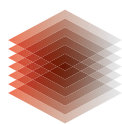


# EFFECTS OF OPEN ACCESS

LITERATURE STUDY ON  
EMPIRICAL RESEARCH  
2010–2021

David Hopf  
Sarah Dellmann  
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Effects of Open Access. Literature study on empirical research 2010–2021.  
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## Preliminary remarks on the English version

This text is a translation, checked by the authors, of the study originally published in German language in early 2022. All findings and literature are up to date with the version published at that time. No new literature was taken into account and no new analyses were carried out.

This study was conducted on behalf of the German Federal Ministry for Education and Research (BMBF) between September 2021 and January 2022. Even though the study was only published in German, we registered some interest from outside Germany. Due to a lack of capacity for an update, we decided to provide a translation of the otherwise unchanged German-language version. Nevertheless, we believe that this English translation will facilitate referencing our findings in international debates and policy-making.

The authors still consider a continuation of this work to be desirable. We are very interested in international exchange and invite you to share your comments and thoughts with us.

Hannover (Germany), May 2024

The original version can be found at: Hopf, D., Dellmann, S., Hauschke, C., & Tullney, M. (2022). Wirkungen von Open Access. Literaturstudie über empirische Arbeiten 2010–2021. Hannover : Technische Informationsbibliothek (TIB). <https://doi.org/10.34657/7666>

## 1 Executive Summary

Open access—the free availability of scholarly publications—intuitively offers many benefits. At the same time, some academics, university administrators, publishers, and political decision-makers express reservations. Many empirical studies on the effects of open access have been published in the last decade. This report provides an overview of the state of research from 2010 to 2021. The empirical results on the effects of open access help to determine the advantages and disadvantages of open access and serve as a knowledge base for academics, publishers, research funding and research performing institutions, and policy makers. This overview of current findings can inform decisions about open access and publishing strategies. In addition, this report identifies aspects of the impact of open access that are potentially highly relevant but have not yet been sufficiently studied.

### **What has been researched?**

In a comprehensive literature search, we identified 318 academic studies that empirically analyse various effects of open access. From this corpus, 61 particularly relevant studies were selected for a systematic comparison and were then analysed in detail. The main topics of the studies were categorised into seven impact areas.

### **What is the state of research on the effects of open access?**

In the following section, we present the results of our analysis of the empirical literature on the effects of open access in the seven impact areas. It should be noted that the 2 potential for generalizing statements on some of the effects is limited by the fact that the international publishing system may be influenced by a variety of conditions. In addition, randomised studies, which could systematically control possible confounding factors, are not only rare in this area of investigation, but also very difficult to conduct.

1. **Attention from the academic world:** The majority of studies confirm a citation advantage for open access publications. However, there is also a non-negligible number of studies that report no citation advantage. The generalisability of the statements in this impact area is therefore limited: The existence of an open access citation advantage cannot be regarded as completely empirically confirmed. However, this does not mean that the open access citation advantage has been proven to be non-existent; a citation advantage for open access publications can still be reasonably assumed.
2. **Quality of scholarly publications:** In the studies analysed, no differences in quality between open access publications and closed access publications were found.
3. **Knowledge transfer:** The studies analysed show a significantly higher number of references from the non-academic sector (patents, news, court documents) to open access publications. This means that open access improves the knowledge transfer to society.
4. **Productivity of the publication system:** The analysed studies come to different conclusions. Neither an increase nor a decrease in the volume of publications due to open access can be universally claimed. Studies on the duration of the publishing process show that open access shortens the time between submission and acceptance or publication of articles.
5. **Use of publications:** The analysed studies report significantly higher download numbers and page views for open access publications. This implies that open access publications are used more often than non-open access works.

6. **Inequality in the science system:** Several studies report that open access business models with *Article Processing Charges* (APCs) lead to lower participation of certain groups of authors: authors at financially disadvantaged institutions, authors in the Global South, and authors outside of the higher education sector are particularly disadvantaged. At the same time, other studies show that open access publications are used by a more diverse audience than closed access publications. The diversity of both authors and users is considered as an indicator of the representation of different groups of people and therefore as an indicator of inequality in the science system.
7. **Economic impact on the publishing system:** A number of studies contain model-based results on the costs of various open access scenarios. However, the potential for generalisation of these results is low, as the studies analysed here are highly context-dependent. Other studies show that there is no correlation between the (parallel) publication of books in open access and the sales figures of a print edition.

#### **Which questions have not yet been researched?**

Surveys show that the effects of open access on academic careers are considered important. However, there are no studies that provide sufficient empirical confirmation for this connection. The impact of open access on specific groups of participants (e.g. researchers outside well-funded academic institutions or people of different genders) is also under-researched. Finally, correlations between the individual effects of open access have not yet been sufficiently analysed empirically.

#### **Recommendations**

Based on these results, it is recommended:

- R1** to further expand open access activities,
- R2** to close the research gaps mentioned (effects not yet investigated),
- R3** to carry out additional studies that provide further evidence concerning certain effects
- R4** to take action to counter the negative, inequality-increasing effects of APCs.

#### **Overall conclusion**

Overall, various advantages of open access can be considered as empirically confirmed by the current state of research. These advantages include improved knowledge transfer, increased speed in the publishing process and increased use by a professionally and geographically diverse readership. At the same time, some presumed negative effects of open access—such as lower quality of publications and disadvantages in the sale of print editions—can be regarded as empirically refuted. The empirical results on the effects of open access therefore support the aim of a far-reaching transition to open access, to which German academic organisations, among others, have committed themselves.

## 2 Introduction

For over twenty years, open access—i.e. free and unrestricted online access to scholarly information<sup>1</sup>—has been a declared goal for the transformation of the academic system. Open access has already led to far-reaching changes and has become a relevant part of the publishing system in many respects. Open access is associated with high hopes but also strong reservations. It is therefore legitimate to ask whether the hopes and reservations regarding effects of open access can be empirically substantiated. This meta-study therefore aims to collect, categorise and analyse in detail the existing empirical literature on effects of open access in order to provide an overview of the current state of research.

