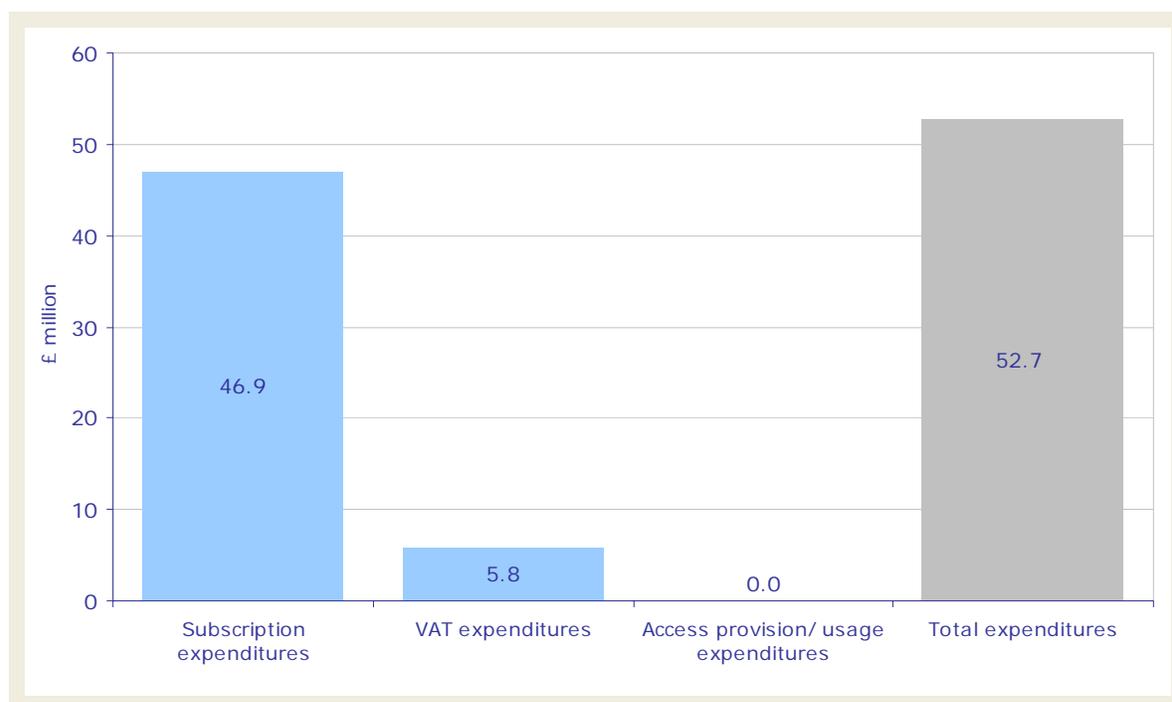
Because the actual costs of the scholarly communication process are unchanged, there are no changes in the estimates of UK contribution presented in the base case.

5.5.3 Scenario 3 results: UK access provision and library budgets

The model assumes that moving towards cash remuneration of peer reviewers would have no impact on access provision costs incurred by libraries in the UK. However, Figure 5.12 shows the dramatic increase in UK libraries' subscription budgets for unchanged journal portfolio assumptions. The increase in cost is very significant indeed – around 40% compared with current estimated library subscription expenditure.

As noted above, we do not think it plausible to suggest that academic research institutions could recover these amounts by offsetting reductions in the 'on-costs' of salaried researchers.

Figure 5.12: Key differences in UK library budgets under the base case and Scenario 3



5.5.4 Scenario 3 results – global research value chain

The model assumes that global cash peer-review costs (of £1.9bn) are passed on into subscription prices and through libraries into the cost of research production⁷². This is the only impact of this scenario on the global system cost.

5.6 Scenario 4: increase in research funding and article production

This scenario captures the impact of increasing the level of global research funding made available such that:

- total global research funding increases by an annual rate of 2.5% over a period of ten years (which is broadly consistent with average annual research funding increases);
- the UK's global share of research funding and article production stays constant relative to its current level; and
- the average number of articles per journal increases at a compounded annual rate of about 1.5%, which is in line with a range of estimates for growth rates seen over the last decade.

It is expected that the impact of this scenario will be an increase in the supply of articles and journals produced by authors both globally and in the UK, and an increase of costs incurred in the scholarly communications process.

Table 5.5 presents the input assumptions used to define Scenario 4, in terms of the position in ten years time.

⁷² In practice, we would expect libraries to respond to increases in subscription prices by reducing the portfolio of journals that they hold. Therefore the actual impact is likely to be a combination of increased expenditure (i.e. research cost increases) and reduced access to journals.

Table 5.5: Scenario 4 input assumptions

Parameter	Base case	Scenario 4
R&D funding global	£439bn	£562bn
R&D funding UK	£17.9bn	£22.8bn
Average number of articles per journal per year ⁷³	114	132

An increase in global R&D funding, at an assumed constant level of researcher productivity, will result in an increase the production of articles and journals. Table 5.6 shows the impact on global publications: it shows that, because the average number of articles per journal is assumed to increase, the growth in articles of 28% to 2.03m results in only an 11% growth in journals.

Table 5.6: Impact of increased research funding on the number of globally published articles and journals

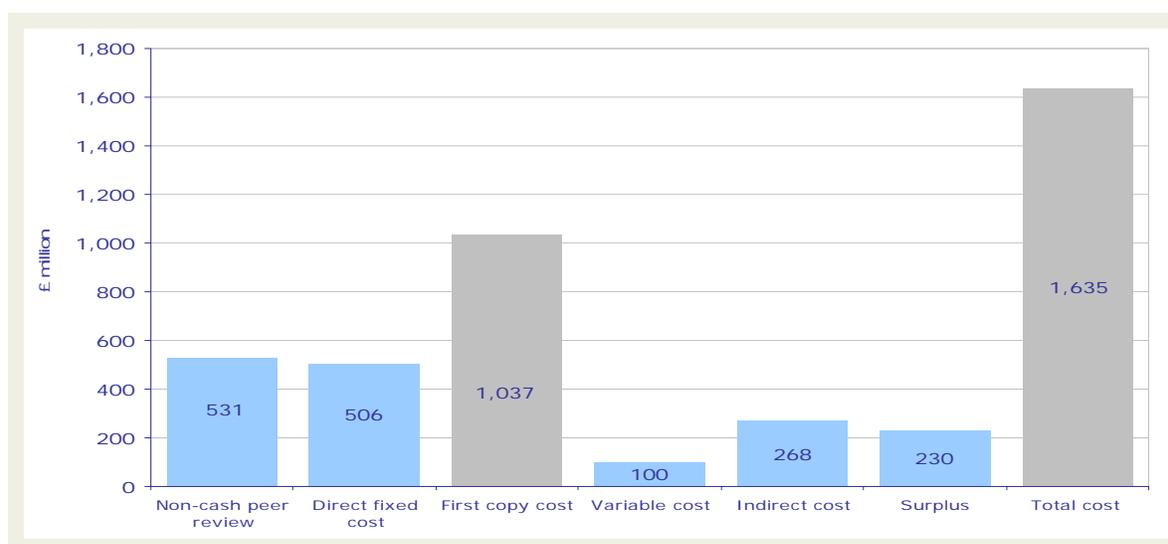
Item	Base case	Scenario 4
Number of articles published	1.58m	2.03m (+28%)
Number of journals published	23,700	26,300 (+11%)

5.6.1 Results – publication and distribution (global)

Changes in publication and distribution costs and funding (global)

Figure 5.13 shows that, based on the above input assumptions, the growth in research funding would result in the global publication and distribution costs rising by about £1.6bn (25%), mostly as a result of the £1bn increase in first copy costs.

