

Commissioned by the

UK Open Access Implementation Group



Going for Gold?

The costs and benefits of Gold Open Access for UK research institutions: further economic modelling

Report to the UK Open Access Implementation Group

June 2012

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Contents

1. Introduction	1
1.1 The context for this work	1
1.2 The new institutional model	2
1.3 The universities modelled	3
2. The likely cost impacts of Gold Open Access on UK universities	4
2.1 The headline findings	4
2.2 The effect of different average article-processing charge levels	4
3. The likely cost impacts of unilateral Gold Open Access on UK universities	11
3.1 The headline findings	11
3.2 The effect of different average article-processing charge levels with unilateral adoption of Open Access	11
3.3 Summary of the costs and benefits to universities of Gold Open Access	16
4. The likely cost impact of Green Open Access	15
4.1 The effect of worldwide adoption of Green open Access	15
4.2 The effect of unilateral adoption of Green Open Access	15
5. Summary of costs and benefits to universities from Open Access	17
6. Summing-up	18
7. Methodology	19
References	22

Boxes and charts

Box 1: University profiles	3
Chart 1: Savings from Gold Open Access using the average APC value of USD 906 (GBP 571)	5
Chart 2: Savings from Gold Open Access using current APC prices and calculated on a basis of the disciplinary mix of articles from each university	5
Chart 3: Savings from Gold Open Access using the average APC value of GBP 1000	6
Chart 4: Savings from Gold Open Access using the average APC value of GBP 1500	7
Chart 5: Savings from Gold Open Access using the average APC value of GBP 2000	7
Chart 6: Savings from Gold Open Access using the average APC value of GBP 2500	8
Chart 7: Savings for University A from Gold Open Access using a range of average APC values	9
Chart 8: Savings for University B from Gold Open Access using a range of average APC values	9
Chart 9: Savings for University C from Gold Open Access using a range of average APC values	9
Chart 10: Savings for University D from Gold Open Access using a range of average APC values	9
Chart 11: Costs of unilateral Gold Open Access using the average APC value of USD 906 (GBP 571)	10
Chart 12: Savings from Gold Open Access using current APC prices and calculated on a basis of the disciplinary mix of articles from each university	11
Chart 13: Savings from unilateral Gold Open Access using the average APC value of GBP 1000	11
Chart 14: Savings from unilateral Gold Open Access using the average APC value of GBP 1500	12
Chart 15: Savings from unilateral Gold Open Access using the average APC value of GBP 2000	12
Chart 16: Savings from unilateral Gold Open Access using the average APC value of GBP 2500	13
Chart 17: Savings for University A from unilateral Gold Open Access using a range of average APC values	14
Chart 18: Savings for University A from unilateral Gold Open Access using a range of average APC values	14
Chart 19: Savings for University A from unilateral Gold Open Access using a range of average APC values	14
Chart 20: Savings for University A from unilateral Gold Open Access using a range of average APC values	14
Chart 21: Savings from Green Open Access	15
Chart 22: Costs of unilateral Green Open Access	16
Chart 23: Cost savings to universities of Open Access alternatives with worldwide and unilateral adoption (calculated using an average of the sample of the four UK universities in this study)	17

Executive summary

The purpose of this work is to provide information to UK universities and policy makers on the likely cost impacts of Gold OA, where the costs of peer review, editorial work and other publishing services are covered by fees paid per article.

Previous economic modelling work on the costs and benefits to the UK of Open Access (OA) identified the costs and benefits that accrue to UK research institutions and showed that OA via any of three scenarios explored would be a more cost-effective scholarly communication system for the nation (Houghton *et al*, 2009). Subsequent work confirmed this finding for the Gold OA scenario providing article-processing charges (publication fees) are of a sufficiently low level (CEPA, 2011).

Further work, modelling the costs and benefits *for individual universities* showed similar benefits in most cases (Swan, 2010). The exception was for the largest research-intensive universities where the 'Gold' scenario modelled would cost more than present subscriptions. This 'Gold' scenario was, however, based on the assumption that any one university modelled would incur the costs of Gold OA for *all* articles published from that institution.

However, that is an unlikely scenario since some of these publication charges would be borne by others outside that institution. For example, research funders may permit grant money to be used for publishing costs or co-authors in other universities may pay the publishing charges. We have, therefore, further developed the economic model to take account of these possibilities.

The model explores the various scenarios under the assumption of: (i) worldwide Open Access (i.e. where the alternative model explored is assumed to be universally in place), and (ii) unilateral Open Access (i.e. where the alternative model is adopted by the institution alone, all else remaining the same). The latter is intended to shed light on the issue of transitioning to Open Access.

We have run the new model using both the current average APC (GBP 571) and the average APCs for different disciplines according to the disciplinary mix of articles published from each university (see Methodology section). We have also explored a range of article charges up to GBP 2500.

Based on this analysis, the main findings are:

- so long as research funders commit to paying publication costs for the research they fund, and
- publication charges fall to the reprint author's home institution,
- all universities would see savings from (worldwide) Gold OA when article-processing charges are at the current averages,
- research-intensive universities would see the greatest savings, and
- in a transition period, providing Open Access through the Green route offers the greatest economic benefits to individual universities, unless additional funds are made available to cover Gold OA costs

Only when the average level of APC rises above GBP 2000 per article would any university face increased costs, and then only the few most research-intensive institutions.

Addressing the issue of transitioning to Open Access, we have also modelled the cost impacts of an institution unilaterally adopting OA publishing for its article output, while remaining a part of the current scholarly publishing system (i.e. maintaining subscriptions).

Under these conditions, we find that all universities would face additional costs for Gold OA publishing charges, and the more research-intensive universities would face higher costs. As publication charges rise, these costs become substantial, and may in some case exceed current subscription costs.

We have also calculated the costs and savings that would accrue from the various 'Green' OA scenarios (i.e. Open Access provided by authors self-archiving their articles in repositories while journals remain subscription-based). We find that all universities would face additional repository-related costs if they were to unilaterally adopt Green OA.

However, for all the sample universities during a transition period when subscriptions are maintained, the cost of adopting Green OA is much lower than the cost of Gold OA - with Green OA self-archiving costing institutions around one-fifth the amount that Gold OA might cost, and as little as one-tenth as much for the most research intensive university sampled. In a transition period, providing OA through the Green route would have substantial economic benefits for universities, unless additional funds were released for Gold OA, beyond those already available through the Research Councils and the Wellcome Trust.

1. Introduction

1.1 The context for this work

The purpose of this work is to provide information to UK universities and policy makers on the likely cost impacts of Gold Open Access, where the costs of peer review, editorial work and other publishing services are covered by fees paid per article (referred to from here on as article processing charges or APCs).

Previous economic modelling work on the costs and benefits to the UK of Open Access (OA) identified the costs and benefits that accrue to UK research institutions and showed that OA via any of three scenarios would be a more cost-effective scholarly communication system for the nation (Houghton *et al*, 2009). The scenarios modelled were:

- Gold Open Access, where research is published in openly accessible journals that cover their costs by charging a fee for publication;
- Green Open Access, where articles are published in subscription journals and copies placed in Open Access repositories to provide open accessibility; and
- Green Open Access (overlay model), where articles are placed in repositories and, after peer review and editorial services are carried out, are opened up ('published') as part of the peer reviewed literature.

Subsequent work confirmed this finding for the Gold OA scenario providing article-processing charges (publication fees) are of a sufficiently low level (CEPA, 2011).

Further work, modelling the costs and benefits *for individual universities* showed similar benefits in most cases (Swan, 2010). The exception was for the largest research-intensive universities where the 'Gold' scenario modelled would cost more than present subscriptions: in these cases the cost of paying article-processing charges (APCs) far outweighs existing costs to those universities of the subscription-based system due to the number of publications emanating from these institutions each year.

This Gold scenario was, however, based on an assumption that any one university modelled would incur the costs of Gold OA for *all* articles published from that institution. This, however, is an unlikely scenario since some of these publication charges would be borne by others outside that institution. For example, research funders may permit grant money to be used for publishing costs or co-authors in other universities may pay the publishing charges. In addition, many OA journals do not charge publication fees at all (Solomon & Björk, 2012), and we wished to factor this into the calculations.

We have therefore further developed the economic model to take account of these possibilities.

1.2 The new institutional model

As part of the previous work, an economic model was developed and made available for all to use, so that individual institutions could enter their own data to discover how Open Access would work out for that particular institution.

In this study, we have produced a new version of that model¹. The model is a further development of the institutional models for the UK and US and indicates the likely cost to UK universities of Gold OA, taking account of:

1. Multiple authorship of articles within and across institutions, on the assumption that the corresponding author represents the paying institution.
2. Articles for which there is a funder with a policy to support Gold OA article-processing charges.
3. The actual APC fees charged by journals in various disciplinary fields – as well as the estimated average per article cost of Gold OA articles – based on Solomon and Björk (2012). Details of the variation in APCs by discipline are given in the Methodology section.
4. We also explore a range of possible APCs, up to GBP 2500 per article, in order to obtain the broadest possible picture of the economic implications to universities of Gold OA.

The model also includes Green OA (repository-based) alternatives. These are:

- Where authors self-archive their articles in repositories in parallel with subscription publishing (the current state of affairs as repositories and their contents grow while libraries continue to subscribe to journals), and
- The more speculative scenario where authors place their articles in repositories and peer review, editorial and production services (publishing services) are overlaid upon these repositories. There are a few examples of journals produced in this manner but they are not numerous. The 'author fees' for this model are estimated at 75% of the Gold OA article-processing charges, as that was the ratio of the per-article costs in Houghton et al. (2009).

We have run the model using both the current average APC (USD 906, GBP 571) and the average APCs for different disciplines according to the disciplinary mix of articles published from each university (see Methodology section), as well as a range of APCs up to GBP 2500.

A further development of the model is to explore the various scenarios under the assumption of worldwide Open Access (i.e. where the alternative model explored is assumed to be universally in place), and unilateral Open Access (i.e. where the alternative model is adopted by the institution alone, all else remaining the same). The latter is intended to shed light on the issue of transitioning to Open Access.

¹ [http://www.cfses.com/Gold_OA_Cost_Model_\(UK_HEIs\).exe](http://www.cfses.com/Gold_OA_Cost_Model_(UK_HEIs).exe)

1.3 The universities modelled

The same institutions have been used for the modeling as before (Swan, 2010: see Box 1 below).