This study pursues three main research questions:

1. Which topics in the area of effects of open access—hereinafter referred to as “impact areas”—can be identified in the empirical literature?
2. What are the results of existing studies on these impact areas?
3. Which effects of open access have not yet been empirically investigated, or not sufficiently?

Based on the answers to these questions, this report formulates recommendations for further research and points of action. Empirical studies about the effects of policy measures *on* open access—for example as part of the evaluation of such policy measures—are not subject of this meta-study, which exclusively focuses on the effects *of* open access.<sup>2</sup>

This report is divided into six sections: Following the *executive summary* and the introduction, the method used to identify, select and analyse the studies is described. The fourth section provides a detailed description of the findings in the individual impact areas. The fifth section discusses gaps in the state of research. The final section summarises the results in an overall interpretation and formulates recommendations for follow-up measures. The appendix includes details of the literature research and a tabular overview of the analysed literature.

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1 Definition according to Suber (2009), p.4.

2 In addition, our literature research did not identify extensive existing literature on this complex of questions.

### 3 Methode

This study summarises and analyses empirical results from the existing research literature on the effects of open access as a form of publishing. This study is a literature overview in the form of a *scoping review*:<sup>3</sup> The aim of this report is not to collect and quantitatively evaluate all data on this topic, as would be the case with meta-analyses in a *systematic review*. The existing literature and the empirical data it contains are too multifaceted and heterogeneous for such a comparison. Instead, the aim of this study is to provide an overview of the main effects discussed in the literature and the most relevant empirical results. In line with the third research question, areas that may have received little attention to date should be emphasized in order to highlight potential research gaps. The applied research method comprises a total of four steps:<sup>4</sup>

1. Literature research in specialised bibliographic databases
2. Identification of relevant articles and grouping according into impact areas
3. Systematic expansion of the literature corpus
4. Analysis of selected publications

In the first step, open search queries in the bibliographic databases *Dimensions*, *Library, Information Science and Technology Abstracts (LISTA)*, *Scopus*, and *Web of Science* were conducted.<sup>5</sup> This general search returned a total of 7,217 titles.

In the second step, relevant titles were identified: Initially, the entries were deduplicated and titles were limited to publications from the years 2011–2021. Older titles were excluded in order to reflect the current state of research in the dynamic field of academic publishing. The remaining 3,521 titles were then manually screened and checked for relevance: based on title and abstract, publications without any connection with empirical research on open access effects were excluded. This left 1,702 titles. Subsequently, a more detailed review of the abstracts of the remaining titles was carried out. This included a summary analysis of the full texts in order to positively identify those publications that report empirical results on effects of open access. This resulted in a preliminary corpus of 255 publications.

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3 For a discussion of differences between various forms of reviews cf. Arksey and O'Malley (2005).

4 The procedure is based on the methodology from Arksey and O'Malley (2005) and Elm, Schreiber, and Haupt (2019).

5 Detailed information on both search queries can be found in the Annex.



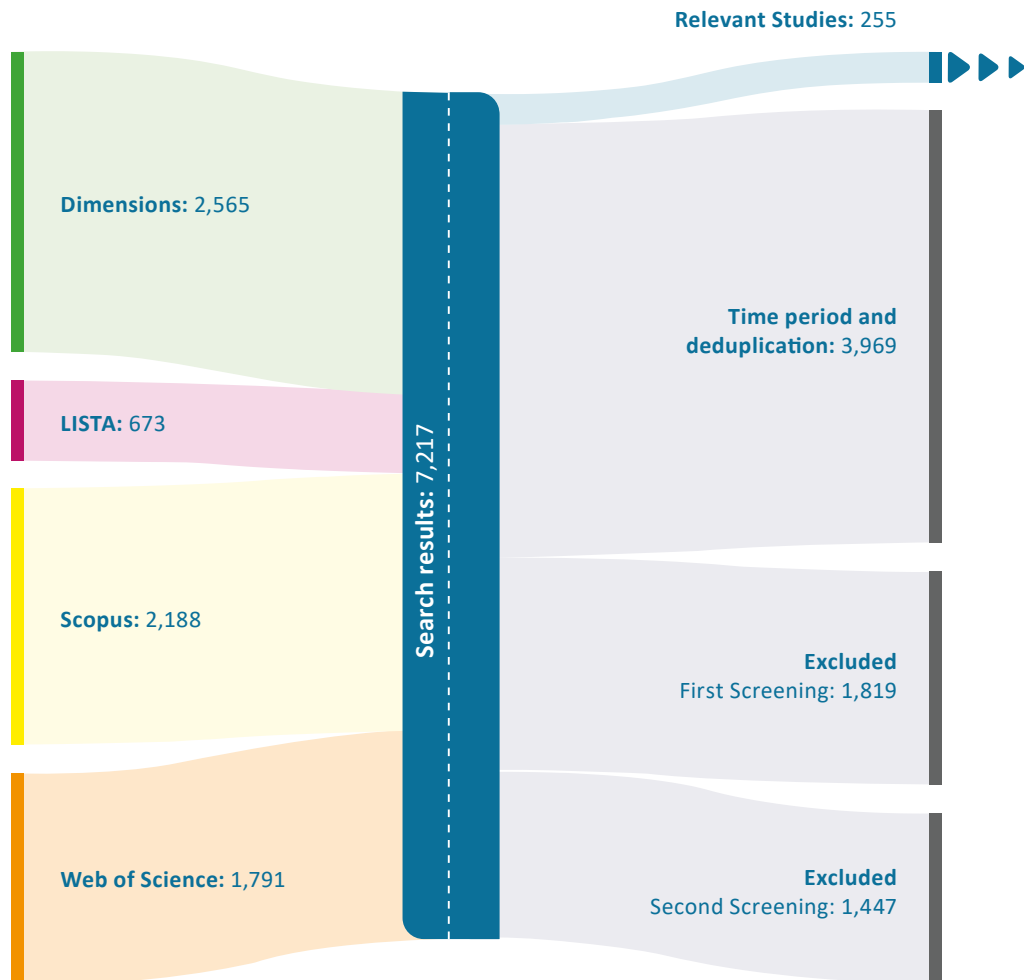


Figure 1:  
Literature research and determination of relevance

In this step, the remaining publications were clustered by content, and the topics covered were assigned to one of the seven impact areas.<sup>6</sup> These impact areas are a thematic grouping of the indicators for effects of open access found in the analysed literature. The grouping of indicators is based on a categorisation of effects of open access from Tennant et al. (2016), which was adapted for the study presented here.