Figure 5.13: Key differences in global publication and distribution costs between the base case and Scenario 4

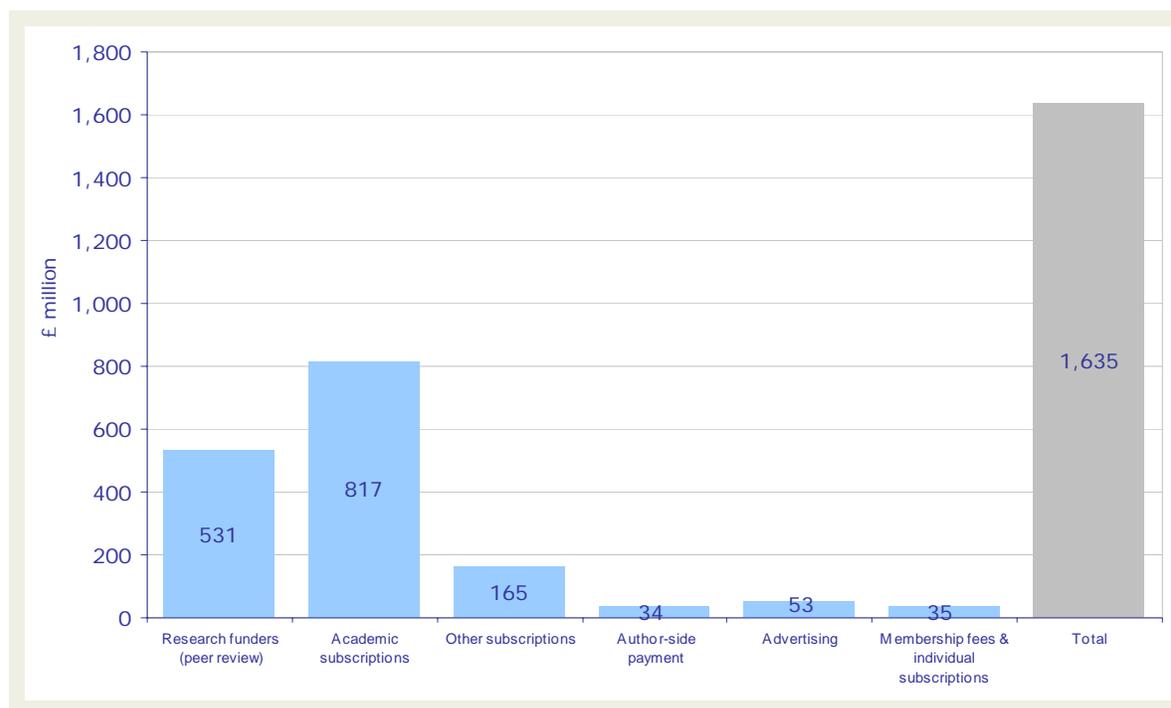


⁷³ Global averages 2007 based on ISI/Scopus data. The model disaggregates this figure for journal categories (PopHyb, Major discipline, Niche journals) and subjects. These figures will be extrapolated by the assumed annual growth rate over 10 years.

On a per journal basis the increase in first copy cost would result in increased break-even and subscription prices. Prices for the average major discipline journal would, for example, increase by 12% in real terms over the period. The increases for the average popular hybrid and niche journal would be 5% and 13% respectively.

The modelling assumes that the full cost increase of £1.6bn in publication and distribution is passed on to the funders of the scholarly communications process through increases in journal breakeven prices and an overall increase in the number of journal subscriptions. Figure 5.14 shows how these cost increases are in principle allocated across the various different funding sources at the global level.

Figure 5.14: Key differences in global publication and distribution funding between the base case and Scenario 4



5.6.2 Scenario 4 results – impact on UK access costs and library budgets

Impact on UK access costs

Figure 5.15 shows the increase in access provision costs in the UK that might result under this scenario⁷⁴. The total increase in access cost is estimated to be around £157m (26%). However, the majority of this relates to increases in user search cost. The increase in libraries' fixed and variable access provision is estimated to be £7.5m. (10%).

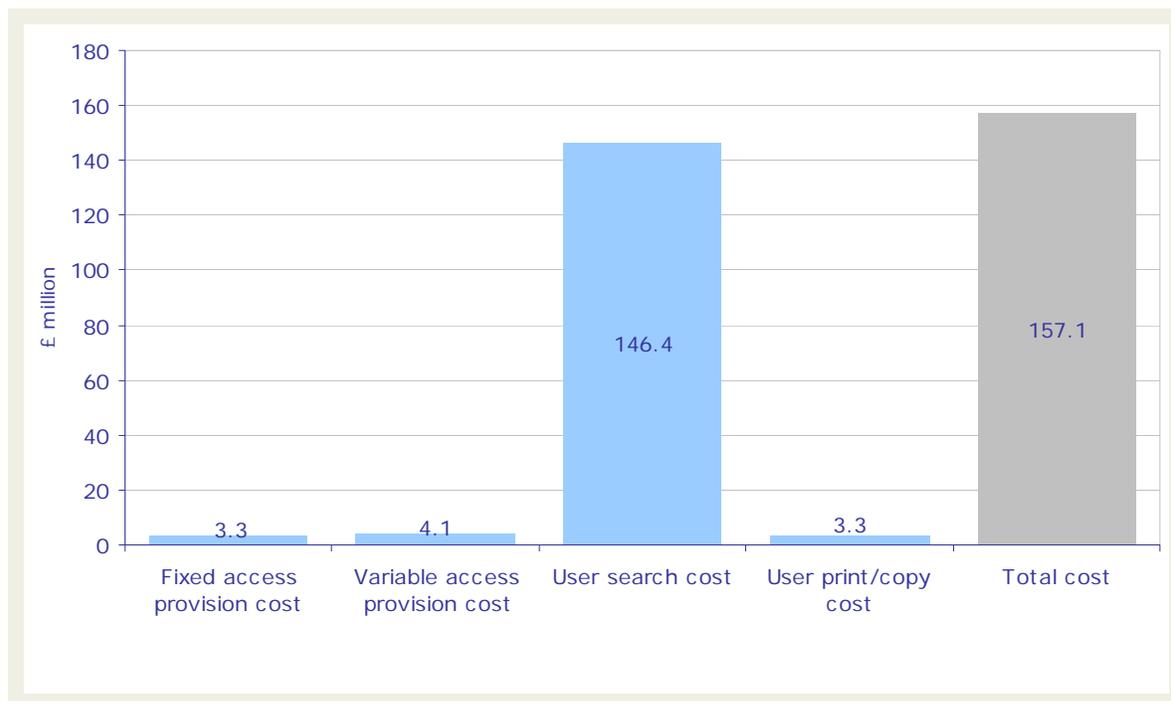
Key points to note are as follows:

- Libraries' fixed access costs are estimated to rise by £3.3m, as a result of increases in staff and capacity requirements related to the increase in overall journal subscriptions per library. Given the assumed cost structures of libraries the increase in fixed costs for access provision is lower than the increase in total average journal subscriptions (i.e. only 6% compared with 11%).

⁷⁴ The pro-rated increase in fixed and variable access cost at a global level is assumed to be £218m.

- Libraries' variable access costs are expected to rise by £4m as a result of an increased number of research users per library. Without technology changes and a move to electronic subscriptions the cost increase is a result of increased journal usage activities (check in/out, reserve activities, etc.).
- The main increase in access costs arises from an increase in the number of researchers who will spend time searching for and accessing articles. User search cost will increase by £146m or 28% which equals the rise in research funding and the growth in number of researchers.
- The rising volume of reading is assumed to result in increase of printand copying costs of £3.3m.