University A: a relatively small, post-1992 institution with a strong vocational/professional focus and with a growing, good-quality research base. It provides a counterweight to the research-primacy of some of the other case studies. Research income: circa 2 million GBP *per annum*.

University B: a pre-1992 university with a tradition of strength in applied research and with a strong enterprise and innovation focus. Research income: circa 10 million GBP *per annum*.

University C: a large, research-intensive Russell Group University. Research income: circa 75 million GBP *per annum*.

University D: a large, very research-intensive, high-performing university. Research income: circa 200 million GBP *per annum*

Box 1: University profiles

2. The likely cost impacts of Gold Open Access on UK universities

The vertical-axis in all charts shows net savings in GBP *per annum* arising from the *worldwide* adoption of Gold OA.

2.1 The headline findings

The main findings are as follows:

- so long as research funders commit to paying publication costs for the research they fund, and
- publication charges fall to the reprint author's home institution,
- all universities would see savings from (worldwide) Gold OA when article-processing charges are at the current averages, and
- research-intensive universities would see the greatest savings.

Only when the average level of APC rises above GBP 2000 per article would any university face increased costs, and then only the few most research-intensive institutions.

The detailed results are shown graphically on the following pages. We present them in various ways:

- (i) Using the current overall average APC (GBP 571);
- (ii) Using current average APCs for each discipline, modelling the disciplinary mix for the outputs of each university;
- (iii) Using a range of APCs up to GBP 2500; and
- (iv) By university, showing the effect of a range of APCs for each institution.

2.2 The effect of different average APC levels

The graphs following here show the modelled savings for the sample universities for a range of average APC levels, assuming *worldwide* adoption of Gold OA.

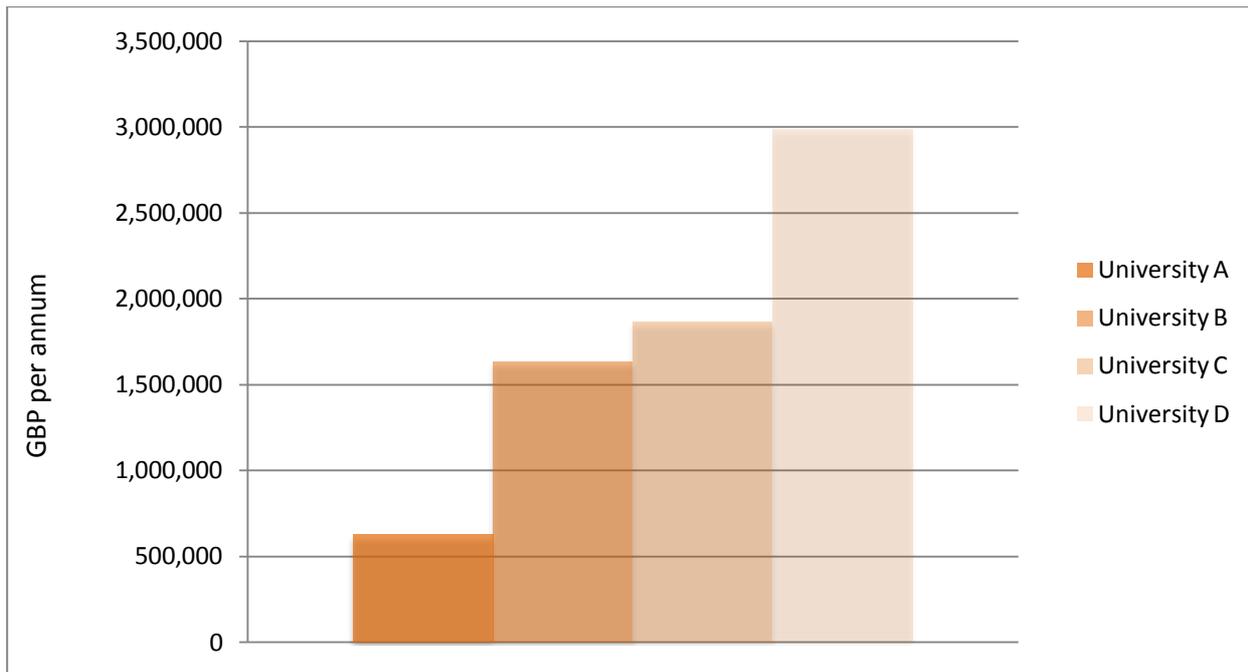


Chart 1: Savings from Gold OA using the average APC value of USD 906 (GBP 571)

All universities would make a saving from Gold OA in an Open Access world if the average APC were around 570 GBP.

Modelling the current, real-life situation, where we have taken into account the disciplinary mix of outputs from each university and the APCs that would be incurred accordingly, produces the result shown in Chart 2 below.

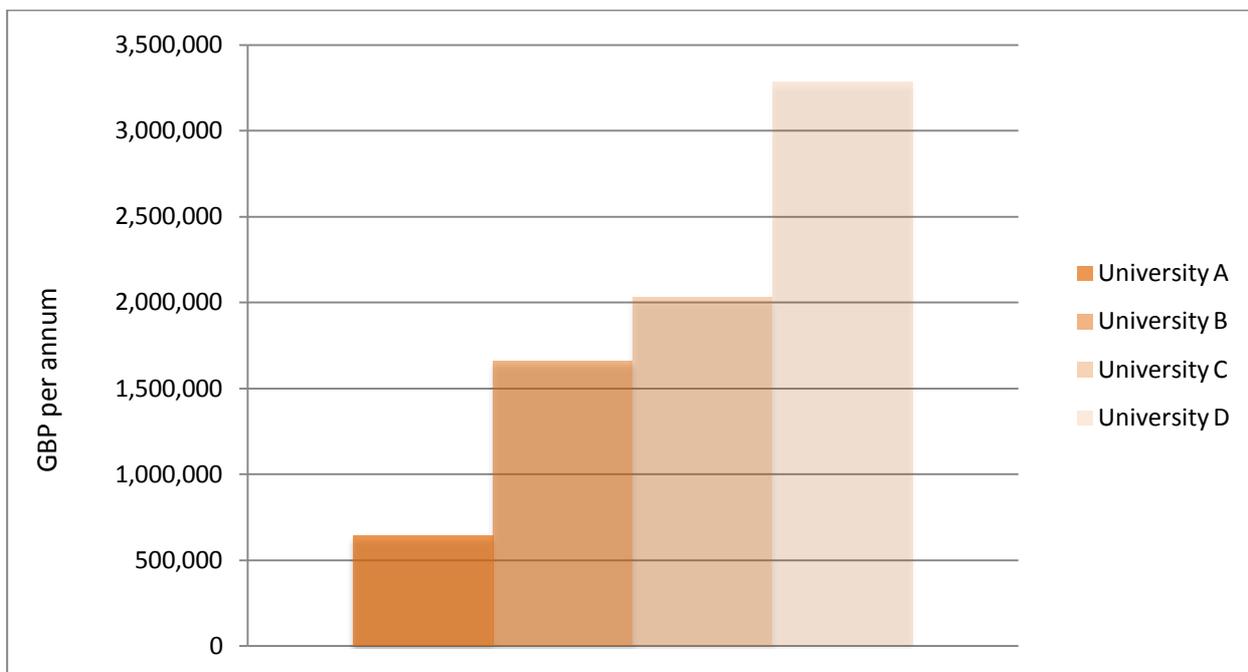


Chart 2: Savings from Gold OA using current APC prices and calculating on a basis of the disciplinary mix of articles from each university

All universities would make savings from Gold OA in an Open Access world calculated in this way.

So far, we have used the values for article-processing (publishing) charges calculated by Solomon & Björk (2012) who used data from the Directory of Open Access Journals for their analysis. Around two-thirds of journals listed by this Directory do not report charging an article-processing fee: while this may include some degree of under-reporting, it is clear that the ‘pay to publish’ model is by no means ubiquitous in Open Access publishing.

At the other end of the scale, however, the large commercial publishers’ charges are relatively high – in the order of USD 1000-3000². As these larger publishers shift their business model to Gold OA, a higher average APC is likely, so we have modelled scenarios where the average APC is GBP 1000, 1500, 2000 and 2500.

The results for average APC of GBP 1000 are shown in Chart 3, and for an average APC of GBP 1500 in Chart 4.

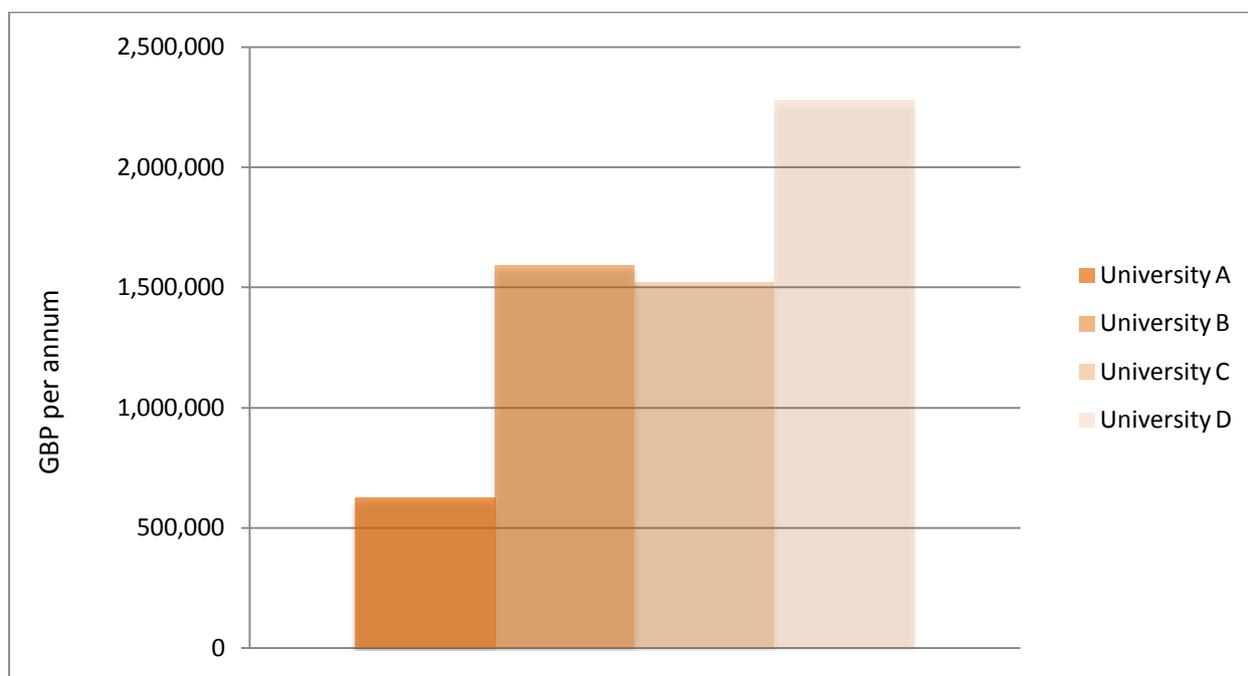


Chart 3: Savings from Gold OA using the average APC value of GBP 1000

² Ware, M and Mabe, M (2009) The STM report: An overview of scientific and scholarly journal publishing. International Association of Scientific, Technical and Medical Publishers. [http://www.stm-
assoc.org/2009_10_13_MWC_STM_Report.pdf](http://www.stm-
assoc.org/2009_10_13_MWC_STM_Report.pdf) and Bird, C (2009) Continued adventures in Open Access: 2009 perspective. *Learned publishing* **23(2)**, 107-116 doi:10.1087/20100205