In the third step, the corpus was systematically expanded. This involved adding entries from the Open Access Tracking Project (OATP)<sup>7</sup> that were not included in the open search queries. The results from OATP were also deduplicated and sorted by relevance in two stages. This addition via OATP expanded the corpus to 276 titles. Finally, 42 relevant titles provided by experts were added to the corpus, bringing the final corpus to a total of 318 titles.

<sup>6</sup> A tabular overview of the impact areas can be found in section 4.

<sup>7</sup> [https://cyber.harvard.edu/hoap/Open\\_Access\\_Tracking\\_Project](https://cyber.harvard.edu/hoap/Open_Access_Tracking_Project)

In the fourth step, the most relevant titles for each impact area<sup>8</sup> were selected.<sup>9</sup> In addition, the state of research on the effects was evaluated with regard to the empirical evidence; this was achieved through a qualitative expert judgement based on the consistency or inconsistency of the overall results on the corresponding effects and methodological aspects such as the control of confounding factors. The results of this evaluation are presented and discussed in the next section, sorted by impact area.



Figure 2:  
Systematic expansion

<sup>8</sup> The relevance was determined with regard to the aim of covering all analysed effects of open access the respective impact areas. The decisive factors were the research question and the methodological design of the studies. The 61 titles remaining at the end were systematically analysed.

<sup>9</sup> The articles were compared in terms of the method used, the variables investigated and the size of the sample.

## 4 Results & Discussion of the impact areas

The following subsections describe the results of the evaluation for each impact area and discuss possible interpretations of these results.

### **Definition of the impact areas and number of studies analysed by impact area**

1. **Attention from the academic world:** Change in the number of references to publications exclusively from the academic field (12 studies)
2. **Quality of scholarly publications:** Change in scientific evidence, methodology, and quality control (5 studies)
3. **Knowledge transfer:** Change in the number of references to publications exclusively from the non-academic sector (9 studies)
4. **Productivity of the publishing system:** Change in the volume of publications and the speed of the publication process (12 studies)
5. **Use of publications:** Change in downloads and page views (9 studies)
6. **Inequality in the science system:** Change in access to publications for authors and users (8 studies)
7. **Economic impact on the publishing system:** Change in costs for the science system and in book sales figures (9 studies)

## 4.1 Attention from the academic world

**Conclusion:** The empirical results on a citation advantage & Mendeley-readership<sup>10</sup> are inconclusive.

Studies assigned to this impact area discuss the question whether a connection can be established between the open access status of a publication and the number of references to these publications from the academic context.

The most frequently investigated effect of open access is a possible open access citation advantage (OACA): Does open access increase citations for scholarly publications compared to traditional forms of publication? (cf. Swan 2010, p. 1; Langham-Putrow, Bakker, and Riegelman 2021 p. 1). In addition to traditional citation references, alternative metrics—so-called *Altmetrics*—are discussed.<sup>11</sup> Alternative metrics count references in sources other than scholarly publications. A subcategory of alternative metrics is the number of readers counted by the reference management service *Mendeley*. The impact area “Attention from the academic world” also includes studies that report results on the latter indicator.

### 4.1.1 Results

With over two hundred titles in the literature search, the citation advantage is by far the most covered effect of open access. In order to reduce the number of publications to be analysed in detail to a manageable number, it was possible to draw on a recently published meta-study (Langham-Putrow, Bakker, and Riegelman 2021).<sup>12</sup> The authors compared 134 studies on the citation advantage and concluded the following:

*“64 studies (47.8%) confirmed the existence of OACA, while 37 (27.6%) found that it did not exist, 32 (23.9%) found OACA only in subsets of their sample, and 1 study (0.8%) was inconclusive.”(ibid. p. 1)*

For the present study, these results were supplemented by a thorough analysis of additional studies. Firstly, studies were considered that were too new to have been included in Langham-Putrow, Bakker und Riegelman (2021). From these, four out of five studies confirmed a positive correlation between open access status and the number of citations (Bautista-Puig et al. 2020; Clayson, Baldwin, and Larson 2021; Kolpekwar and Shidham 2021; Momeni et al. 2021); only one study did not reach a clear conclusion (Basson, Blanckenberg, and Prozesky 2021).

10 Mendeley (<https://www.mendeley.com>) is a literature management service aimed primarily at researchers.

11 Cf. Williams (2017).

12 There are a number of previous literature reviews such as Swan (2010), Davis and Walters (2011), Tennant et al. (2016), and Lewis (2018). However, these articles deal with a much smaller number of studies, are significantly older, and do not come to clear conclusions about the citation advantage either.

Secondly, publications were analysed that investigate differences between gold and green open access in terms of citation advantage. There was no clear result here: studies for both forms of open access confirm a citation advantage—for example for green open access in Calver and Bradley (2010), Demetres, Delgado, and Wright (2020), and Eger, Mertens, and Scheufen (2021) and for gold open access in Cintra, Furnival, and Milanez (2018). At the same time, there are also studies with negative or at least unclear results for both forms of open access: Cintra, Furnival, and Milanez (2018) for green open access and Eger, Mertens, and Scheufen (2021) for gold open access in the discipline of economics. In a direct comparison, Cintra, Furnival, and Milanez (2018) see an advantage for gold open access; Clayson, Baldwin, and Larson (2021) find no differences at all in the citation advantage between green open access and other forms of open access.

Studies on the connection between open access and readership on *Mendeley* do not come to unambiguous results, either: All three studies (Cintra, Furnival, and Milanez 2018; Holmberg et al. 2020; Taylor 2020) find an advantage for open access only in some subsets of their samples;<sup>13</sup> however, a negative correlation was not detected.