Figure 5.15: Key differences in access provision and usage cost in the UK between the base case and Scenario 4



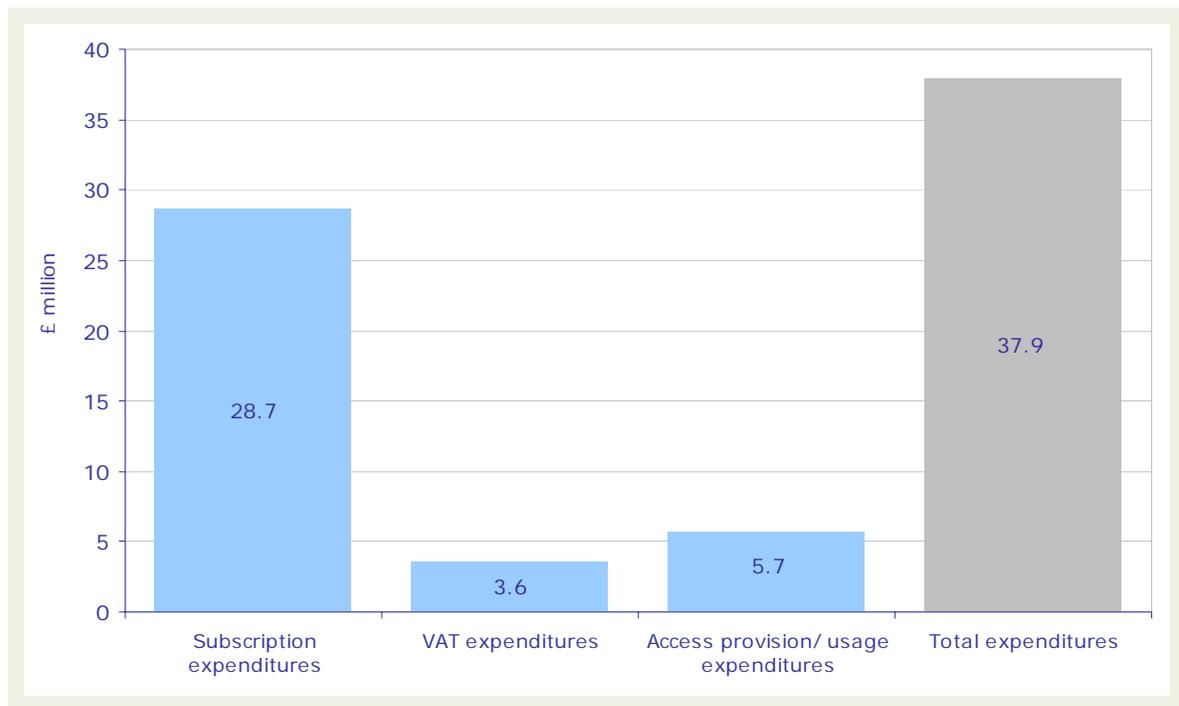
Impact on academic library budgets

In addition to the increase in access provision cost, UK academic libraries would also see increases in their subscription budgets, a result of the increased journal break-even prices and the rise in average library journal subscription portfolios.⁷⁵ Figure 5.16 shows how the total academic library budgets are expected to change, assuming that they maintain the journal portfolios⁷⁶ as in the base case. It shows that the total expected cost burden for UK academic libraries of this scenario is expected to be of the order of £38m (or 20 % of total library budgets for acquiring and providing access to scholarly journals).

⁷⁵ Special libraries (including corporate and individual subscribers) would also see price reduction. The following section, however, only models the impact on the budgets of academic libraries.

⁷⁶ As a proportion of the total by journal type.

Figure 5.16: Changes in UK academic library budgets between the base case and Scenario 4

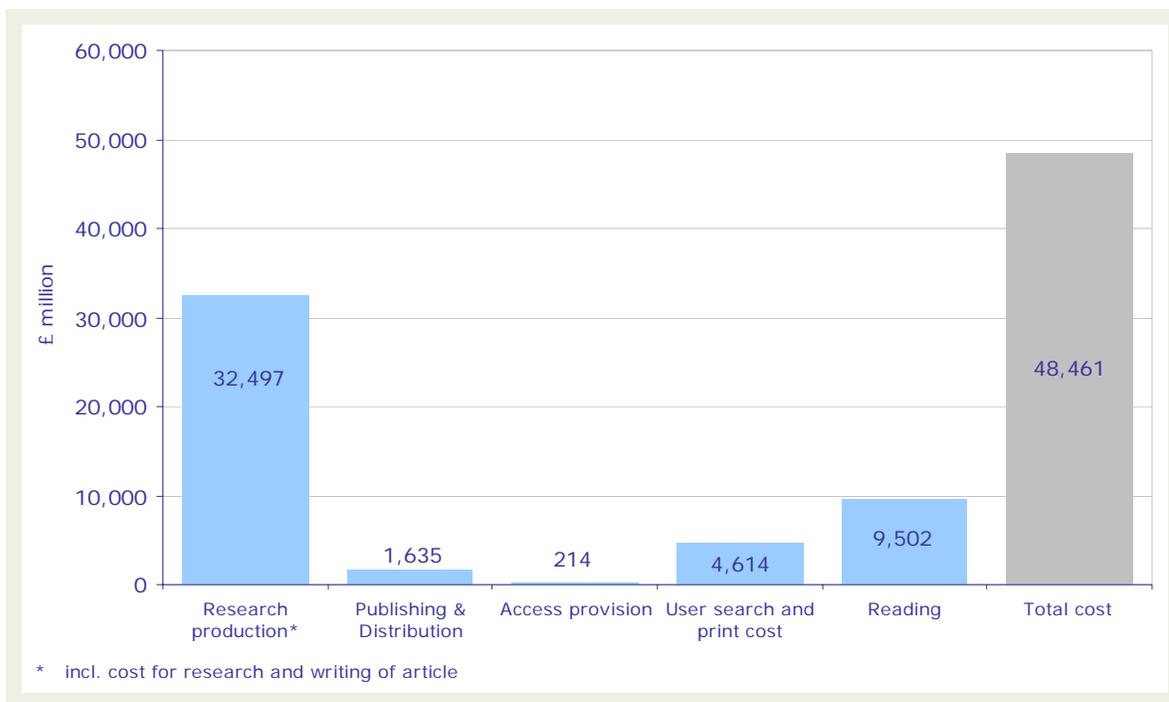


The total budgets of different library types are assumed to increase by around 20% with a similar assumption of scale economies between larger and smaller libraries. A more accurate estimate of the cost impact on specific library types can be made only on the basis of more realistic assumptions about how libraries would amend their journal portfolios in the light of higher prices and additional journal titles. Also, the model assumes a roughly even distribution of the increase in researchers across all academic (and special) library types –this is a driver of library access cost.

5.6.3 Scenario 4 results – impact on global scholarly communication value chain

Figure 5.17 below shows the estimated the impact of increased research funding in the context of the global research system. Total research production cost increases by £32bn.⁷⁷ Reading costs increase accordingly.⁷⁸ The total increase in the scholarly communication system is estimated to be £6,462m or 26%. Total publication and distribution cost, as shown previously, increases by £1,635m and usage costs rise by £4,614m.

Figure 5.17: Key differences in global research system-wide incurred costs between the base case and Scenario 4



⁷⁷ Note that this scenario assumes significantly higher increase in global RandD funding, but only £28bn are attributed towards primary and applied research funding which results in researchers producing scholarly publications.

⁷⁸ These figures should be treated with caution though, since they are based on contextual modelling only.

Annex A: CEPA Methodology

A1. *Purpose of this section*

In this section we set out the approach to the study involved the completion of several major workstreams. This section summarises the set of activities undertaken to deliver each workstream to provide an indication of how each component supported the overall objectives of the project. Activities are presented broadly in chronological order.

A2. *Stage 1: Consultation and literature review*

With the RIN and the Expert Panel members

The first set of activities involved meeting with representatives from the RIN and each of the Expert Panel members to identify and discuss:

- the emerging policy considerations, current issues and topics being debated within the research, publishing and library sectors, to establish the context in which the project was being undertaken;
- the possible interviewees and sources of numerical data that could be drawn upon to inform the project team's understanding of: the context in which the study was being carried out; and the most appropriate approach to modelling the scholarly communications value chain (SCVC) and assumptions to be used to populate the model;
- the set of activities that make up the SCVC, to establish the universe of activities from which specific value chain components would be modelled in detail; and
- the scope of SCVC activities to be costed (modelled) in detail, and the scope of activities to be modelled 'contextually' during the project⁷⁹.

Scholarly communications professionals

A series of consultations were carried out with other publishing and library professionals to establish the context in which the project was taking place; the current and possible future business models of article delivery; and approaches to costing activities across the value chain. The interviewees included representatives from different components of the SCVC and care was taken to ensure that a range of opinions on possible futures was taken into account.

Literature review

A literature review was undertaken to provide CEPA with appropriate background to the key policy and related issues; and to identify data that could be used as input assumptions for the model. Discussions with Expert Panel members and experts identified specific literature references from which relevant data could be drawn and from which to refine the definition of different business models and approaches to costing activities across the value chain.