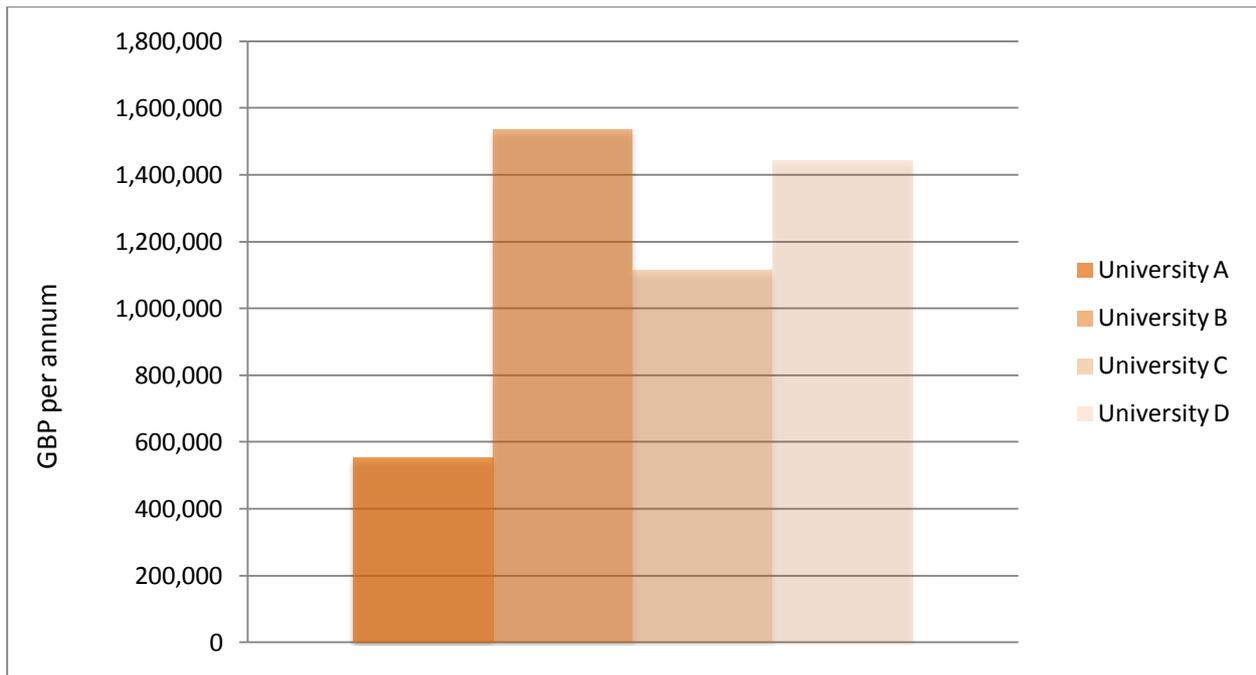


Chart 4: Savings from Gold OA using the average APC value of GBP 1500

The savings in the case where the average APC is GBP 1500 begin to decline for the more research-intensive universities because of the volume of publications they produce. The costs of paying higher APCs begins to outweigh the economic benefits of the efficiency savings from Open Access within the institution.

Charts 5 and 6 below show savings for increasing average APC levels.

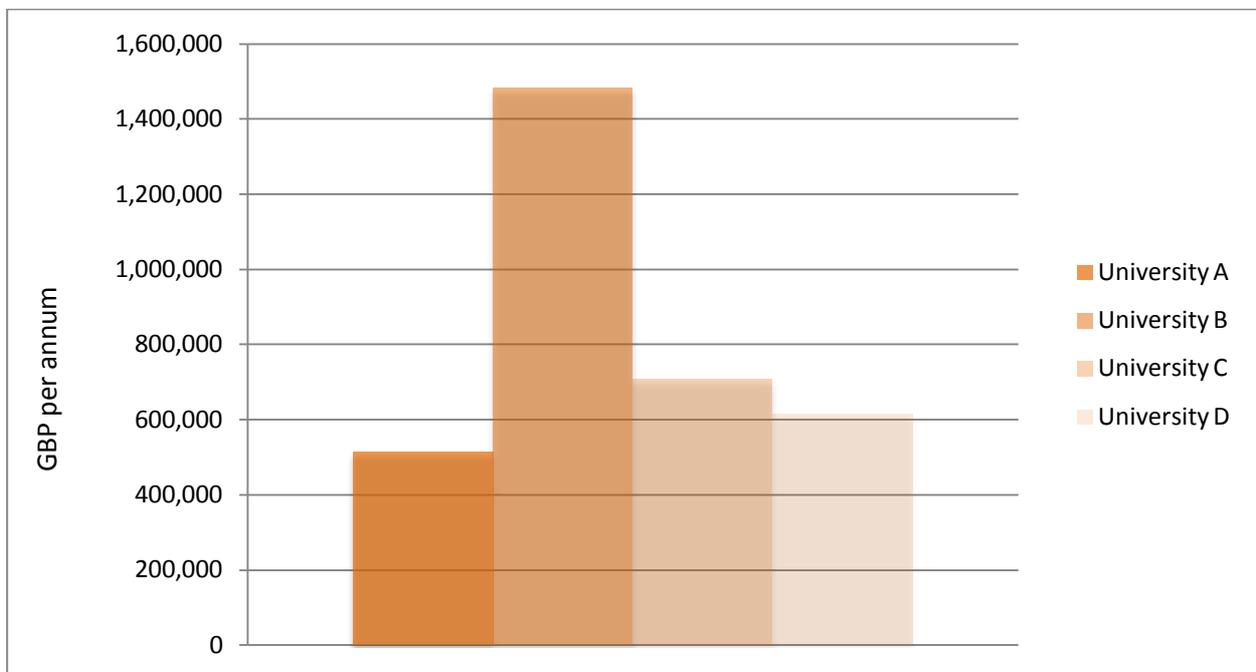


Chart 5: Savings from Gold OA using the average APC value of GBP 2000

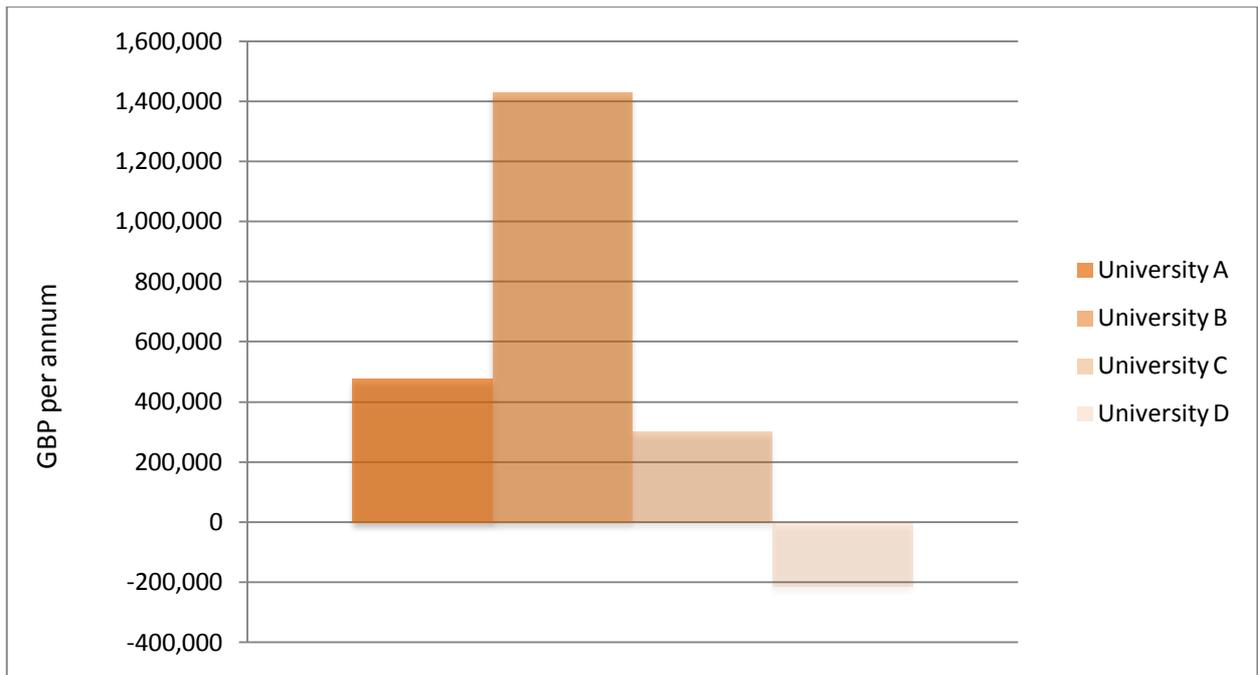


Chart 6: Savings from Gold OA using the average APC value of GBP 2500

When the average APC rises above GBP 2000 the most research intensive university finds costs outweigh savings.

In the series of charts below, we show the savings for each university from Gold OA with different average APC values.