#### 4.1.2 Discussion

The majority of studies confirm a citation advantage for open access publications. Nonetheless, there is also a considerable number of studies that were unable to identify a citation advantage. In addition, many studies report an open access citation advantage for only a subset of their sample.<sup>14</sup> How should these disparate findings in the state of research be interpreted?

The difference in results indicates that it is methodologically challenging to empirically investigate the OACA. This methodological challenge is also discussed in the literature: the meta-study by Langham-Putrow, Bakker, and Riegelman (2021) also includes a *risk of bias analysis*<sup>15</sup> for the included publications.

Overall, 131 of 134 publications on the OACA were assessed as having a high risk of bias, and the remaining three studies come to contradictory conclusions (cf. *ibid.* p.7). The additional literature analysed in this study does not affect the overall picture.

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13 Depending on the study, a distinction was made according to open access form (Cintra, Furnival, and Milanez (2018)), discipline (Holmberg et al. 2020) and publication form—in particular individual chapters versus the book as a whole (Taylor 2020).

14 This summarises the results of the aforementioned meta-study (cf. Langham-Putrow, Bakker, and Riegelman 2021, p.6). In the meta-study, no significant correlations were found between certain subsets of the sample—such as different academic disciplines—and the existence of an open access citation advantage (*ibid.* p. 6f). Still, it was found that studies that examined several disciplines significantly more often reported a citation advantage in at least one sub-area and less often found no citation advantage at all than studies covering only one subject area (cf. *ibid.*).

15 A risk of bias analysis is a systematic assessment of each publication with regard to the risk that the results of the study could be distorted by methodological problems. In this case, studies were categorised and assessed according to the criteria “(1) population, (2) data collection, (3) study design, and (4) results” (*ibid.*, p. 7).

The result that considerable differences were observed between different subsamples indicates that factors other than the open access status influence the results. Such confounding factors have long been discussed in the literature on OACA. Swan (2010) points out in a literature review that a citation advantage could be explained partially by an *Early Advantage*, *Selection Bias*, or *Quality Advantage* in addition to the actual advantage of free access (cf. *ibid.* p. 2–3). These factors were also taken into account in some of the studies on the OACA: Ottaviani (2016), for example, finds an open access citation advantage after controlling for various possible confounding factors (cf. p. 10). If it could be shown that biases only affect one of the two sides, it would explain the contradictions in the state of research. However, this would require a systematic comparison of all studies with regard to their handling of confounding factors. A comprehensive analysis on this topic is currently not available.

Considering the large differences in the results reported by the studies and the methodological limitations with regard to possible confounding factors, the robustness of the empirical results on the citation advantage is limited: an OACA cannot be empirically confirmed beyond doubt by the literature analysed in the present study; however, its existence is by no means refuted.

These methodological limitations also apply to studies on difference between forms of open access or the area of *Mendeley* readership: It is plausible that the same confounding factors have an influence here as in studies on the citation advantage, and the results so far are ambiguous.

However, it can be reasonably assumed that a citation advantage for open access publications does exist: It is very plausible that open access publications are used by more researchers than non-open access publications—a general usage advantage can be confirmed in the impact area “use of publications”. As described in more detail in subsection 6.1, an increased use should also lead to an increase in citations. However, there is no clear empirical evidence for this alleged effect of open access.

## 4.2 Quality of scholarly publications

**Conclusion:** There is no difference in quality between open access and non-open access publications.

This impact area contains studies that analyse the effects of open access on the quality of scholarly publishing. Quality of scholarly publications is a multifaceted concept that cannot be captured in its entirety by any single study. The studies analysed here examine the methodological quality of open access articles, quality in relation to the evidence provided, and quality control in connection with retracted articles.

### 4.2.1 Results

Pastorino et al. (2016) analyse cohort and meta-studies with regard to methodological quality and quality of reporting using existing rating scales. Sabharwal, Patel, and Johal (2014) and Tahim et al. (2016) assess the impact of open access on the quality of evidence. To this end, the authors draw on the evidence hierarchy from the field of *Evidence Based Medicine*, which considers certain study designs such as *Randomised Controlled Trials* and *Systematic Reviews* to be of particularly high quality.<sup>16</sup> None of the three studies found a significant difference between the quality of open access and non-open access publications.

Two other studies investigate the effect of open access on retracted articles: Shah et al. (2021) find a greater number of retracted publications for open access articles; these are also retracted later and cited longer after retraction than non-open access articles. In contrast, Peterson (2013) finds no differences in the citations of retracted open access and non-open access articles.

### 4.2.2 Discussion

Some limitations should be mentioned with regard to the informative value of the studies in this impact area: Only very few studies could be assigned to the impact area “quality of scholarly publications” at all. Further studies that also investigate other aspects of the quality of publications could improve the information available on this effect.

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<sup>16</sup> Cf. Burns, Rohrich, and Chung (2011).

That having said, the findings of the available studies are unanimous: None of the three studies on the methodological quality of open access articles found a correlation between open access status and the quality of publications. All three studies thus refute concerns that open access could lead to a deterioration in the quality of scholarly works.<sup>17</sup> The interpretation of the results on retracted articles as a consequence of open access is more difficult: Firstly, the two studies contain contradictory information on the citation behaviour of retracted articles. Secondly, the result that open access articles are withdrawn more frequently than non-open access articles is open to interpretation: The results can be explained both by a higher proportion of inferior articles in open access and by better quality control as a result of increased visibility.

