PRIME

Informing Policy with Evidence

Analysis of the economic impact of NIHR's Open Access policy

James Mahon

Nick Hex

York Health Economics Consortium

The Kings Fund

YHEC York Health Economics Consortium

University of York

YHEC

York Health Economics Consortium

Analysis of the economic impact of NIHR's open-access policy: a report commissioned by the Department of Health and Social Care

James Mahon, Associate

Nick Hex, Project Director

York Health Economics Consortium

08/11/2021

Investors in People | Health & Wellbeing Award

UNIVERSITY of York

Table of Contents

The Partnership for Responsive Policy Analysis and Research (PREPARE) is a collaboration between the University of York and the King's Fund, producing fast-response analysis to inform developing policy. The research programme is funded by the NIHR Policy Research Programme (grant number NIHR200702). Views expressed are those of the authors and not NIHR or the Department of Health and Social Care.

1 Introduction

1.1 Background

UK Research and Innovation (UKRI) is proposing a policy that all publications based upon research funded by the UKRI and its constituent councils should be available open access (OA). In December 2020, Alma Economics produced a report [1] for UKRI detailing what the impact would be for Higher Education Institutes (HEIs), publishers of academic journals and wider society if the proposed UKRI OA policy was put into practice.

In April 2021 the Department of Health and Social Care (DHSC) asked York Health Economics Consortium (YHEC) to carry out a rapid analysis to estimate the potential costs and benefits of the National Institute for Health Research (NIHR) OA policy proposals based on the methodology outlined in the Alma Economics report. The Alma Economics report included both quantitative and qualitative analysis (in the form of interviews with stakeholders affected by the proposed OA policy). The scope of the analysis undertaken by YHEC was to replicate the quantitative analysis used in the report, applied to data on NIHR funded research publications.

This project was commissioned through the Partnership for Responsive Policy Analysis and Research (PREPARE), a collaboration between the University of York and the King's Fund producing fast-response analysis and review to inform developing policy (NIHR200702). This report has been prepared by researchers at York Health Economics Consortium. The views expressed are those of the authors only and not necessarily those of NIHR or the Department of Health and Social Care.

1.2 Methods

Closely following the Alma Economics quantitative analysis, the starting point for this analysis was to determine the total number of publications that were funded by the NIHR that would be in scope of the potential NIHR OA policy. The costs and benefits of a full OA policy for NIHR funded publications were then estimated to include:

- Costs of moving to a full and immediate OA to NIHR and its funded research organisations (ROs)[1]
- The net impact of OA to academic publishers

[1] The NIHR fund both HEIs and other research active organisations across the health and social care.

- The societal benefit of OA

Adjustments were to be made to the Alma Economics approach where the idiosyncrasies of NIHR funding, or funding in health and social care research compared to UKRI funding, meant that the Alma Economics approach was not generalisable to the NIHR. In practice, the Alma Economics approach was so broad that adjustments were almost entirely unnecessary.

2 NIHR funded publications

2.1 Background

For the proposed OA policy, NIHR defines publications in scope of their OA policy as peer reviewed research articles that result from NIHR funded research projects, with the exception of NIHR Infrastructure. For NIHR Infrastructure the policy applies to research studies where the majority of the research costs (as defined by AcoRD) [2] are funded by the NIHR.

In most cases, apart from the NIHR Infrastructure, throughout the duration of the NIHR research award and five years after its completion the NIHR expects recipients of its funding to report research findings, including any publications arising from the research, through Researchfish, an online data collection platform. The DHSC provided YHEC with an extract of data from Researchfish for the years 2017, 2018 and 2019 listing the of publications submitted by recipients of NIHR funding and the journals in which they were published. This data was further enriched with information on the OA status of the articles and the journals. The open access nature of the publications was identified using the following OA descriptions:

- **Pure Gold OA:** the article is free to all from the date of publication in a journal where all the articles are OA. This is frequently associated with the payment of an article processing charge (APC).
- **Hybrid Gold OA:** the article is free to all from the time of publication following the payment of an APC to a journal where some of the articles are OA, and some are behind a paywall.
- **Green OA:** a copy of the article is available in a freely accessible repository. The article might be embargoed behind a paywall at publication but made freely available after a certain point of time.
- **Bronze OA:** the article is free to read only on the publisher page, but lacks a clearly identifiable license. Such articles are typically not available for reuse and for the purpose of this analysis are assumed to be the same as closed articles
- **Closed:** the article is only available behind a paywall

2.2 Publication numbers

The Researchfish data provided by the DHSC is summarised in Table 2.1. This showed a total number of publications associated with NIHR funding of 7,783 between 2017-19, with 51.6% gold open access at the time of publication (in full OA journals or as a Gold OA article in a hybrid journal). A further 9.8% were behind of a paywall and 12.9% Bronze OA meaning 22.7% would not be compliant with a full OA policy. A further 25.8% were Green OA and potentially not compliant with a full OA policy.