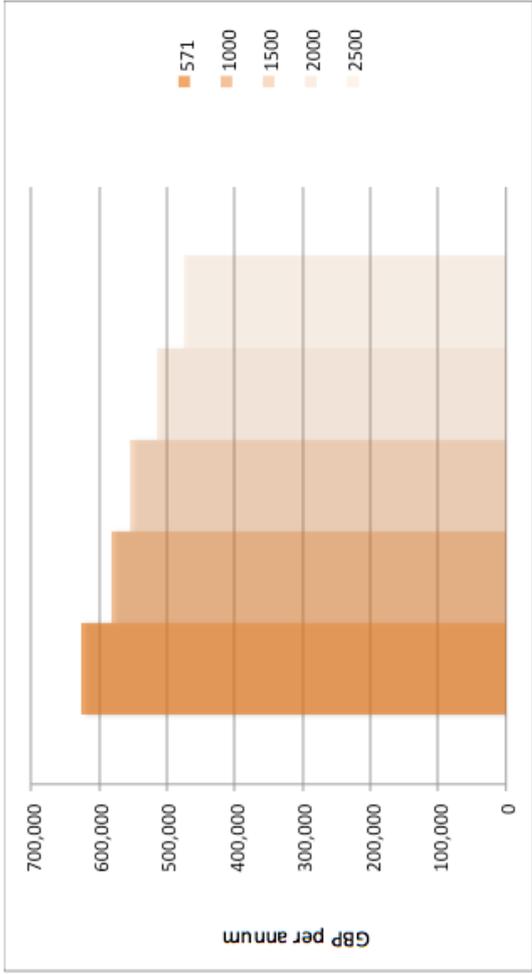


Chart 7: Savings for University A from Gold OA using a range of average APC values

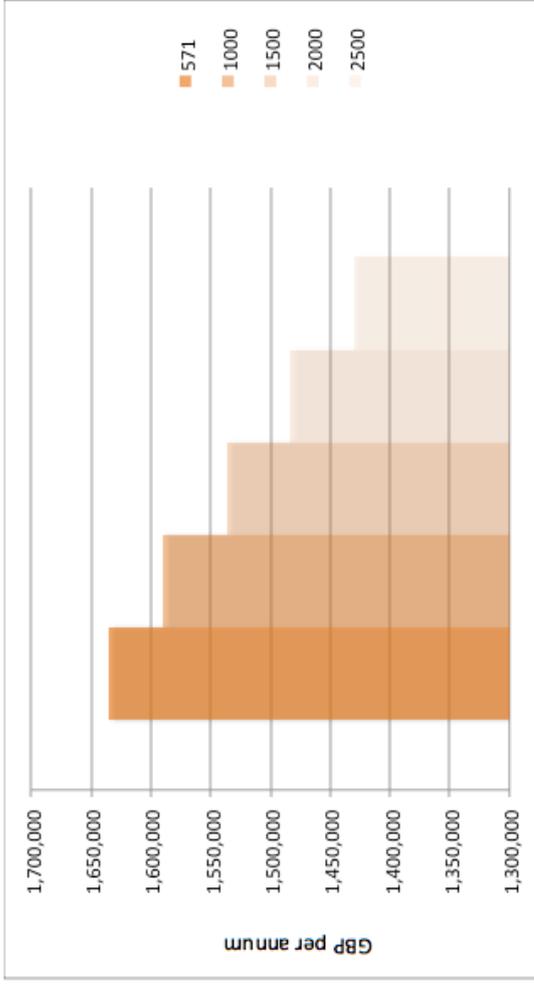


Chart 8: Savings for University B from Gold OA using a range of average APC values

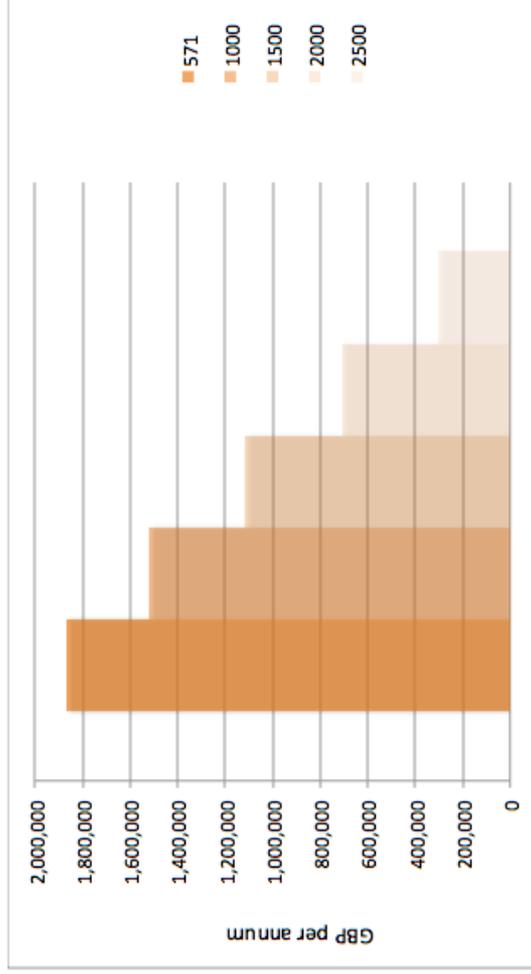


Chart 9: Savings for University C from Gold OA using a range of average APC values

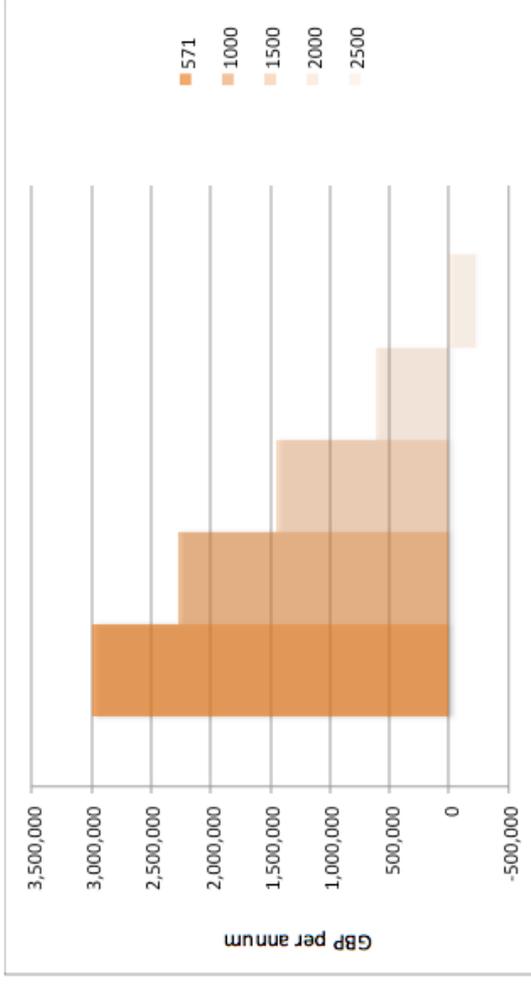


Chart 10: Savings for University D from Gold OA using a range of average APC values

3. The likely cost impacts of unilateral Gold OA on UK universities

Addressing the issue of transitioning to Open Access, we have also modelled the cost impacts of an institution *unilaterally* adopting OA publishing for its article output, while remaining a part of the current scholarly publishing system (i.e. a system that maintains subscriptions).

3.1 The headline findings

The main findings are that all universities would face additional costs for Gold OA publishing charges, and the more research-intensive universities would face higher costs. As APCs rise, these costs become substantial. The detailed results are shown graphically on the following pages. We present them in various ways:

- (i) Using the current overall average APC (GBP 571);
- (ii) Using current average APCs for each discipline, modelling the disciplinary mix for the outputs of each university;
- (iii) Using a range of APCs up to GBP 2500; and
- (iv) By university, showing the effect of a range of APCs for each institution.

3.2 The effect of different average APC levels with unilateral adoption of Gold OA

The charts following show the modelled savings (costs) for the sample universities for a range of average APC levels, assuming *unilateral* adoption of Gold OA at the institutional level.

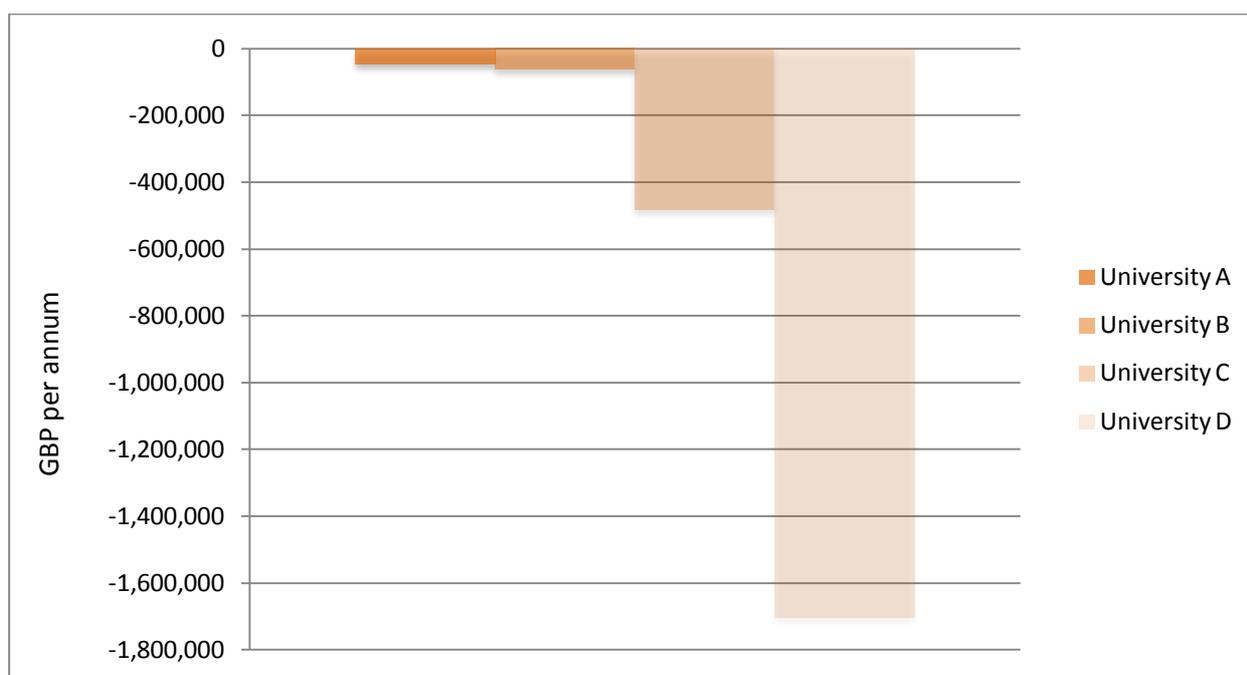


Chart 11: Costs of unilateral Gold OA using the average APC value of USD 906 (GBP 571)