⁷⁹ Annex B contains a discussion of the activities that were modelled in detail and those that were modelled contextually.

A3. Value chain mapping

Fundamental to the definition of the scope of activities to be modelled in detail was an exercise to define and map the SCVC. Consultations with industry experts and the literature review informed work to identify the board value chain components, the detailed activities that comprise each component, and the key agents involved in the delivery of each activity. Detailed value chains of three different business models – subscription-based print publication, subscription-based electronic publication, and author-side payment publication – are contained in Annex B.

A4. Development of the modelling approach

Taken together, the overall purpose of the above set of activities was to inform the structuring and development of a spreadsheet model of the scholarly communications process. In particular, the above activities helped to define:

- the scope of the model – i.e. those activities to be modelled in detail and those activities to be modelled contextually;
- the modules of the model – i.e. decisions about which sets of assumptions and activities combine in order to inform the project objectives; and
- the input assumptions – i.e. the volume and unit cost assumptions which can be tailored to model either the current state of the scholarly communications process, and/or particular sensitivity analyses for the purpose of considering different policy questions.

Annex B contains a detailed description of the structure of the model including descriptions of: the modelling requirements (as presented in the RIN Specification document); the modular approach and role of each of the three modules; and definitions of different cost types.

A5. Data collection

Once the model structure had been established, work was done to construct the spreadsheet model and to populate it with data or 'input assumptions', namely volume assumptions (allocations of published articles to business models, library demand for journals, percentages of peer reviews from the UK etc), or unit cost assumptions (first copy costs, access provision activity costs, variable cost by format etc). The data sources discussed below were drawn upon to establish modelling input assumptions.

A5.1 Consultations with publishers

A detailed questionnaire was sent to eight commercial publishers and ten society publishers requesting information about costs incurred during the publication and distribution of published articles. Costs were requested by different activities of the publication and distribution process, and by journal category to try to capture variations in the unit cost of publishing articles in different titles. The response by publishers to this questionnaire was poor with only 1 submitting a response.

A5.2 Consultations with libraries

A data questionnaire was also sent to twelve academic libraries in the UK. The sample included libraries representing SCONUL's four library classifications to try to capture differences in unit costs incurred by different library 'types' in the provision of access to published articles. The questionnaire asked respondents to show the costs of managing an electronic version of a journal separately from the cost incurred by print version. Five libraries submitted a response to this questionnaire.

A5.3 Literature and interviews

Input data was also collected from the extensive literature on the cost of scholarly communications, and where appropriate from interviewees. Key sources for input used in the modelling work are set out in the Modelling Assumptions Book (Annex C).

A5.4 Development of scenarios

Finally, a set of modelling scenarios was established to reflect current and future policy and structural issues of interest in the industry. These are discussed in more detail in section 5. The purpose of developing modelling scenarios was to allow the RIN and other policy makers to understand the incurred cost and funding flow implications of different possible future states of the scholarly communications process. Scenarios are defined in the model simply by altering particular volume or unit cost assumptions. Input assumptions used to define different scenarios are set out at the end of the Modelling Assumptions Book contained in Annex C.

Annex B: Model structure

The model structure paper is available separately.

Annex C: Modelling assumptions book

The model assumption book is available separately.

4 Annex D: Total impact of Scenarios 1 and 2

This section presents the combined impact of key figures on cost and funding flows used in Scenarios 1 and 2 to present the total impact that a move towards electronic only and author-side payment might have on the scholarly communications system.

Figure D.1: Key differences in global publication and distribution cost between the base case and Scenarios 1 and 2 (total impact)

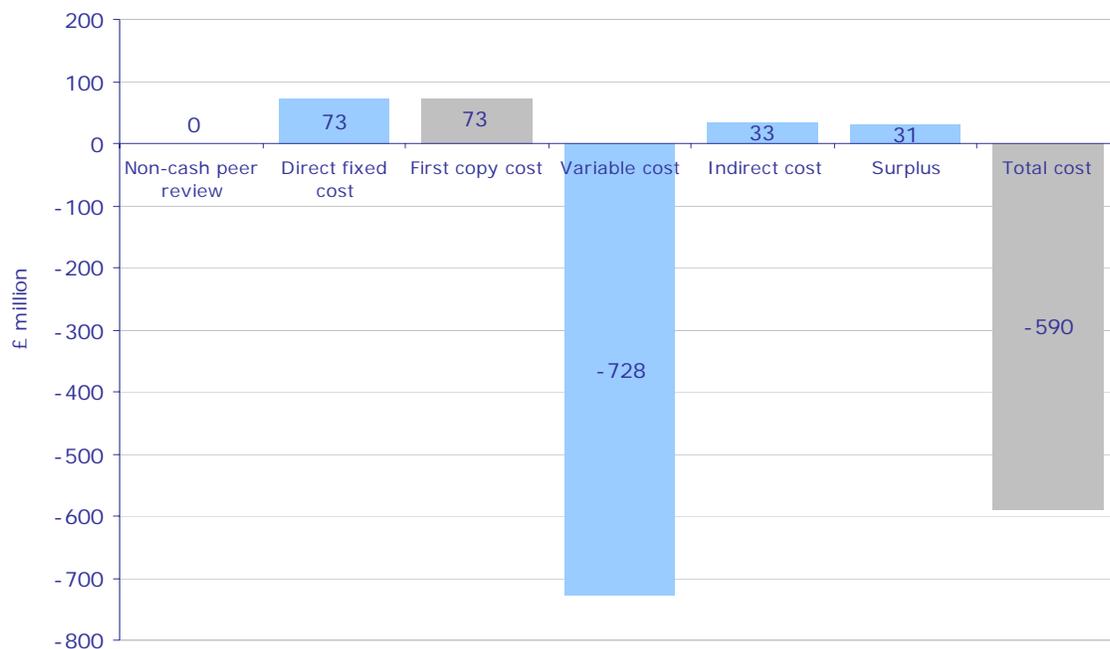


Figure D.2: Key differences in global publication and distribution funding between the base case and Scenarios 1 and 2 (total impact)



Figure D.3: Key differences in access provision and usage cost in the UK between the base case and Scenarios 1 and 2 (total impact)

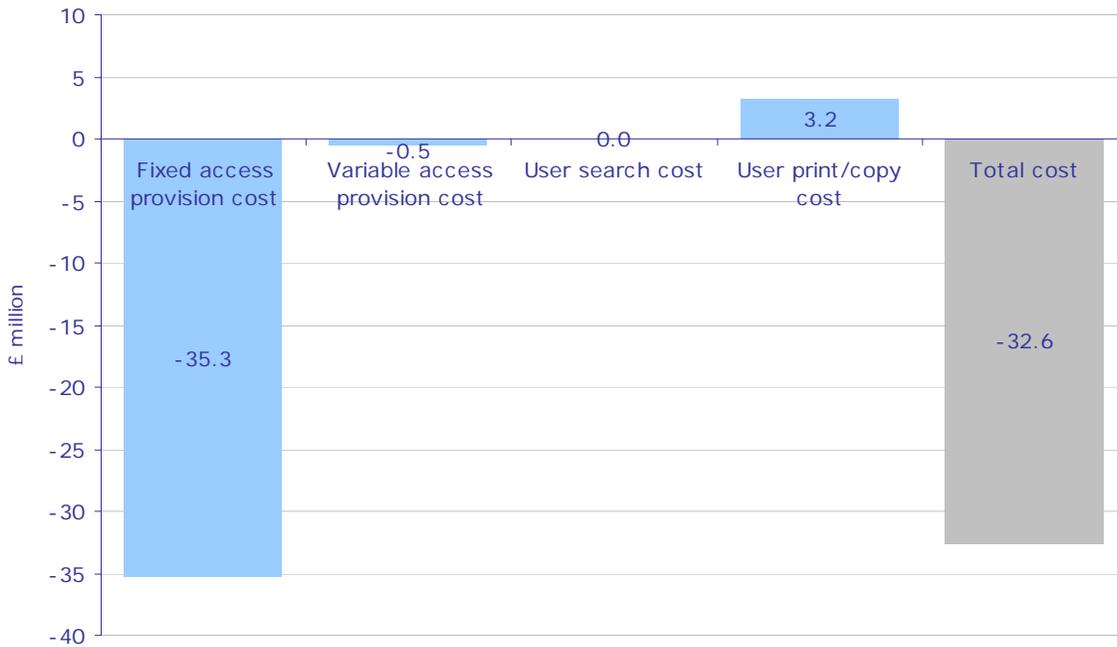


Figure D.4: Changes in UK Library budgets between the base case and Scenarios 1 and 2 (total impact)