Table 2.1: Numbers of publications linked to NIHR funding in Researchfish 2017-19

OA status	2017	2018	2019	2017-2019
Pure Gold	751 (30.9%)	795 (31.8%)	902 (31.6%)	2448 (31.5%)
Hybrid Gold	435 (17.9%)	496 (19.8%)	631 (22.1%)	1562 (20.1%)
Green	698 (28.7%)	618 (24.7%)	692 (24.2%)	2008 (25.8%)
Bronze	338 (13.9%)	346 (13.8%)	318 (11.1%)	1002 (12.9%)
Closed	206 (8.5%)	244 (9.8%)	313 (11%)	763 (9.8%)
Subscription only	*37 (1.5%)*	*49 (2%)*	*57 (2%)*	*143 (1.8%)*
Hybrid[2]	*169 (7%)*	*195 (7.8%)*	*256 (9%)*	*620 (8%)*
Total	2428	2499	2856	7783

The numbers in Table 2.1 could be an under- or over-estimate of the total number of journal articles that would fall under the proposed NIHR OA policy.

Data provided to YHEC by the DHSC showed that between 2017-2019, approximately 25% of NIHR funding awards that were eligible that year to submit into Researchfish did not submit a Researchfish report that year. It may be that these awards felt they had little to report back to the NIHR for that year. Alternatively, it could be these awards resulted in a similar number of publications to awards where publications were registered on Researchfish.

The NIHR also funds research through its Infrastructure schemes, such as Biomedical Research Centres (BRCs) and Applied Research Collaboratives (ARCs), which largely do not report research publications through Researchfish. The DHSC estimated through its annual NIHR Infrastructure reports [3] that these funding streams result in about 800 publications a year that would fall in scope of the NIHR OA policy (or approximately 33% of the publications on Researchfish) but information on the open access nature of the publications was not available.

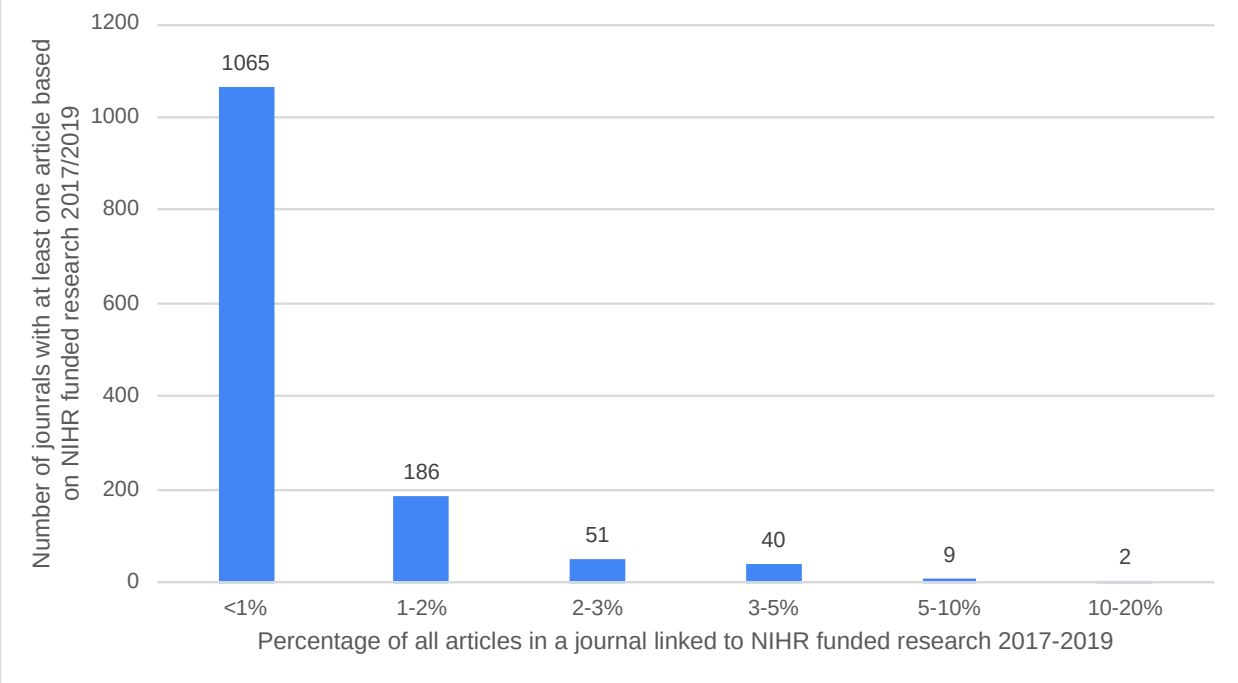
The DHSC also informed YHEC that the researchers often log publications and research findings on Researchfish that build on the findings from NIHR funded research, but where funding now comes from another source and thus would not be in scope of the NIHR OA policy. Further, the NIHR found that in a review of research outputs from the NIHR Academy, funded researchers were often logging all of their research publications whilst receiving an NIHR Academy fellowship, even if the research in question was not funded by NIHR. The NIHR Academy estimates that of the 7,783 publications on Researchfish, 1,645 (21.1%) were likely not based upon research funded by the NIHR, and thus not in scope of the OA policy.