### 4.3 Knowledge transfer

**Conclusion:** Open access publications result in more knowledge transfer than non-open access publications.

Studies in this impact area investigate the question whether open access has an effect on the dissemination of scholarly content in the non-academic sector. These studies measure an effect by comparing open access and non-open access publications with regard to the number of non-academic documents that refer to either set of publications. These indicators are also discussed under the term *Altmetrics*. Only studies that provide more detailed information on the sources of the references were considered here: Some studies exclusively report a so-called *Altmetrics score* (based on data from *Altmetrics.com*). This score includes both indicators for attention from academia—such as the aforementioned *Mendeley* readership—as well as non-academic references, for example from legal or journalistic sources. Therefore, an unqualified *Altmetrics score* cannot be interpreted as an indicator of knowledge transfer. The interpretation of mentions on Twitter also remains ambiguous, as this service is highly relevant in non-academic contexts, but is also used widely by academics as a professional network. All in all, it should be kept in mind that the number of references to a scholarly publication is only an indirect indicator of the impact of scholarly publications on society: If a publication is mentioned in a non-academic context, it does not mean that the content has been adequately received; conversely, there is no certainty that a publication with a far-reaching impact will also be cited in a relevant document.

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17 This fear is expressed by researchers, for example, in a meta-study on literature on the perception of open access (cf. Togia and Korobili 2014, p. 18).



### 4.3.1 Results

The majority of studies found a positive correlation between open access status and non-academic references: This applies to journalism (Dehdarirad and Karlsson 2021; Schultz 2021), patents (Bryan and Ozcan 2020), Wikipedia (Teplitskiy, Lu, and Duede 2017) as well as judicial documents (Donovan, Watson, and Osborne 2014).<sup>18</sup> For references from Twitter, no correlation (Snijder 2016) or even a negative correlation (Fabiano et al. 2020) was found.

### 4.3.2 Discussion

Open access publications are mentioned significantly more often than non-open access publications in various areas of society. This clearly indicates that open access contributes to the knowledge transfer of scholarly content to society.

Although the results for references from Twitter are ambiguous, this is also the area where it is least clear whether it can be considered a genuinely non-academic area: As described above, many researchers use this service to communicate with each other, therefore references from Twitter could also be considered in the impact area “attention from the academic world”.

## 4.4 Productivity of the publishing system

**Conclusion:** [1] The empirical results on the volume of publications are ambiguous. [2] Open access publications are published faster than non-open access publications.

Studies in this impact area investigate either whether open access leads to an increase in the number of publications, or they analyse whether open access has an effect on the time span between submission and publication of an article. Compared to other impact areas, it is not clear how the effects of open access in this area should be assessed: Whether an increase or decrease in publication volume appears desirable at all is debatable. A quicker publication process, however, is generally to be welcomed.

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<sup>18</sup> Donovan and Watson (2011) originally found no significant correlation between open access status and citations in such documents; however, the replication study with a larger sample (Donovan, Watson, and Osborne 2014) did find a positive correlation.

#### 4.4.1 Results

The results on the aspect of the publication volume are divided: AlRyalat et al. (2021), AlRyalat, Saleh, et al. (2019), and AlRyalat, Nassar, et al. (2019a, 2019b) find a lower publication volume in open access; in contrast, Ezema (2021), Momeni et al. (2021), and Wakeling et al. (2017) find a higher volume in connection with open access.

Statements on the effect of open access on the speed of the publication processes can be found in two articles: Björk (2021) reports a shorter time span between submission and acceptance of articles between *open access mega journals*<sup>19</sup> compared to other journals, but only in the discipline of engineering and not for biomedicine. In contrast, Lin (2021) confirms generally shorter time spans between submission and publication of articles in open access.

#### 4.4.2 Discussion

Altogether, the results for this impact area do not appear to be very reliable. The results on publication volume are contradictory; a negative correlation with open access was only found in a number of articles that were very similar in terms of methodology and the authors of the respective studies. While both studies on the publication speed report a positive effect of open access articles, one of the studies deals specifically with *mega journals* and can only prove the advantage for one discipline. While this indicates overall higher speed in connection with open access, further studies would be desirable to confirm this result.

### 4.5 Use of publications

**Conclusion:** Open access publications are used more than non-open access publications.

This impact area contains studies that deal with the effect of open access on the use of publications. In addition to the number of downloads, this is measured by website usage statistics. As these statistics do not differentiate whether users come from an academic context or not, the results in this impact area cannot be directly assigned to the impact areas “attention from the academic world” or “knowledge transfer”. However, some studies also make statements about the diversity of users; these are discussed in the impact area “inequality in the science system”.

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<sup>19</sup> These are open access journals with a relatively large coverage of topics that publish a large volume of articles compared to other journals.

### 4.5.1 Results

Eight out of nine studies report an open access advantage for download numbers (Alkhawtani, Kwee, and Kwee 2020; Davis 2010, subsection 4.7; Emery et al. 2017; Ozaygen et al. 2020; Wenaas 2021; Wirsching et al. 2020) and page views (Zhang et al. 2021). While most studies focus on the effect on articles in scholarly journals, two also confirm this effect for open access books (Emery et al. 2017; Ozaygen et al. 2020). Only one study (Mallett et al. 2021) does not come to a clear conclusion; however, this concerns a case study with a sample of only three journals.

### 4.5.2 Discussion

An open access advantage regarding the use seems to be clearly confirmed by the existing literature: The authors of almost all studies reach the same conclusion. The only inconclusive study applied an experimental design with low empirical power while the confirming studies include two that applied *randomised controlled trials*. (Davis 2010, subsection 4.7).

## 4.6 Inequality in the science system

**Conclusion:** [1] Article Processing Charges are an obstacle for some authors. This particularly affects authors from financially disadvantaged institutions, authors from the Global South, and authors outside the academic sector. [2] Open access publications have a more diverse audience than non-open access publications.

This impact area groups studies on the effect of open access on the participation of different groups of people in the academic system. It focuses on differences in access to research results as well as in active participation in the research process. Indicators of forms of inequality are the diversity of users and authors of scholarly publications. With regard to the latter, the existing studies particularly stress the impact of APCs for the ability of different groups of people to publish in open access.