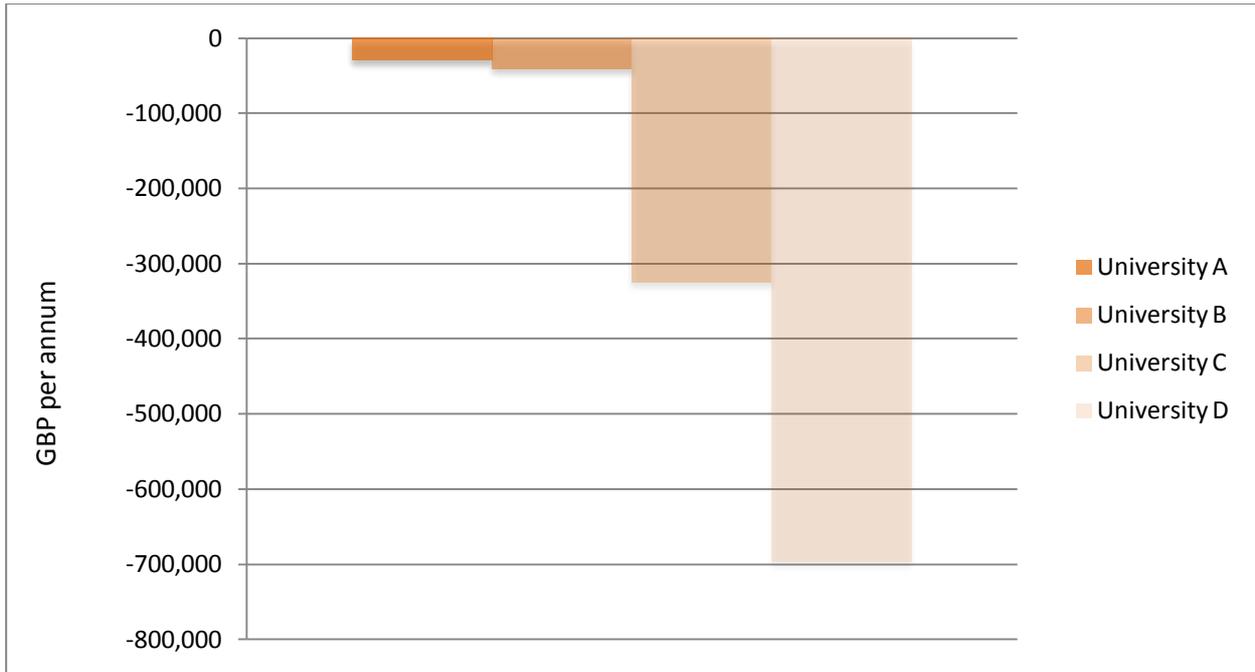


Chart 12: Costs of unilateral Gold OA using current APC prices and calculating on a basis of the disciplinary mix of articles from each university