The balance of potential under-and over-reporting of publication numbers in Researchfish data cannot be accurately estimated. As such, Table 2.1 can be used as a reasonable approximation of the base case (BC) analyses for publication numbers that could be impacted by a fully OA policy for NIHR funded research, with scenario analysis looking at the impact if publications were actually 25% lower (LB: lower bound) or 60% higher (UB: upper bound) than the base case.

[2] Hybrid closed were identified using the journals' 2019 publishing patterns.

Figure 2.1 shows the proportion that NIHR funded research articles make-up of the total articles published by non-fully OA journals. Journals which published ten or fewer articles a year have been excluded. This highlights that of 1355 journals that are not fully OA and published an NIHR funded research article , only eleven journals (ADD %) had more than 5% of their publications based upon NIHR funded research and only two had more than 10%: The Cochrane Database of Systematic Reviews (12%) and the Journal of Health Services Research & Policy (11%).

Figure 1: Number of not fully OA journals publishing at least one NIHR funded research article as a percentage of total articles published by the journal in 2017-2019 (excluding journals which publish 10 or fewer articles a year)



2.3 NIHR publications numbers affected by different OA policies

The Alma Economics report considered three scenarios under which a full OA policy could progress:

Scenario 1: Funded research can be published in hybrid journals as OA as well as in full OA journals. This would mean that research could not be published where access was behind a paywall or where it was not under an open licence (e.g. bronze OA), meaning embargoed Green OA publications would not be acceptable.

As shown in Table 2.2, if Green OA articles were still be permitted in this scenario, 22.7% of all publications based on research funded by the NIHR would be affected (BC: 1,258 publications per year, LB: 944, UB:2,013). If Green OA articles were not permitted in this scenario, 48.5%

of all publications based on research funded by the NIHR would be affected (BC: 588 publications per year, LB: 441, UB:941).

Table 2.2 Publications from 2017-19 based on NIHR funded research that would not be funded if OA publication could be in hybrid journals as well as full OA (Scenario 1)

OA status	2017	2018	2019	2017-2019
Closed/Bronze	544 (22.4%)	590 (23.6%)	631 (22.1%)	1765 (22.7%)
Green OA	698 (28.7%)	618 (24.7%)	692 (24.2%)	2008 (25.8%)
Total (excluding Green OA)	**544 (22.4%)**	**590 (23.6%)**	**631 (22.1%)**	**1765 (22.7%)**
Total (including Green OA)	**1242 (51.2%)**	**1208 (48.3%)**	**1323 (46.3%)**	**3773 (48.5%)**

Scenario 2: Funded research can be published in full OA journals and hybrid journals where a Transformative Agreement (TA) is in place[3]. Again, this would mean that research could not be published where access was behind a paywall or where it was not under open licence, meaning embargoed Green OA publications would not be acceptable. It also means that some Hybrid Gold OA publications would be in journals where publication would no longer be allowed. It is important to note that this analysis assumes all NIHR funded researchers have access to Jisc negotiated TAs [4], which is not presently the case.