Figure D.5: Key differences in global research system-wide incurred costs between the base case and scenario 2



* incl. cost for research and writing of article

Annex E: Cost to the UK of Scholarly communication process

This annex provides, for ease of reference the waterfall chart showing the cost to the UK for the Scholarly Communication Process in the for each of the four Scenarios – which compares with Figure 4.9 (the base case – reproduced here for ease of reference)

Figure E.1: UK funding contribution to the total cost of scholarly communication (base case – Figure 4.9)

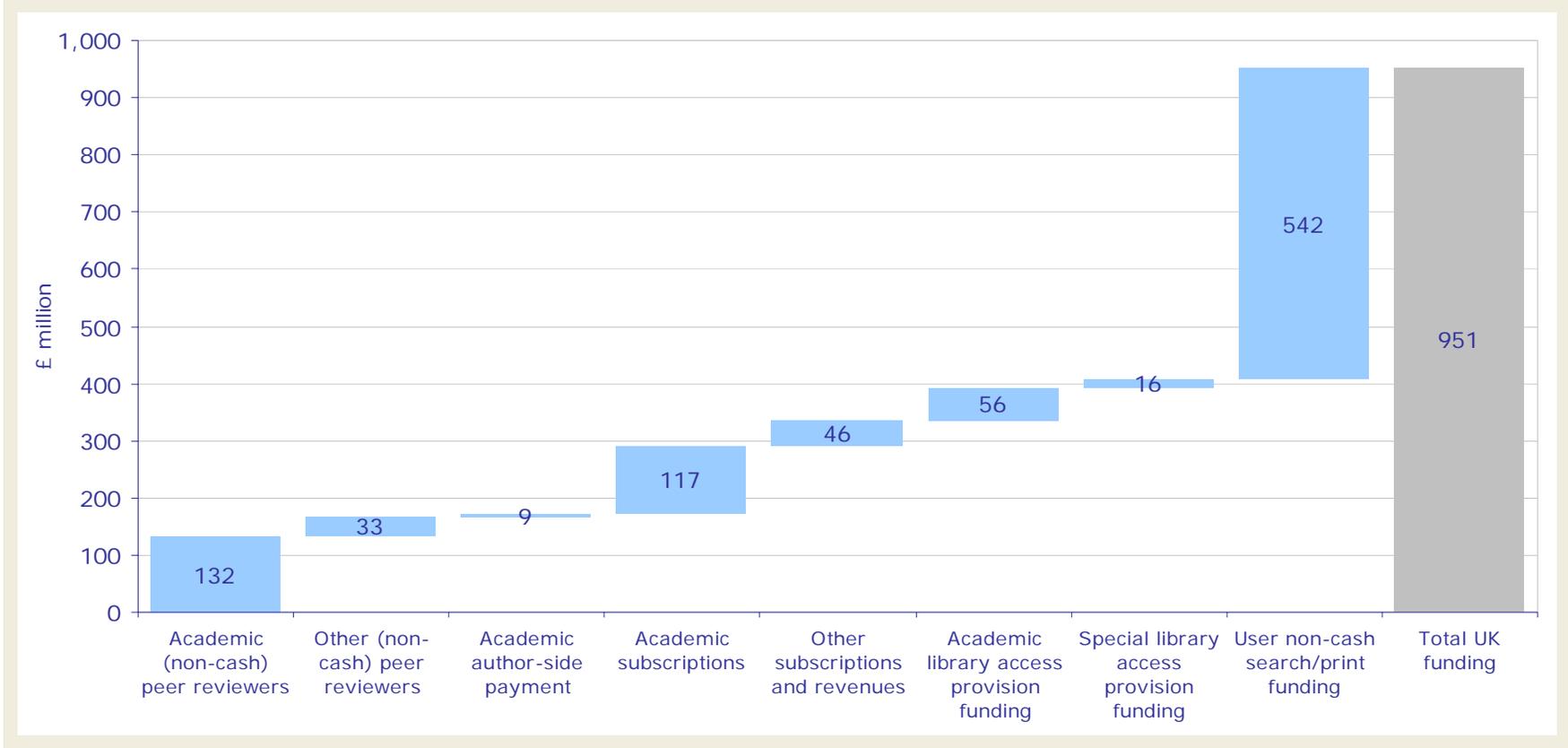


Figure E.1: UK funding contribution to the total cost of scholarly communication excl. usage cost (base case – Figure 4.10)

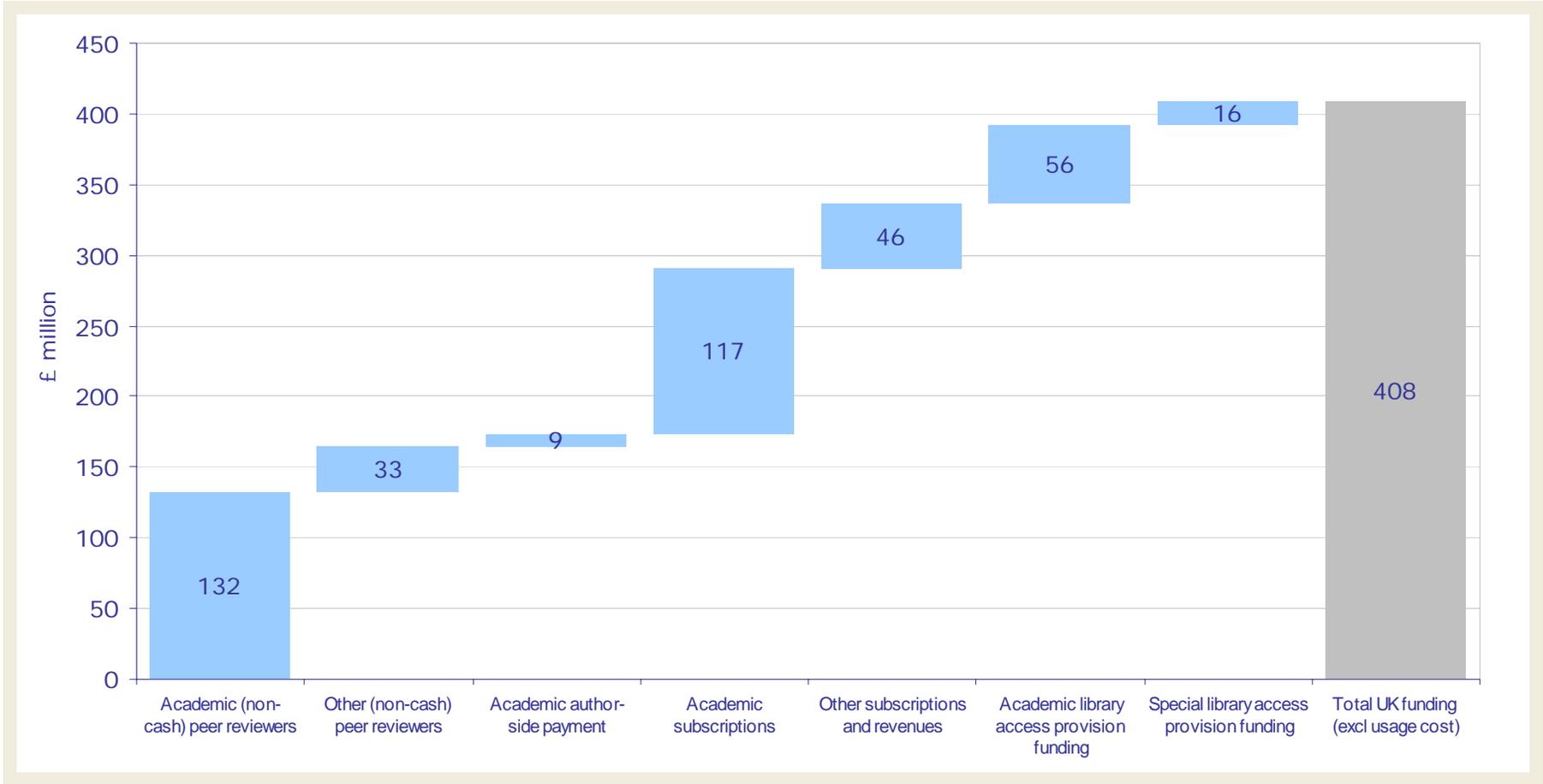


Figure E.2: UK funding contribution to the total cost of scholarly communication – Scenario 1