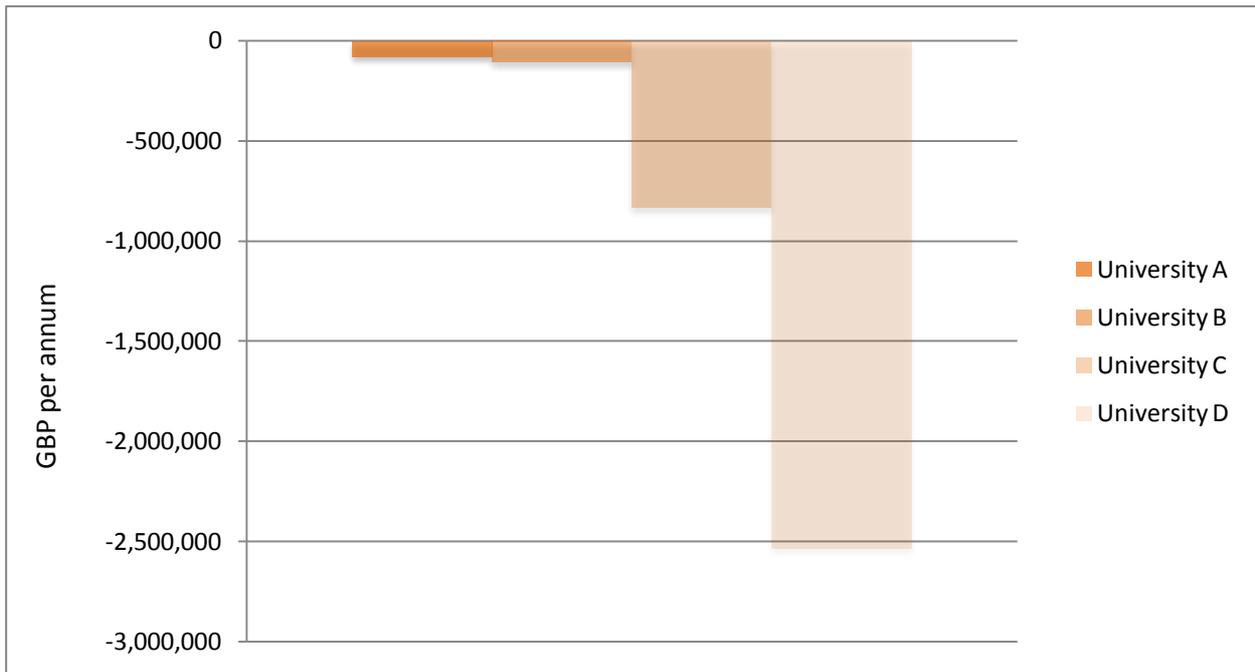


Chart 13: Costs of unilateral Gold OA using the average APC value of 1000 GBP

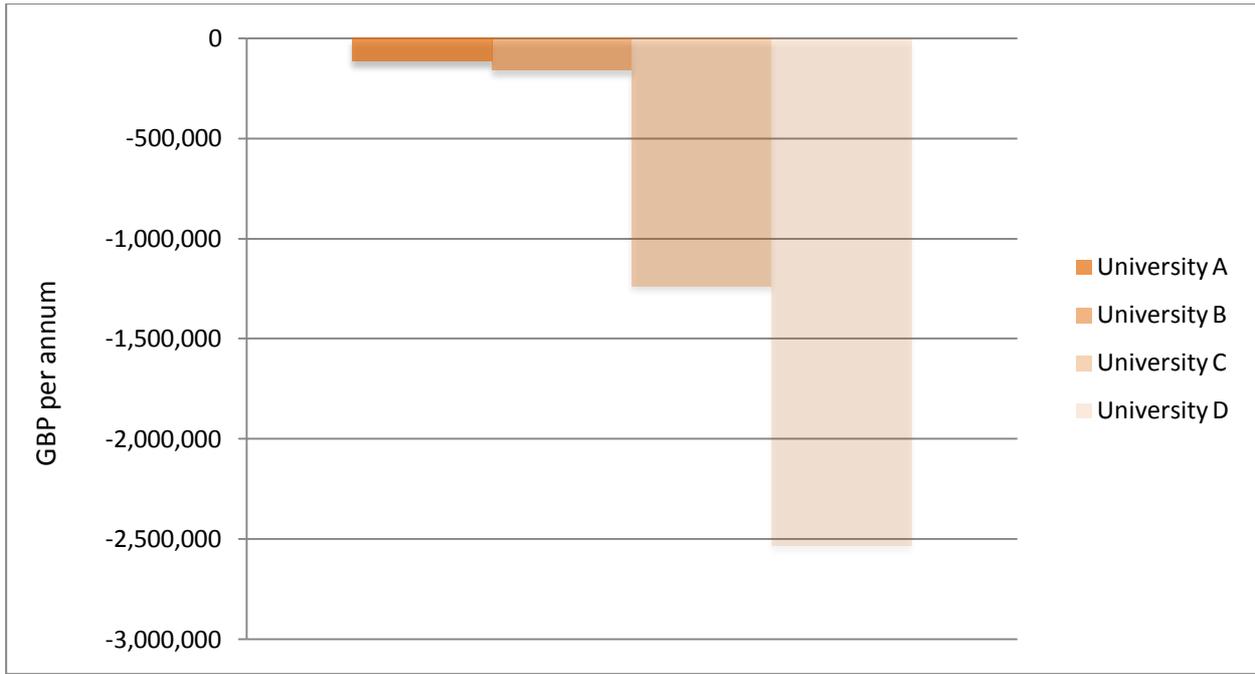


Chart 14: Costs of unilateral Gold OA using the average APC value of GBP 1500

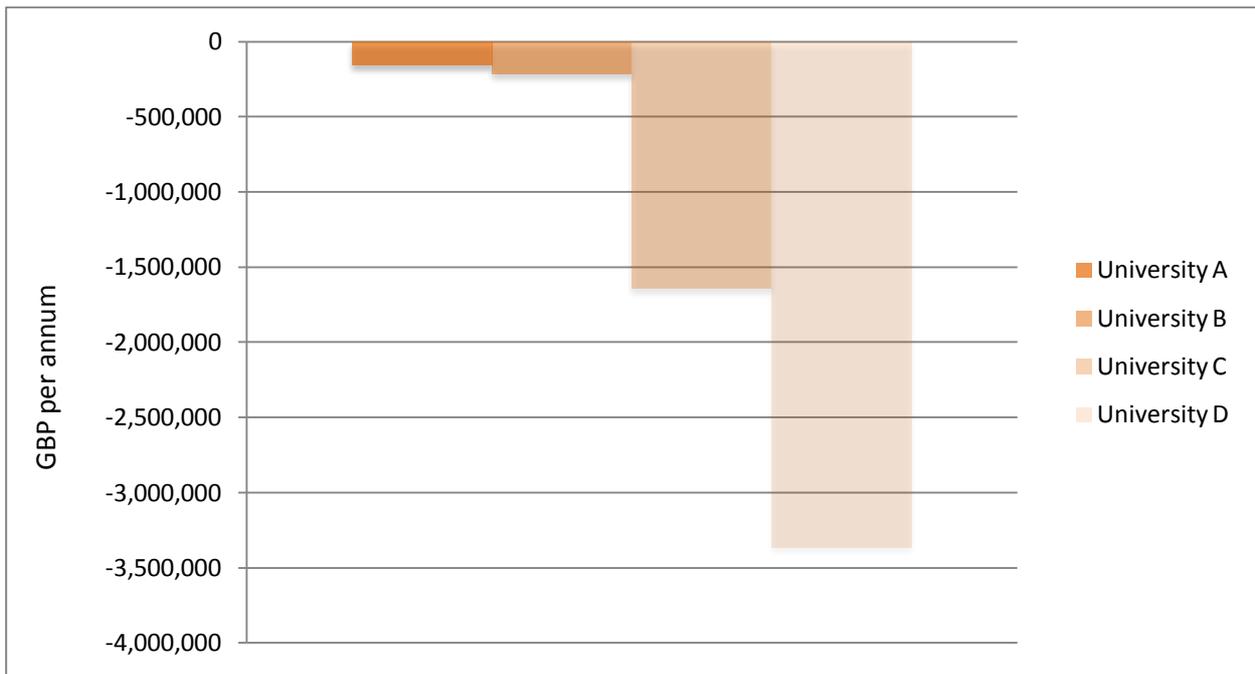


Chart 15: Costs of unilateral Gold OA using the average APC value of GBP 2000

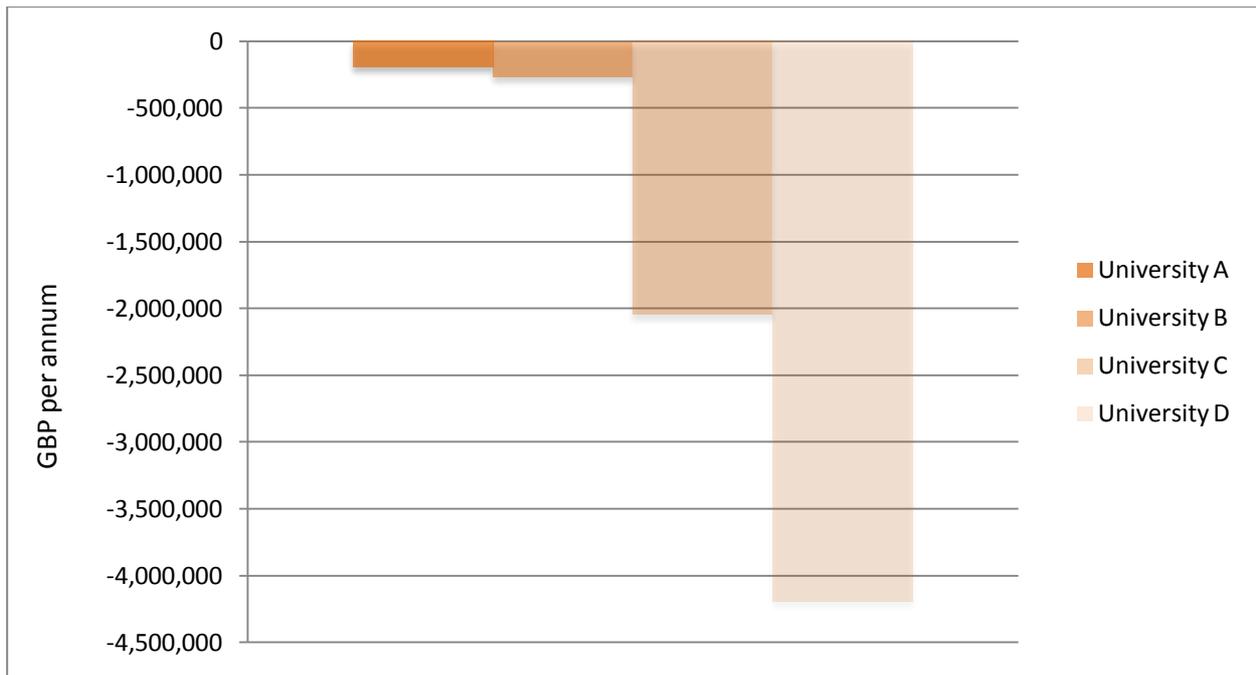


Chart 16: Costs of unilateral Gold OA using the average APC value of GBP 2500

Universities adopting an all-‘Gold’ mode of publishing their research results when the rest of the research community retain the current model (a mix of Open Access and subscription publishing) would find costs outweighing benefits in all cases.

The following charts show the effects of different levels of APC on *unilateral* Gold OA for each university.

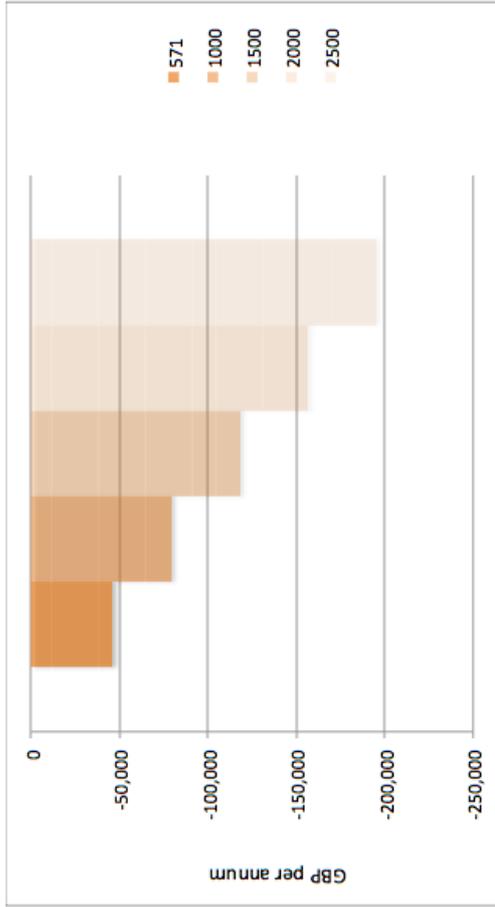


Chart 17: Savings for University A from unilateral Gold OA using a range of average APC values

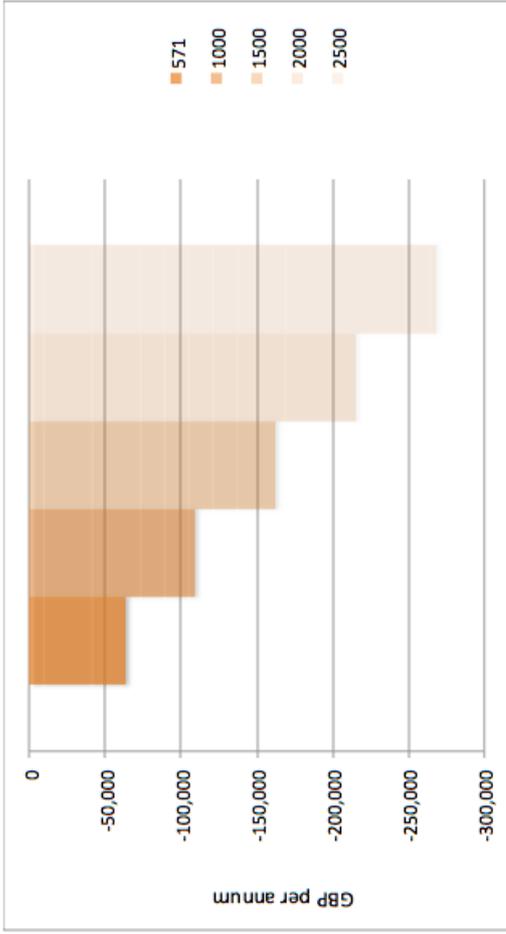


Chart 18: Savings for University B from unilateral Gold OA using a range of average APC values

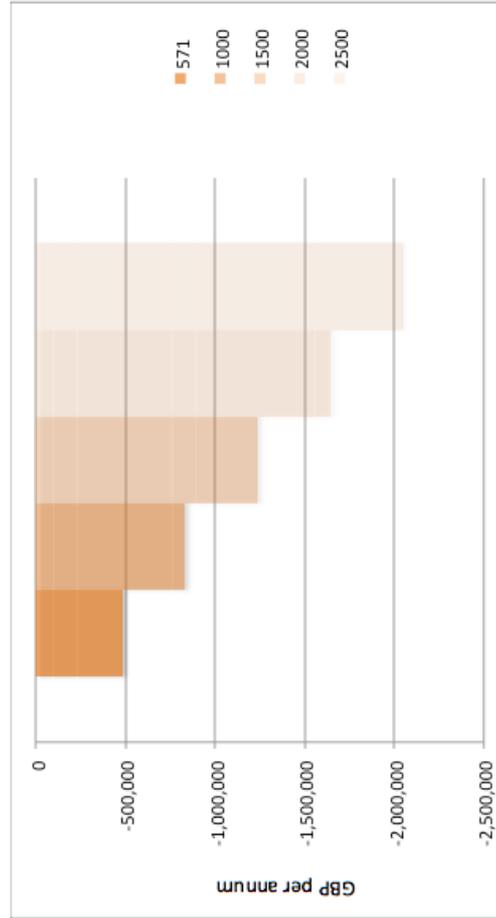


Chart 19: Savings for University C from unilateral Gold OA using a range of average APC values

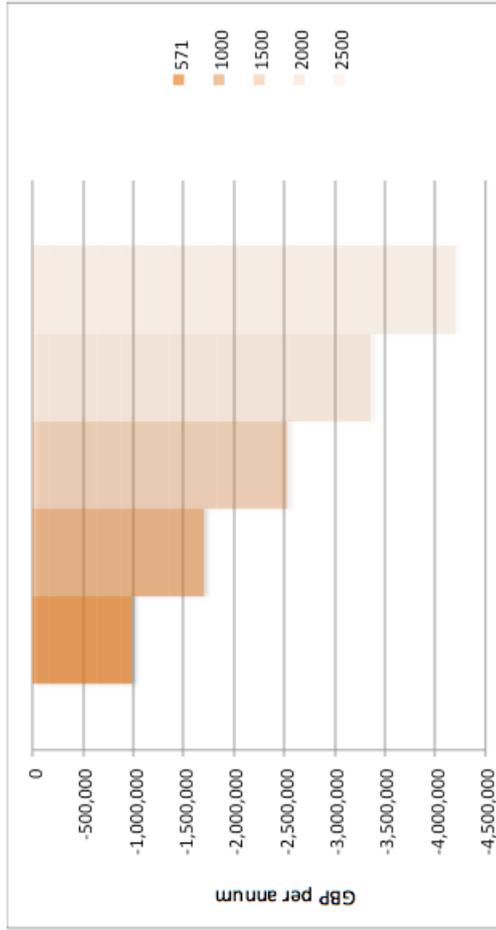


Chart 20: Savings for University D from unilateral Gold OA using a range of average APC values

4. The likely impact of Green Open Access

4.1 The effect of worldwide adoption of Green Open Access

We have also calculated the savings that would accrue from the various Green OA scenarios. These are:

- (i) Open Access provided by authors self-archiving their articles in repositories while journals remain subscription-based (i.e. the current developing scenario); and
- (ii) Open Access provided by authors self-archiving their articles in repositories and peer-review and editorial/production services overlaid upon those repositories. We have modelled this variant using:
 - 75% of the current average APC for 'Gold' OA (USD 680, GBP 428)
 - 75% of the current average APCs for the disciplinary mix of outputs from each university.