As shown in Table 2.3, if Green OA articles were still permitted in this scenario, 32.5% of all publications based on research funded by the NIHR between 2017-19 would be affected (BC: 844 publications per year, LB: 633, UB:1,350). If Green OA articles were not permitted in this scenario, 58.3% of all publications based on research funded by the NIHR would be affected (BC: 1,514 publications per year, LB: 1,135, UB:2,422).

Table 2.3 Publications from 2017-19 based upon NIHR funded research that would not be funded if a journal needed a TA (Scenario 2)

OA status	2017	2018	2019	2017-2019
Closed/Bronze	544 (22.4%)	590 (23.6%)	631 (22.1%)	1765 (22.7%)
Green	698 (28.7%)	618 (24.7%)	692 (24.2%)	2008 (25.8%)
Hybrid Gold	211(8.7%)	247 (9.9%)	310 (10.9%)	768 (9.9%)
Total (excluding Green OA)	**755 (31.1%)**	**837 (33.5%)**	**941 (32.9%)**	**2533 (32.5%)**
Total (including Green OA)	**1453 (59.8%)**	**1455 (58.2%)**	**1633 (57.2%)**	**4541 (58.3%)**

Scenario 3: Funded research can only be published in journals that are fully OA. This would mean that Green OA and Hybrid Gold OA publications would not be permitted.

[3]Journals with a Jisc Transformative Agreement in March 2021.

As shown in Table 2.4, in this scenario, 68.5% of all publications based on research funded by the NIHR would be affected (BC: 1,778 publications per year, LB: 1,334, UB:2,845).

Table 2.4 Publications from 2017-19 based upon NIHR funded research that would not be funded if a journal needed to be fully OA (Scenario 3)

OA status	2017	2018	2019	2017-2019
Closed/Bronze	544 (22.4%)	590 (23.6%)	631 (22.1%)	1765 (22.7%)
Hybrid Gold	435 (17.9%)	496 (19.8%)	631 (22.1%)	1562 (20.1%)
Green	698 (28.7%)	618 (24.7%)	692 (24.2%)	2008 (25.8%)
Total	**1677 (69.1%)**	**1704 (68.2%)**	**1954 (68.4%)**	**5335 (68.5%)**

Whilst the three scenarios do not impact the cost and benefit calculations in Sections 3 and 4, they do highlight that, regardless of the OA strategy chosen, it is likely that it will impact no lower than 22% and no higher than 69% of NIHR funded research publications.

3 Financial impact of a fully OA policy

3.1 Cost to NIHR

An OA model for publication is currently largely reliant on a payment to the publisher by the author of an Article Processing Charge (APC). Moving to a full OA policy would mean that these costs would have to be met by the NIHR although, as reported in the Alma Economics report, in practice at least a proportion APCs are currently either met by another funder of the research, the author or its institution.

The level of APC varies from journal to journal. It is driven by a journal's CiteScore and by the type of OA offered. Average APCs in the Health Sciences that are paid for journals for making articles OA, or estimated for journals where articles are not already OA, were calculated by Alma Economics and are shown in Table 3.1.

Table 3.1 Average Health Sciences APCs in 2018

OA status	Estimated APC
Closed/Bronze	£1,646
Full OA	£1,523
Hybrid Gold OA	£2,297
Hybrid Green OA	£2,182
Hybrid-subscription	£2,142

Source: Alma Economics

Applying these costs allows an approximation of the total APC costs for publication of NIHR funded research from 2017 to 2019, if it was all made OA through a payment of an APC. This is shown in Table 3.2. The total costs of APCs for full OA between 2017 and 2019 would be £14.91m or approximately £4.97m per year (LB: £3.73m per year, UB: £7.95m per year).