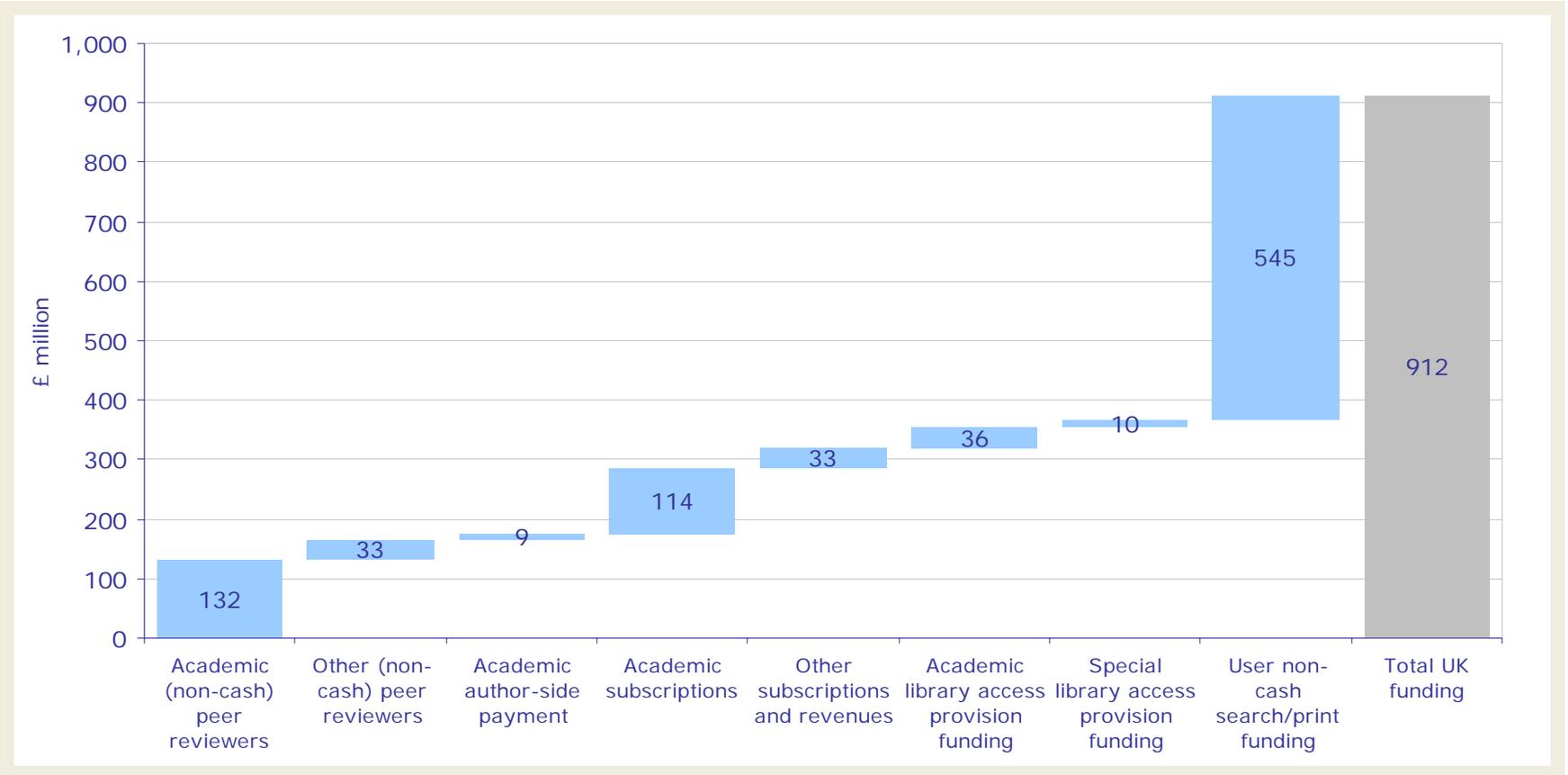


Figure E.2: UK funding contribution to the total cost of scholarly communication – Scenario 1 (excl. usage cost)

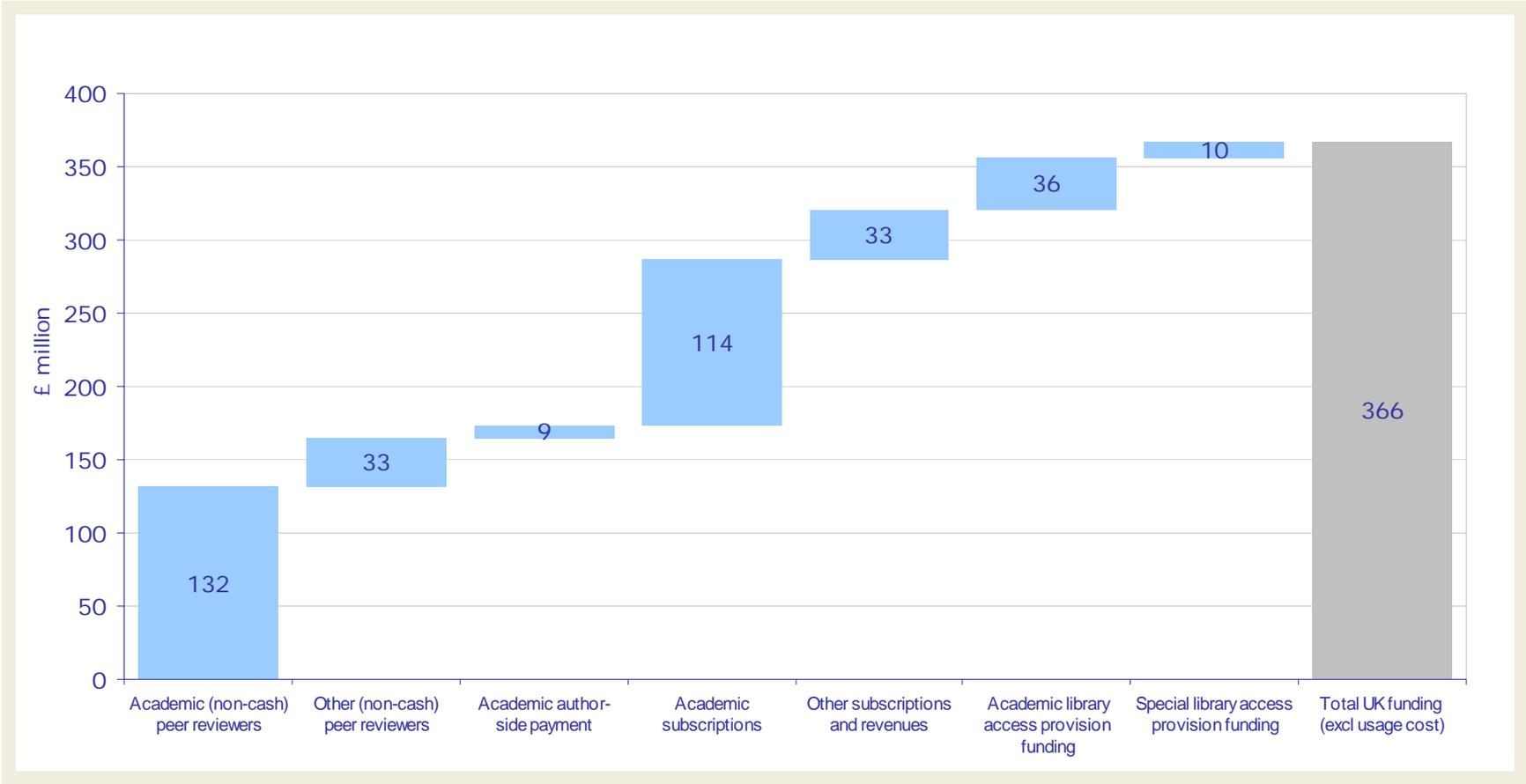


Figure E.3: UK funding contribution to the total cost of scholarly communication – Scenario 2 (including Scenario 1 changes)