Again, these scenarios are modelled on the assumption of *worldwide* adoption of the Open Access alternative. The results for all three of these scenarios are shown in Chart 21 below.

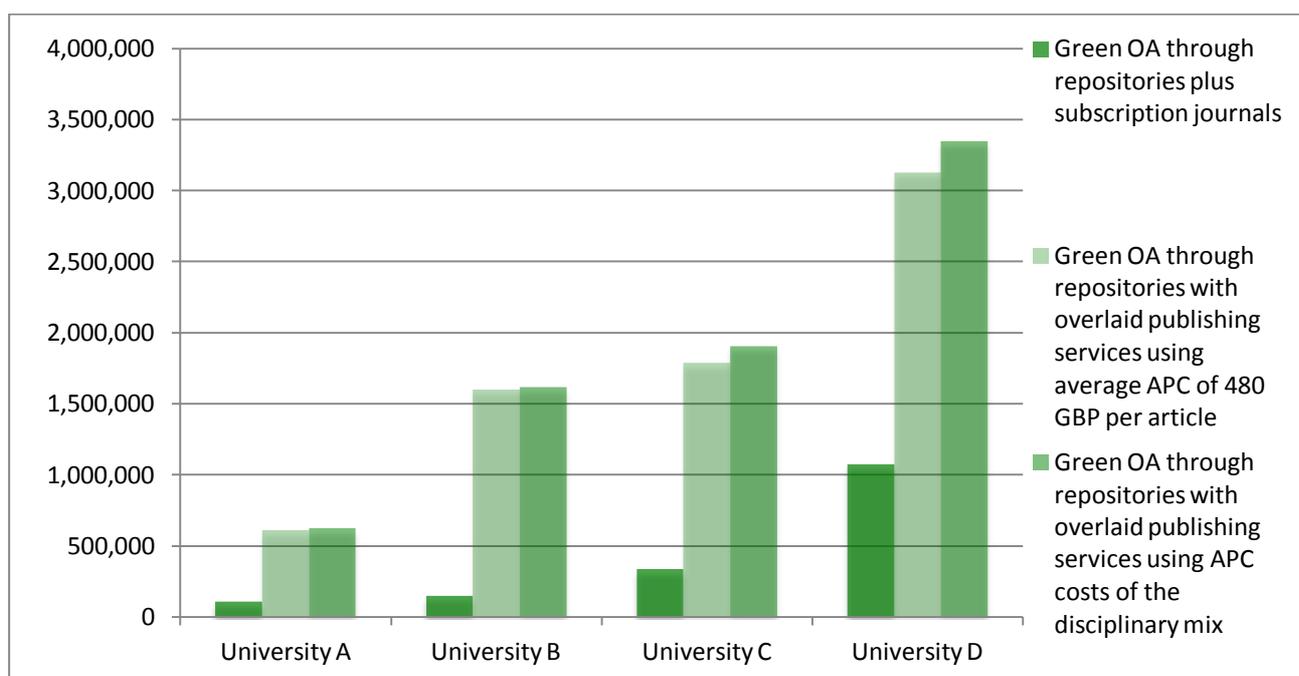


Chart 21: Savings from Green OA

4.2 The effect of unilateral adoption of Green OA

We have also calculated the costs and savings that would accrue from the various Green OA scenarios if universities adopted these unilaterally. As above, these are:

- (iii) Open Access provided by authors self-archiving their articles in repositories while journals remain subscription-based (the current developing scenario); and

- (iv) Open Access provided by authors self-archiving their articles in repositories and peer-review and editorial/production services overlaid upon those repositories. We have modelled this variant using:
- 75% of the current average APC for Gold OA (USD 680, GBP 428); and
 - 75% of the current average APCs for the disciplinary mix of outputs from each university.

These scenarios are modelled on the assumption of *unilateral* institutional adoption of the Open Access alternative. The results for all three of these scenarios are shown in Chart 22 below.

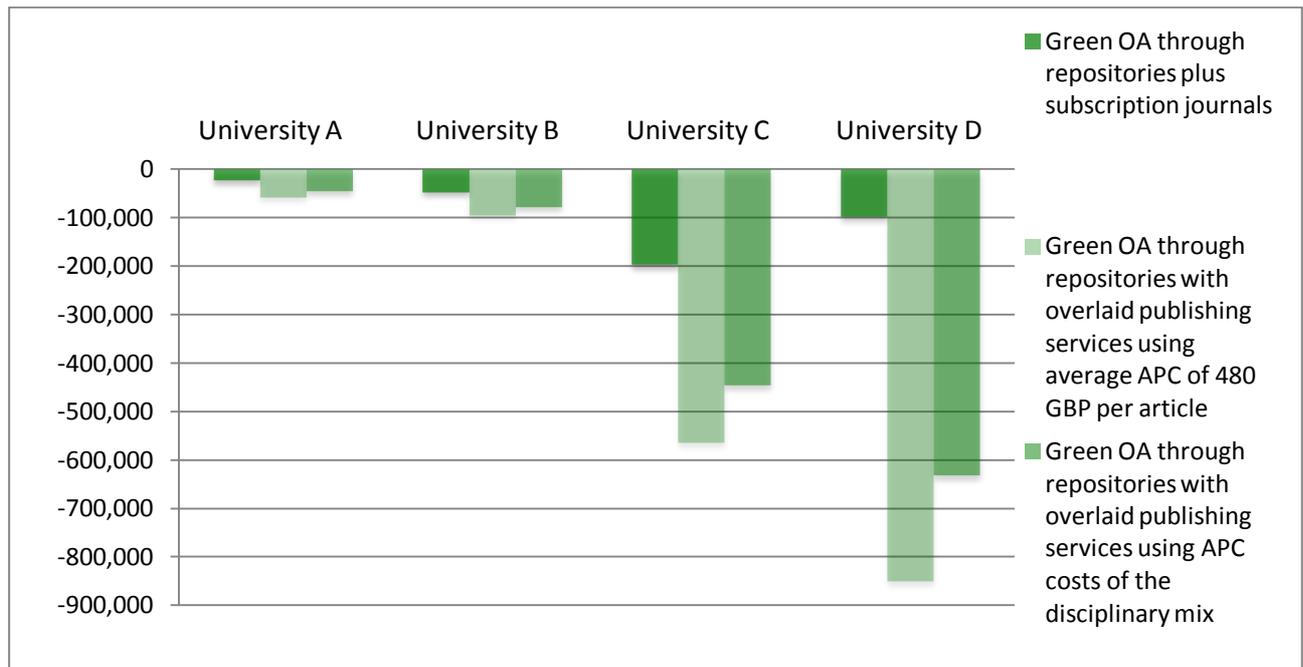


Chart 22: Costs of unilateral Green OA

All universities would face repository-related costs if they were to *unilaterally* adopt Green OA. However, for all the universities, the cost of adopting Green OA is much lower than the costs of Gold OA.

For example, at the current average APC of GBP 571, University D (the most research intensive) would face additional costs of close to GBP 1 million *per annum* were it to unilaterally adopt Gold OA, whereas, the unilateral adoption of Green OA (in parallel with current subscriptions) would involve additional costs of less than GBP 100 000 *per annum*.

5. Summary of costs and benefits to universities of Open Access

Finally, we calculated the overall costs and savings to a UK university (actually, the average of the four universities in the sample for this study) of Gold and Green Open Access adopted either worldwide or unilaterally by that university. The results are presented in Chart 23.

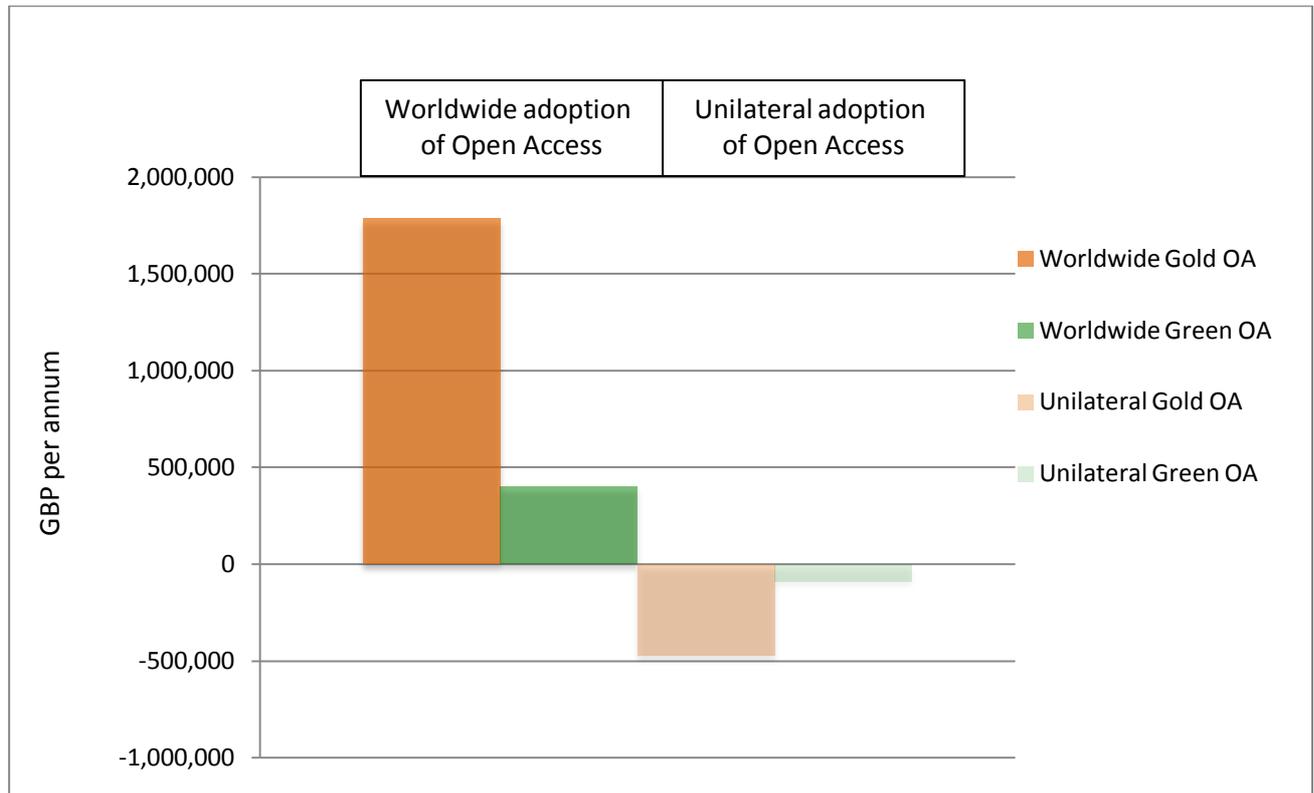


Chart 23: Cost savings to universities of OA alternatives with worldwide and unilateral adoption (calculated using an average of the sample of the four UK universities in this study)

6. Summing-up

Our previous modelling was based on the assumption that a university would face publishing costs for every article published that carries the name of at least one author from that institution. We have refined this modelling by taking into account a number of factors:

- That the corresponding (reprint) author is responsible for the payment of the article-processing fee for a journal article, whether the funding comes from that author's institution or funder
- That funders have policies that permit payment of article-processing fees from funder money

The model has been developed to allow these factors to be included, along with an option to model a situation where not all OA journal charge article-processing fees (as is the case currently), and an option to model using the disciplinary mix of articles from any one institution, since APCs – at least currently – vary between disciplines.