### 4.6.1 Results

Two studies (Al Hamzy et al. 2019; Demeter and Istratii 2020) provide information on the relationship between the average cost of publishing in open access journals with APCs and purchase power parity in different countries. Al Hamzy et al. (2019) show large differences for different countries compared to the USA, from a ratio of 0.81 for Australia to more than double the relative costs for South Africa (2.24) or Turkey (2.28) (cf. p. 463). Demeter and Istratii (2020) calculate—also on the basis of APCs and purchase power parity—how many gold open access publications researchers in different countries could afford per year: there are major differences here as well, with the highest average by world region in Wealthier Asia (23.61 possible publications) and the lowest in Africa (1.94). Individual countries score significantly below these averages, such as the Central African Republic with 0.28 financially affordable publications per author per year (cf. p. 513–517).

Asare, Mitchell, and Rose (2021) and Smith et al. (2020) deal with authorship in open access. The latter study finds a negative correlation between open access status and the geographical diversity of authors, with particularly few authors coming from low-income countries. Asare, Mitchell, and Rose (2021) show that authors from Sub-Saharan Africa mainly publish in open access journals with a low impact factor or in non-open access journals with a high impact factor. In both studies, the results are attributed to access barriers caused by APCs.

Burchardt (2014) refers to APCs as a possible barrier for people without institutional affiliation. APCs could also prevent authors in wealthy countries from publishing in open access.

Shafi and Bhat (2011) analyse differences in the cited publications from different countries. The authors find significantly lower citations for articles in open access journals from so-called developing countries. Estakhr, Sotudeh, and Abbaspour (2021), on the other hand, found no significant differences in terms of a citation advantage for articles with authors from certain country blocks.

The last group of studies presents results on the diversity of users of open access publications: Zhang et al. (2021) find a greater geographical diffusion of page views for open access publications, which is also confirmed for open access books by Snijder (2013). In a study on open access in Norway, Wenaas (2021) finds that higher download figures for open access publications compared to non-open access publications can at least partially be attributed to an increased number of users outside the academic sector.

## 4.6.2 Discussion

The findings in this impact area can be divided into two effects: On the one hand, studies address the role of APCs as an access barrier for authors who, due to their background or lack of access to institutional resources, do not have the necessary financial means to publish in open access (at all or at least to the same extent) as other researchers. However, the effects of APCs on the diversity of authors—geographical diversity of authors and citation counts for specific country groups—have only been documented in one study in each case (Shafi and Bhat 2011; Smith et al. 2020). The results of Shafi and Bhat (2011) partially contradict the results of Estakhr, Sotudeh, and Abbaspour (2021). Both results should therefore be considered as relatively weak empirical evidence. In addition, it has to be noted that the barriers for authors identified in these studies do not stem from open access as a publishing model as such, but from high publication costs in certain open access business models.<sup>20</sup> Fee waivers by publishers, which were intended to facilitate access to open access publishing for all authors, have apparently not been successful:

*“Regardless of the mechanism, our results suggest that waiver programs designed to increase the representation of scientists from the Global South in the OA literature by reducing APCs have at best failed to do so, and at worst had the opposite effect.” (Smith et al. 2020, p. 16)*

Therefore, when discussing this problem—even if a significant open access disadvantage in the area of author inequality can be empirically confirmed in the future—the exact form and implementation of open access, that is, its underlying business and financing models must be taken into account, not only the difference between open access and non-open access publications.

Concerning the aspect of use, this impact area contains a relatively well-documented statement about the positive effect of open access on user diversity: At least three studies provide evidence on this point and no study presents contradictory findings.

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<sup>20</sup> There are various business models that do not require payment by authors (or their institutions). These include, among others, consortial open access financing solutions and approaches under the “Subscribe to Open” label, in which a greater number of academic institutions (with no necessary link to authorship) provide the financial requirements of the periodicals.

## 4.7 Economic impact on the publishing system

**Conclusion:** [1] The results of model-based studies on the costs of open access cannot be generalised. [2] In the case of books, the availability of open access editions published in parallel to the printed edition has no effect on the sales figures.

This impact area includes studies that investigate economic aspects of open access publishing. Titles of two main areas were selected in this report: Firstly, model-based studies that compare different forms of publishing in terms of their respective costs for the academic system. Secondly, studies that analyse changes in the sales figures of printed books that have a parallel open access edition.

### 4.7.1 Results

In the area of systemic costs, there are only model-based publications in the corpus of this study, but these are based on empirical data. These studies are very heterogeneous, both in terms of the scenarios considered, the modelling assumptions taken into account, and the discussion of the results. This makes it impossible to summarise results in this field concisely. Therefore, only some general observations on the costs of open access are reported here: In all studies and under almost all model assumptions, there is at least one open access publishing scenario that is assessed as more favourable than the current mix or a publishing system entirely without open access. This applies both to the aspect of costs for the academic system as a whole (Cambridge Economic Policy Associates Ltd 2017; Houghton 2010; Ilva, Laitinen, and Saarti 2016), the mere publication costs (Houghton 2011), expenditures occurring at university level (Swan and Houghton 2012) as well as administrative costs in the publication processes (Johnson, Pinfield, and Fosci 2016). Exceptions are only reported for specific scenarios: For example, Swan and Houghton (2012) calculate higher costs for both green and gold open access for universities, if the increase of open access output occurs exclusively at the level of a single university while there is no global increase of open access publishing. Different forms of open access publishing are also compared with each other, but there are no consistent results that identify one particular form of open access as clearly more favourable than others.

The studies on possible changes in the sales figures of open access book publications (Collins and Milloy 2016; Ferwerda et al. 2018; McGreal and Chen 2011; Snijder 2010) all draw the same conclusion: There is no significant difference in the sales figures of the print edition of books with an open access version published in parallel compared to books published with access restrictions.

## 4.7.2 Discussion

The data on the systemic costs of open access publishing compared to forms of publishing with access restrictions are consistent in that there is an advantage for certain forms of open access in most scenarios. However, this depends on a number of assumptions, particularly with regard to global changes in the scholarly publishing system. Other factors, such as the actual costs of Article Processing Charges (APCs) charged by publishers, need to be considered, too. In addition, the robustness of the model calculations is further weakened by the now comparatively old data. The possibility to generalise the results must also be questioned, as the studies analysed are each set in a specific national context: The studies relate to the publishing system in the UK (Houghton 2010; Johnson, Pinfield, and Fosci 2016; Swan and Houghton 2012), in Switzerland (Cambridge Economic Policy Associates Ltd. 2017) and Finland (Ilva, Laitinen, and Saarti 2016). The latter study explicitly mentions the influence of national differences on the costs of various models of publishing (cf. *ibid.* p. 23). In Germany in particular, the DEAL agreements since 2019 have created a situation that differs from the modelled scenarios and would require separate studies.