Table 3.2 Estimated total APC costs for publications based upon NIHR funded research (£millions)

OA status	2017	2018	2019	2017-2019
Pure Gold	£1.14	£1.21	£1.37	£3.73
Hybrid Gold	£1.00	£1.14	£1.45	£3.59
Bronze	£0.56	£0.57	£0.52	£1.65
Green	£1.52	£1.35	£1.51	£4.38
Closed	£0.42	£0.50	£0.64	£1.56
Subscription only	£0.06	£0.08	£0.09	£0.24
Hybrid	£0.36	£0.42	£0.55	£1.33
Total	**£4.64**	**£4.77**	**£5.49**	**£14.91**

Given that some publications between 2017 and 2019 were already being published OA, a move to a full OA policy would only result in an increase in APC costs for those articles published in fully subscription journals, Bronze OA or in a hybrid journal behind a paywall and potentially a percentage of Green OA articles. Further, the actual APC costs to the NIHR will be dependent on the percentage of the APC that the NIHR would actually cover, as opposed to other research funders, authors or their institutions. The potential additional APC costs if all NIHR funded research had to be published OA are summarised in Table 3.3. Depending on the percentage of Green OAs published in other journals and the APCs that would be met by the NIHR, the additional costs could be as low as £0.54m per year (LB: £0.41m per year, UB: £0.86m per year) or as high as £2.53m per year (LB: £1.90m per year, UB: £4.05m per year).

Table 3.3 Additional APC costs for publications if all NIHR funded research was published OA (£millions)

	Closed/Bronze + hybrid-subscription	Closed/Bronze + hybrid-subscription + 50% Green OA	Closed/Bronze + hybrid-subscription + 80% Green OA	Closed/Bronze + hybrid-subscription + 100% Green OA
50% of APCs attributable to NIHR				
2017	£0.49	£0.87	£1.10	£1.25
2018	£0.53	£0.87	£1.07	£1.21
2019	£0.58	£0.96	£1.19	£1.34
2017-2019	£1.61	£2.70	£3.36	£3.80
75% of APCs attributable to NIHR				
2017	£0.73	£1.31	£1.65	£1.88
2018	£0.80	£1.31	£1.61	£1.81
2019	£0.87	£1.44	£1.78	£2.01
2017-2019	£2.41	£4.05	£5.04	£5.70
100% of APCs attributable to NIHR				
2017	£0.98	£1.74	£2.20	£2.50
2018	£1.07	£1.74	£2.15	£2.42
2019	£1.17	£1.92	£2.37	£2.68
2017-2019	£3.21	£5.40	£6.72	£7.59

3.2 Publisher profits

The business model with OA is necessarily different than a subscription model for publishers. The revenue from a subscription is replaced by the APC with OA, but Alma Economics also highlighted that the costs of an article to the publisher are also lower with OA. The summary of costs and revenues with different models are shown in Table 3.4

Table 3.4 Costs and revenues from publication under different models

Parameter	Value	Source
Revenue per article (subscription)	£4,100	Johnson et al. (2017) [5]
Revenue per article (OA)	£2,156	Open APC Initiative (average APC)
Cost per article (subscription)	£3,247	Publisher costs per article, dual mode (Alma Economics)
Cost per article (OA)	£2,003	Publisher costs per article, dual mode (Alma Economics)

Using the values in Table 3.4 and applying them to NIHR funded research articles published between 2017 and 2019 allows an estimate to be made of the maximum change in profits to the publishing industry if articles published behind a paywall (closed), as Bronze OA or as Green OA had been instead published fully OA (Table 3.5). The loss in revenue for publishers of moving to OA of £2.44m per year (LB: £1.83m per year, UB: £3.90m per year) is partially offset by a cost reduction of £1.56m per year (LB: £1.17m per year, UB: £2.50m per year). The reduction in publisher profits as a result of a full OA policy for NIHR research would therefore be in the region of £0.88m per year (LB: £0.66m per year, UB: £1.41m per year). If Green OA articles are not included then the reduction in publisher profits would be £0.41m per year (LB: £0.31m per year, UB: £0.66m per year)

Table 3.5 Maximum change in publisher profits if all closed, Bronze OA or Green OA were published full OA (£millions)

	2017	2018	2019	2017-2019
Revenue				
Subscription	£5.09	£4.95	£5.42	£15.47
OA	£2.68	£2.60	£2.85	£8.13
Net revenue loss	£2.41	£2.35	£2.57	£7.33
Costs				
Subscription	£4.03	£3.92	£4.30	£12.25
OA	£2.49	£2.42	£2.65	£7.56
Net cost reduction	£1.55	£1.50	£1.65	£4.69
Profits				
Subscription	£1.06	£1.03	£1.13	£3.22
OA	£0.19	£0.18	£0.20	£0.58
Reduction in profits with OA	**£0.87**	**£0.85**	**£0.93**	**£2.64**

4 Benefits of OA

4.1 Societal benefits

Wider societal benefits were considered by Alma Economics, with an acknowledgement that the benefits of OA are difficult to quantify. The estimation of societal benefit was based upon parameters shown in Table 4.1.