When we modelled the four universities for this study we found that:

- so long as research funders commit to paying publication costs for the research they fund, and
- publication charges fall to the reprint author's home institution,
- all universities would see savings from (worldwide) Gold OA when article-processing charges are at the current averages, and
- research-intensive universities would see the greatest savings.

Only when the average level of APC rises above GBP 2000 per article would any university face increased costs, and then only the few most research-intensive institutions.

There is also the issue of transitioning to Open Access, which is of course expected to be a rather gradual process. When we modelled the cost impacts of an institution unilaterally adopting OA publishing for its article output, while remaining a part of the current scholarly publishing system (i.e. maintaining subscriptions), we find that all universities, from the most research-intensive to the least, would face additional costs for Gold OA. The more research-intensive institutions would face the highest costs, which would rise as the average APC rises and may exceed current subscription costs.

For the sake of completeness, we have also modelled the various Green Open Access scenarios making the same assumptions as above about the source of payment for APCs. Green OA is where Open Access is provided by authors depositing ('self-archiving') their articles in repositories while journals remain subscription-based. The model indicates that all universities would face additional repository-related costs if they were to unilaterally adopt Green OA.

However, for all the universities, the cost of adopting Green OA is much lower than the cost of Gold OA, with Green OA self-archiving in parallel with subscription publishing costing institutions around one-tenth the amount that Gold OA might cost.

7. Methodology

The elements of the model are described in detail in Houghton *et al* (2009). The application of the model to an institutional context and the identification of institutional costs are described in Swan (2010). Here, we describe the additional work carried out during the course of this present study.

For initial analysis, the publishing models are treated as alternatives (i.e. modelling the situation in which that publishing model is used for all journal publishing). We then explore the costs associated with unilateral institutional adoption of Open Access, in order to shed light on the real world context facing universities in the transition to alternative publishing models.

The number of articles published by each institution in 2009 (chosen because we have full data for all values from that year) was obtained from the Web of Science. This service does not cover all titles in the arts and humanities and so the modelled costs may be a little low.

Article-processing fee values were obtained from the analysis of journals in the Directory of Open Access Journals (DOAJ) by Solomon & Björk (2012). This study reported that the mean APC is USD 906 and the median APC is USD 800. It also reported the mean APC in a number of disciplinary categories, as follows (GBP values are converted at 1 US dollar = 0.63 GBP):

- Biomedicine USD 1110 (GBP 699)
- Earth sciences USD 700 (GBP 441)
- Technology & Engineering USD 520 (GBP 328)
- Social sciences USD 520 (GBP 328)
- General science USD 400 (GBP 252)
- Arts & Humanities USD 260 (GBP 143)

An institutional transaction handling cost of GBP 25 per article is added to the article-processing charges.

Solomon & Björk's work showed that only 33% of OA journals listed by the Directory of Open Access Journals currently charge publication fees. We have accordingly included in the modelling the likelihood of 'Platinum' OA, where journals do not charge any APCs (they have business models that enable them to operate without front-end fees, such as sponsorship, or being published from within the academy on a very low-cost basis) in the accompanying model³. However, for the analysis present herein we assume that all OA publishing involves costs at the APCs modelled - effectively assuming that Gold OA publishing costs will be met by UK HEIs in proportion to article their output, whether it be through article-processing charges or sponsorship and in-kind support for 'Platinum' OA journals that do not charge author fees.

For each university we analysed the disciplinary mix of articles published in 2009 using the disciplinary categories of Solomon & Björk. The disciplinary mix was determined by analysing each institution's outputs indexed by the Web of Science. This service categorises articles according to a standardised list of subject fields and we mapped these fields against Solomon & Björk's

³ <http://www.cfses.com/projects/knowledge-access.htm>

categories to obtain a final tally of the number of articles from each university in each of these disciplinary categories.

We also included a cost element for 'Platinum' OA journals – journals that do not charge any APCs, but support their publishing activities by other means. When such journals are published from a university, or one of its departments or research groups, the institution incurs costs, in terms of infrastructure and consumables, that are not recovered. In the case of our four sample universities there were none of these journals published from those institutions (i.e. using the universities' primary domain names), but the accompanying model allows for the possibility.

Finally, we derived the source of funding for each paper from the Web of Science. This service cites funders where they are acknowledged in an article. We used this information to find the proportion of articles from each university that have external funding and which can therefore be assumed, in a world where OA is the norm and research funders recognise dissemination costs as part of research costs, to have their APCs covered by these funders.

The model was modified to take account of these more detailed and nuanced costs and now provides the opportunity to enter the following data *in addition to the data originally required*:

- Percentage of articles with the corresponding author at the university being modelled;
- Percentage of articles with funders willing to pay APCs;
- Percentage of articles in journals charging APCs;
- Percentage of articles that need APCs to be paid for by the university being modelled (by discipline, if wished); and
- The number of 'Platinum' OA journals (these make no charges) supported by the university.

Subscription journal publishing is represented as the cost of subscriptions to the universities, based on data from SCOUNL. As such, it does not include any possible department/faculty subscriptions or personal subscriptions not recorded centrally through the university library, nor does it include a range of other possible subsidies to subscription publishing, such as advertising revenue, revenue from reprints, page and plate charges and possible society subsidies. However, not all subscription expenditure is for journals, so it is discounted to reflect the inclusion of things other than journals in subscription expenditures - for preliminary analysis, we assume 75% of subscription expenditure is for journals.

With the focus on cost to individual HEIs, no account is taken of the wider economic and social benefits of Open Access (e.g. through potentially wider use of the research increasing the returns to expenditure on that research), even though such impacts may be an important part of the institution's mission.

The main elements of the modelling are estimated as follows. For scenarios assuming universal *worldwide* adoption of Open Access:

- *Open Access via Open Access journals (Gold OA):*
(Discounted subscription expenditure + ILL + Library handling + research saving) minus OA journal cost.
- *Open Access via institutional repositories in parallel with subscription publishing (Green OA):*
(ILL + research saving) minus total institutional repository cost.

- *Open Access via repositories plus overlay services:*
(Discounted subscription expenditure + ILL + Library handling + research saving) minus (total IR cost + overlay service cost).
- *Open Access journal costs:*
Number of articles published per annum with APCs paid by institution multiplied by article-processing fee and handling cost. Plus the cost of Platinum OA titles @ 100,000 per title, if known.
- *Overlay service costs:*
Number of articles published per annum with APCs paid by institution multiplied by overlay service charge and handling cost. Plus the cost of Platinum OA titles @ 100,000 per title, if known.
- *Current scholarly communication system costs:*
Reading + writing + peer review + editorial duties + publisher costs + library handling costs (at current mix of content).
- *Research system savings:*
Discounted subscription expenditure + ILL + Library handling + research time saving.

For scenarios exploring the transition (i.e. assuming *unilateral* adoption of Open Access by individual HEIs), costs are modelled as follows:

- *Open Access via Open Access journals (Gold OA):*
OA journal cost.
- *Open Access via institutional repositories in parallel with subscription publishing (Green OA):*
Total institutional repository cost.
- *Open Access via repositories plus overlay services:*
Total IR cost + overlay service cost.
- *Open Access journal costs:*
Number of articles published per annum with APCs paid by institution multiplied by article-processing fee and handling cost. Plus the cost of Platinum OA titles @ 100,000 per title, if known.
- *Overlay service costs:*
Number of articles published per annum with APCs paid by institution multiplied by overlay service charge and handling cost. Plus the cost of Platinum OA titles @ 100,000 per title, if known.

An online model is available for people to use to explore the potential cost of alternative OA publishing models to their own institution. It runs as an executable file in MS Excel, but will not run on Apple Mac computers except under a dual-boot windows system, because of the lack of support for Visual Basic Macros.

The model can be downloaded from:

[http://www.cfses.com/Gold_OA_Cost_Model_\(UK_HEIs\).exe](http://www.cfses.com/Gold_OA_Cost_Model_(UK_HEIs).exe)

References

1. Houghton, J.W., Rasmussen, B., Sheehan, P.J., Oppenheim, C., Morris, A., Creaser, C., Greenwood, H., Summers, M. and Gourlay, A. 2009. *Economic Implications of Alternative Scholarly Publishing Models: Exploring the Costs and Benefits*, Report to The Joint Information Systems Committee (JISC) <http://www.cfses.com/EI-ASPM/> (See also Addendum to the model: <http://www.cfses.com/EI-ASPM/JISC%20EI-ASPM%20Report%20%28Addendum%20April%2009%29.pdf>).
2. Cambridge Economic Policy Associates. 2011. Heading for the open road: costs and benefits of transition in scholarly communication. London, Research Information Network. http://www.rin.ac.uk/system/files/attachments/Dynamics_of_transition_report_for_screen.pdf
3. Swan, A (2010) Modelling Scholarly Communication Options: Costs and benefits for universities. <http://ie-repository.jisc.ac.uk/442/>
4. Solomon DJ and Björk B-C (2012) A study of open access journals using article processing charges. <http://www.openaccesspublishing.org/apc2/> (preprint; accepted for publication in the *Journal of the American Society for Information Science and Technology*)