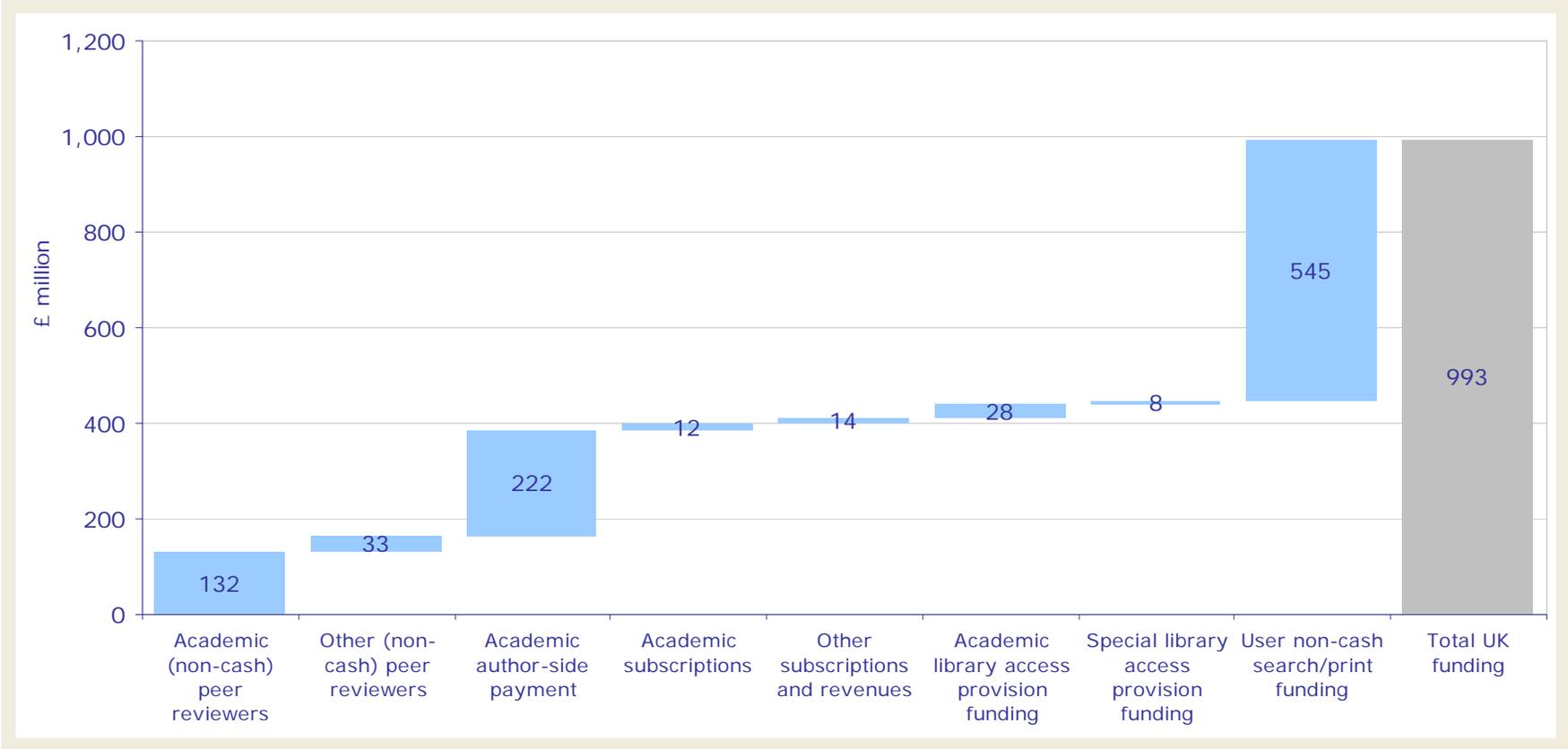


Figure E.3: UK funding contribution to the total cost of scholarly communication excl. usage cost – Scenario 2 (including Scenario 1 changes)

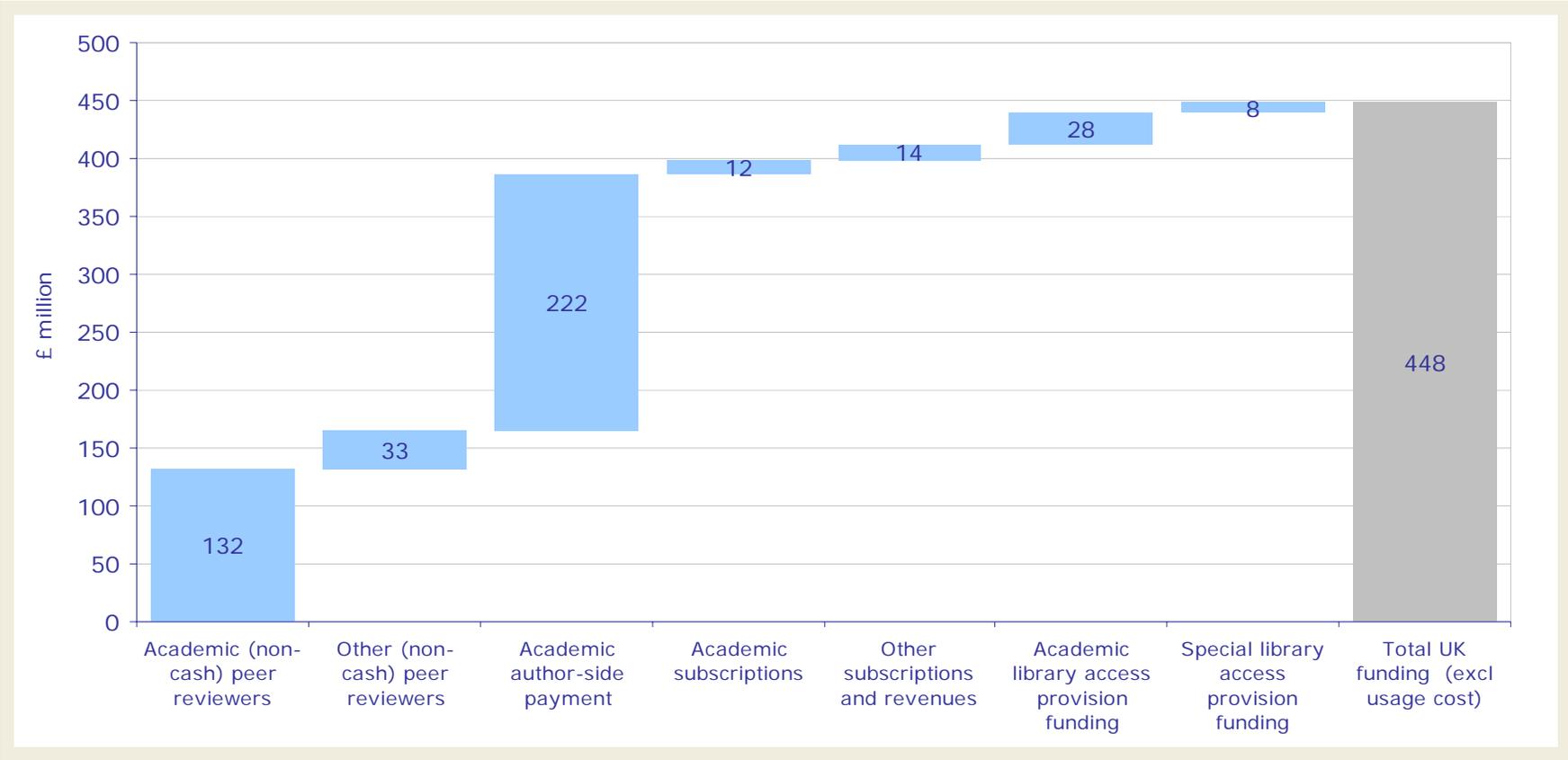


Figure E.4: UK funding contribution to the total cost of scholarly communication – Scenario 3