In contrast, the result on sales figures of print books with a parallel open access version appears to be relatively well documented: Despite concerns to the contrary, access to the electronic full text of books does not significantly reduce the income from book sales of the print edition.<sup>21</sup> All four studies on this topic agree on this point. In addition, three of the studies use randomisation (Collins and Milloy 2016; Ferwerda et al. 2018; Snijder 2010), which strengthens the validity of the literature on this effect.

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21 In a survey of authors on their expectations regarding the sales figures for books in open access, more than a third of respondents stated that they expected a decline (cf. Ferwerda et al. 2018, p. 53).

## 4.8 Summary of the Results

The empirical results of the subsections are visualised in Figure 3.

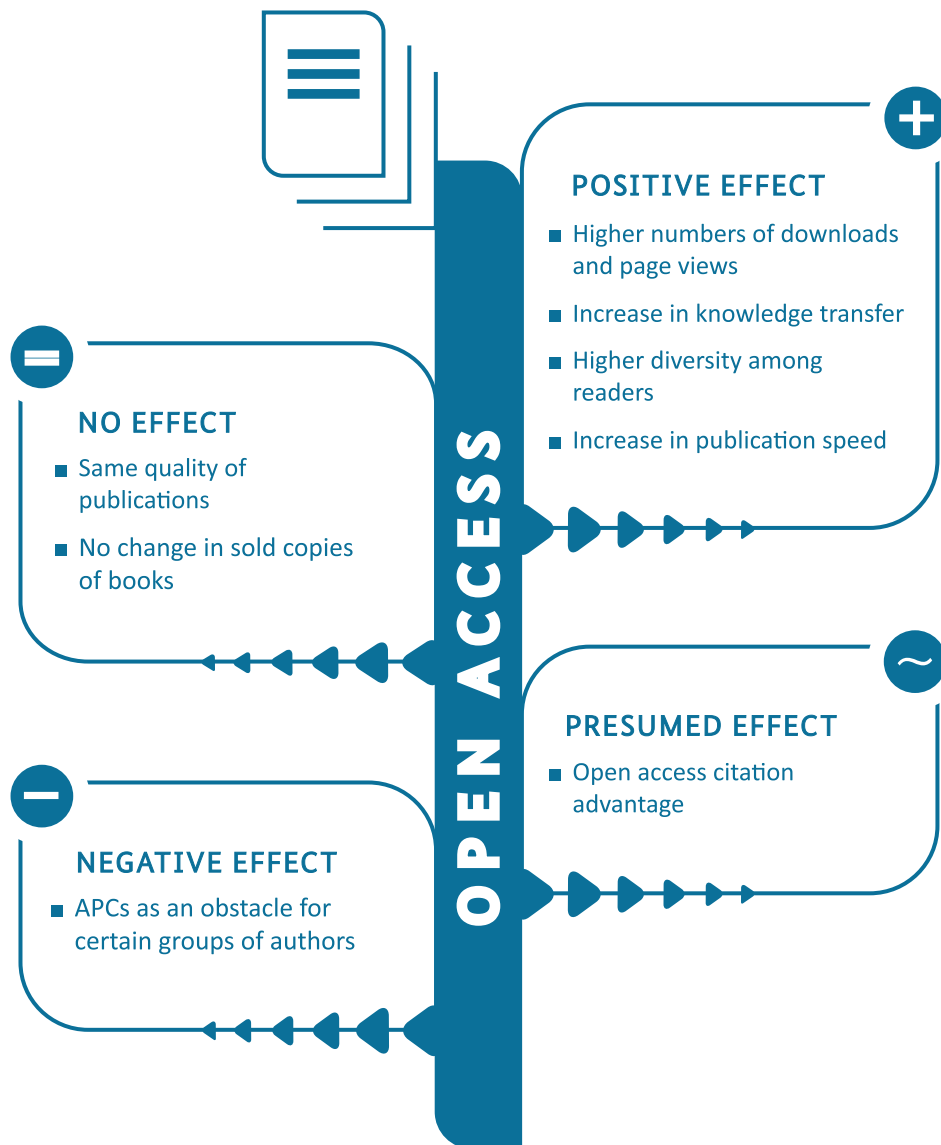


Figure 3:  
Effects of open access studied  
in the empirical literature



## 5. Research Gaps

- **Analysed effects with only a few studies:** Effects of open access on study quality; diversity of authors; economic effects
- **Unexplored effects:** Effects of open access on academic careers; gender-specific differences; authors at financially disadvantaged research institutions
- **Connections between impact areas and/or effects**

While some effects of open access have been analysed in a considerable number of studies, other effects have only been investigated in few empirical studies (see the section “discussion” of the individual impact areas). This applies to the entire impact area “quality of scholarly publications”, studies on publication speed and effects on the diversity of authorship. In the impact area “economic impact on the publishing system” it became apparent that empirical studies on the economic effects of open access are partially outdated and that no transferable study results were available for some country contexts, including Germany.

Other issues that appear to be empirically unexplored concern questions that would also be very relevant. One such topic is the possible effect of open access on the career opportunities of academics. While this plays an important role in the evaluation of open access, only one study could be found in the entire corpus, which is of little empirical value (Ramírez et al. 2014).<sup>22</sup>

There are hardly any empirical studies on potentially different effects of open access on researchers of different genders either. The literature research did find a few studies on this topic<sup>23</sup> that report very specific results—on gender-specific effects of open access exclusively in Vietnam or exclusively in the discipline of political science. These three studies were not analysed in detail in the systematic comparison of this literature study.

Finally, only few studies differentiate the effects of open access more strongly by the institutional background of the authors.<sup>24</sup> Further research that considers possible differences in this respect would be helpful.