Table 4.1 Parameters and sources to estimate societal benefit from OA

Parameter	Value	Methodology
% overall increase in accessibility of knowledge	20%	% of all knowledge from journals, from Houghton et al. 2009) [6] adjusted by share of UK research output relative to global output
% overall gain in efficiency	5%	Houghton et al. (2009) adjusted by share of UK papers published OA
Social rate of return to R&D	20%	Hall, Mairesse and Mohnen (2010) [7]
Annual growth in R&D spending	4%	Office for National Statistics (2018)
Lag between R&D spending and impacts	10 years	Houghton et al. (2009)
Depreciation in stock of knowledge	10%	Houghton et al. (2009)
Discount rate	3.5%	HMT Green Book [8]

Source: Alma Economics

It may be that some of these values in Table 4.1 are pessimistic in relation to research funded by the NIHR, notably around the lag between R&D spending and impacts as the NIHR often funds research into interventions that will be rapidly adopted by the health and social care system if they are shown to improve health outcomes. However, in the absence of values specifically for research in health and social care, YHEC considered that the values in Table 4.1 were sufficient to provide an estimate of the benefits of OA in health and social care research. Therefore, the only thing that would change between the Alma Economics analysis of the societal benefit of UKRI funding and the YHEC analysis of the social benefit of NIHR funding would be the number of articles becoming fully OA under a full OA policy. The Alma Economics 20-year estimate of societal benefit of OA (£304m efficiency gain from reduced publishing costs and £483m excess social return on R&D spending based upon Scenario 1 for OA) needs to be weighted by the proportion of NIHR funded publications. There were 22,614 UKRI funded papers published in 2018 that would become OA under a fully OA policy and formed the basis of the Alma Economics analysis, and there were 1,208 equivalent NIHR funded research papers published in the same year (including Green OA).

Applying the appropriate weighting suggests that the NIHR moving to a fully OA policy would, over 20 years, generate an efficiency gain from reduced publishing costs (using the same differences in costs between OA and subscription for papers in Table 3.4) of £16.24m (LB: £12.18m, UB: £25.98m) and a gain from excess social return on R&D spending of £25.80m (LB: £19.35m, UB: £41.28m). This would give a total return of £42.04m (LB: £31.53m, UB: £67.26m). The benefits would include gains in terms of R&D and also for NHS and social care organisations, patients, clinicians and the public. It is not possible to quantify these individual benefit elements separately using the Alma Economics methodology.

5 References

1. Alma Economics. UK Research and Innovation. December 2020. Economic implications and benefits assessment of an updated UKRI open access policy for peer-reviewed research articles. https://www.ukri.org/wp-content/uploads/2021/08/UKRI-060821-EconomicImplicationsAndBenefitsAssessmentOfAnUpdatedUKRIOpenAccessPolicyForPeerReviewedResearchArticles-FINAL.pdf

2. Department of Health. April 2012. Attributing the costs of health and social care Research & Development (AcoRD). https://www.gov.uk/government/publications/guidance-on-attributing-the-costs-of-health-and-social-care-research

3. NIHR. March 2021. Annual Report 2019-2020. https://www.nihr.ac.uk/documents/annual-report-20192020/26565

4. Jisc. 2016. 'Article Processing Charges (APCs) and Subscriptions'. https://www.jisc.ac.uk/sites/default/files/apc-and-subscriptions-report.pdf

5. Johnson et al. 2017. 'Towards a Competitive and Sustainable Open Access Publishing Market'. https://libereurope.eu/wp-content/uploads/2017/03/OA-market-report-28Final-13-March-201729-1.pdf

6. Houghton, et al. 2009. Economic implications of alternative scholarly publishing models: Exploring the costs and benefits. http://vuir.vu.edu.au/15222/1/EI-ASPM_Report.pdf

7. Hall, et al. 2010. 'Measuring the Returns to R&D.' Handbook of the Economics of Innovation 2:1033-82. https://doi.org/10.1016/S0169-7218(10)02008-3

8. HM Treasury. 2020. The Green Book. Central Government guidance on appraisal and evaluation. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938046/The_Green_Book_2020.pdf


Partnership for
REsponsive
Policy
Analysis and
REsearch