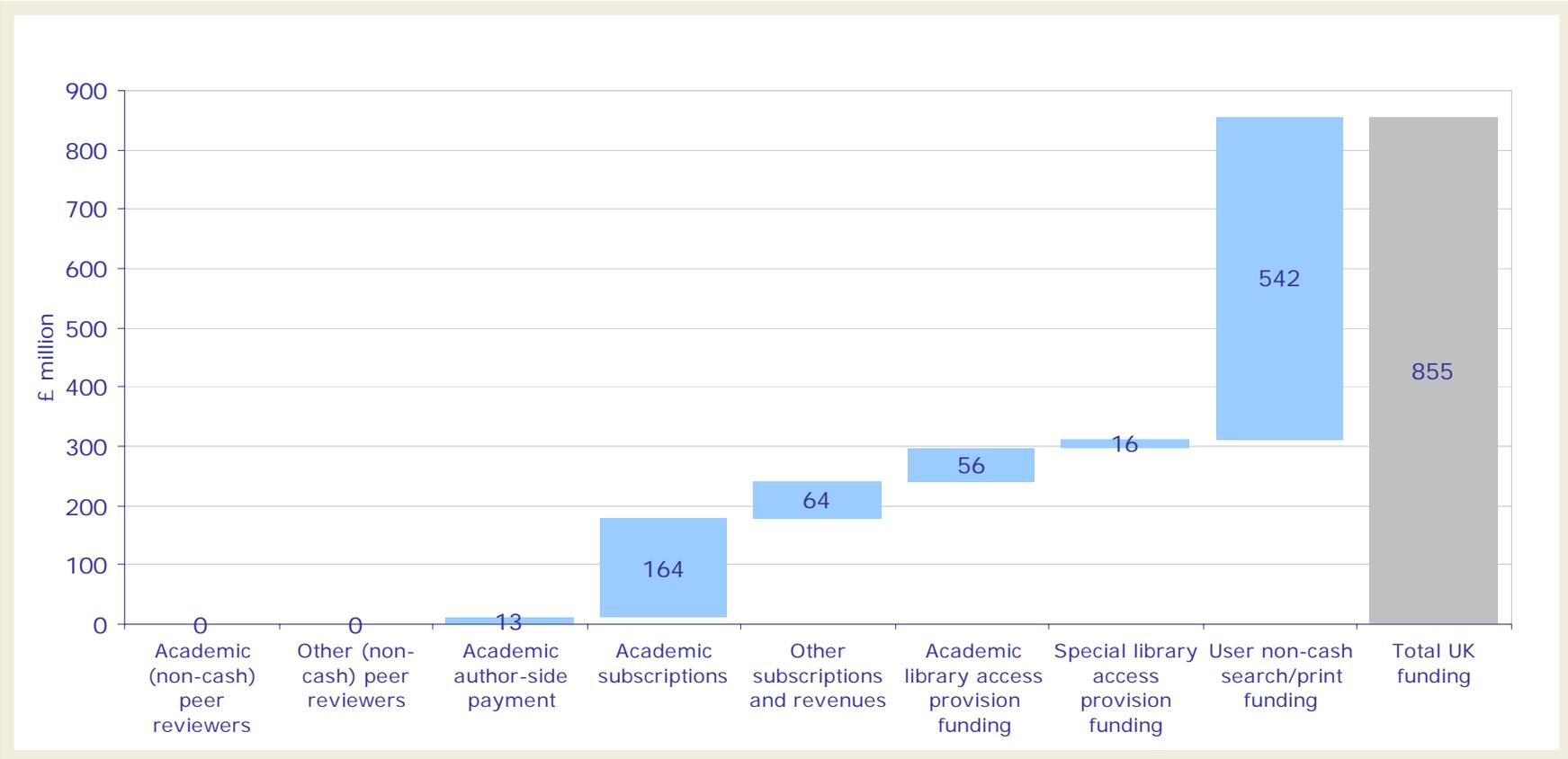


Figure E.4: UK funding contribution to the total cost of scholarly communication excl. usage cost – Scenario 3

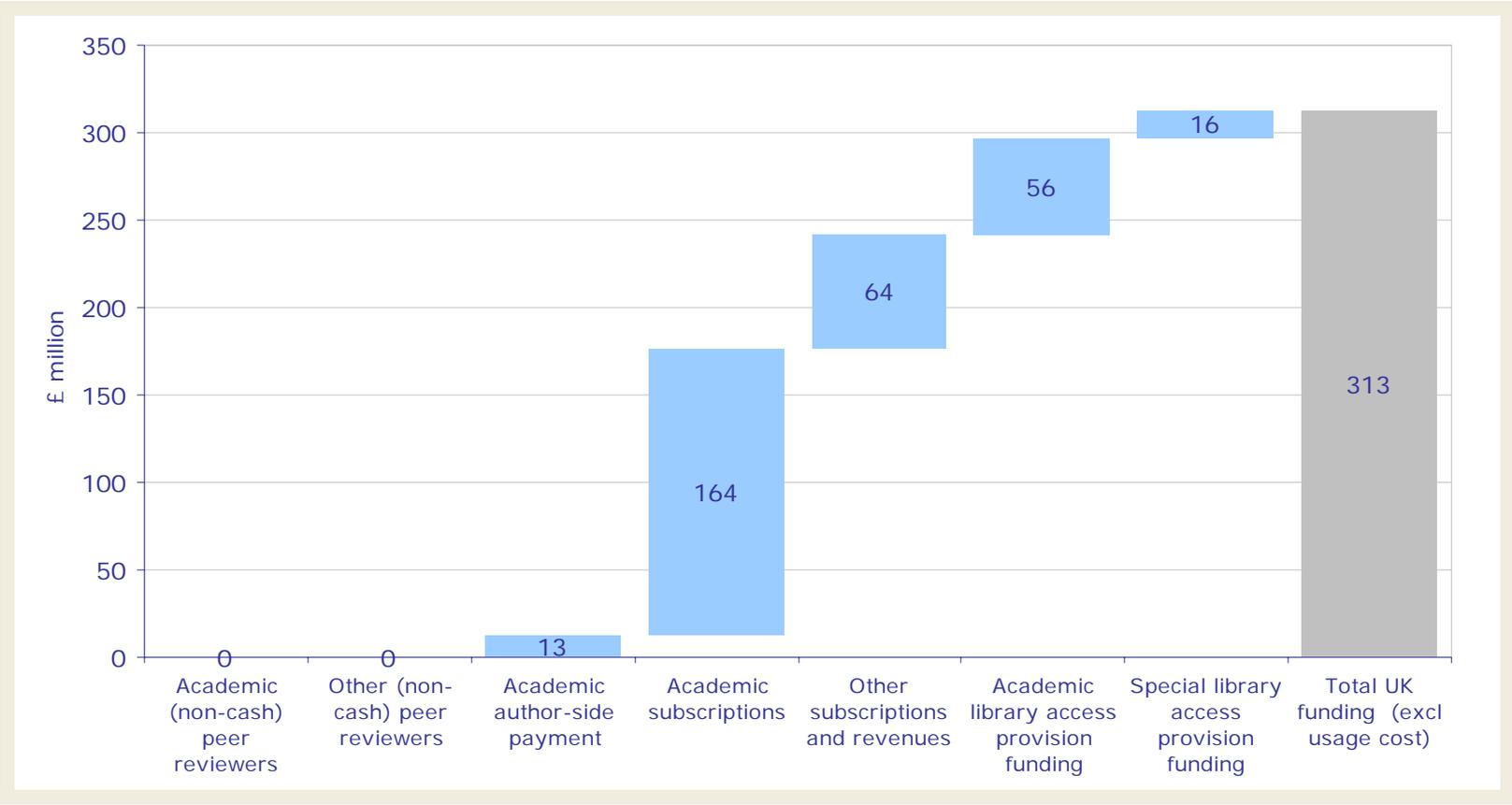


Figure E.5: UK funding contribution to the total cost of scholarly communication – Scenario 4