In addition to these research gaps on individual effects, no studies on the relationship between different impact areas could be identified in the corpus. Only two studies in the systematic comparison report results on interacting effects,

22 The study analysed the extent to which publishers offer the opportunity of republishing theses published in open access afterwards in a scholarly journal. This is only indirectly related to career opportunities.

23 Cf. Atchison (2017), M.-H. Nguyen et al. (2021), H. T. T. Nguyen et al. (2021), and Vuong et al. (2021).

24 For example, it can be assumed that certain benefits of open access are less pronounced for members of financially strong research institutions than for researchers at institutions with fewer resources. The same applies to the opportunities of authors to use fee-based open access offerings.

but these are not very meaningful when considered in isolation: Emery et al. (2017) could not prove a correlation between downloads and citations; Snijder (2016) reports a moderate correlation between citations and references on Twitter. Comprehensive studies would be needed to empirically substantiate a more complex causal impact model of open access—as presented in 6.1.

## 6. Conclusion

### 6.1 Connections between impact areas

This section explains plausible dependencies between the impact areas discussed in section 4. The network of these relations forms a *theoretical* impact model: While empirical results could provide evidence for a relation between open access and the individual impact areas, the relations *between* the impact areas are for the most part not supported by empirical studies. Figure 4 shows a theoretical model including the empirically confirmed effects of open access.

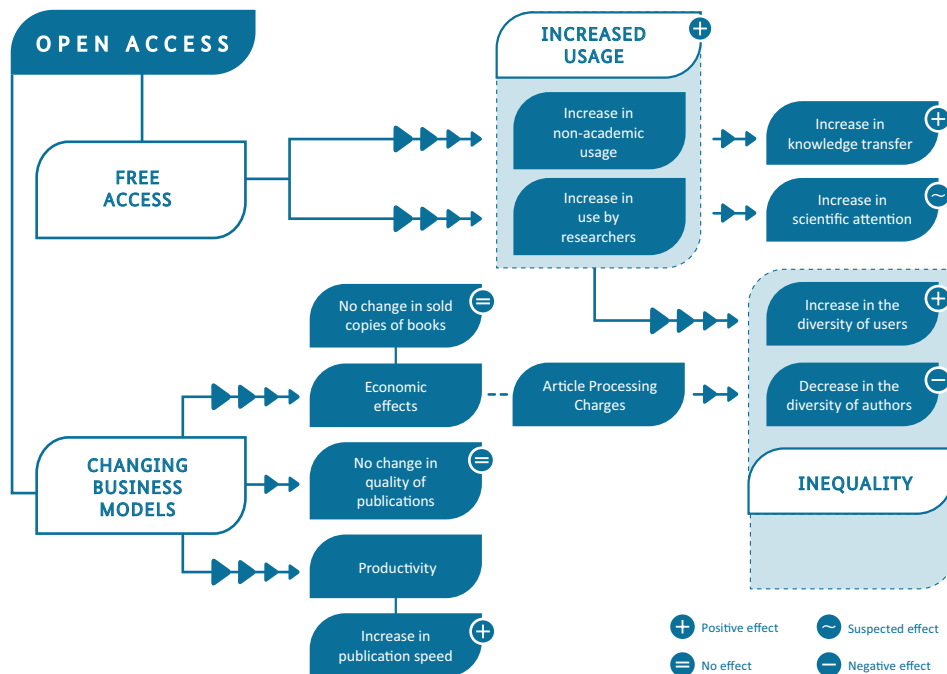


Figure 4: Theoretical impact model of possible interrelations of empirically confirmed open access effects. Empirically confirmed effects are marked by symbols indicating the type of effect.

### **Explanation of the impact model:**

Two changes in the scholarly publishing system are directly linked to a transition to open access: Firstly, open access essentially means free access to publications (top left) that would be restricted in the traditional model. Secondly, this free access requires a change in business models (bottom left), as publishers finance themselves through access costs in the traditional model.

How do these key characteristics of open access relate to the effects and impact areas analysed in this study? The following assumptions seem plausible: Firstly, open access means that scholarly publications become available to people who were previously excluded by access restrictions. This leads to an increased **use of publications** (→ subsection 4.5). This increased use, in turn, affects other impact areas: If open access enables not only more people but also people from a broader range of backgrounds to use scholarly publications, this leads to greater diversity among users and hence reduces **inequality in the science system** (→ subsection 4.6). If publications become available to a larger non-academic audience through open access, the increased use outside the academic sector will also lead to increased **knowledge transfer** (→ subsection 4.3). If publications become available to a larger number of researchers through open access, publications receive greater **attention from the academic world** (→ subsection 4.1) and are therefore cited more often. While the latter seems theoretically plausible, no definite empirical evidence for an OACA could be drawn in this literature study. Does this contradict the theoretical impact model? To begin with, the state of research described in subsection 4.1 does not imply that there is no OACA; it is merely the case that the results of the studies are ambiguous in this respect. It is still possible that a systematic analysis of possible biases will lead to clear evidence for the existence of an OACA. Besides, there are plausible explanations for the observation that the use of open access publications outside of academia increases strongly while this increase is relatively small for certain groups of researchers:

*“As most scientific researchers are concentrated within a relatively small number of elite research universities with excellent access to the scientific literature, a process known as social stratification (22, 23), it is not surprising that providing free access has little (if any) effect on article citations. The fact that we observe an increase in readership and visitors for open access articles but no citation advantage suggests that the increase in readership is taking place outside the core author community.”*  
(Davis 2010, p. 2133)

However, as explained in subsection 4.6, there are researchers who face access barriers to access scholarly publications in the traditional publication model. This applies, for example, to researchers outside of higher education institutions (Burchardt 2014, cf.) as well as to researchers in many regions of the world:

*“The cost of access to non-open access articles was significantly prohibitive for the low-and middle income countries included in our sample.”  
(Al Hamzy et al. 2019, p. 463)*

Increased use of and attention for open access publications can therefore be expected for these groups of researchers, although this may be more difficult to determine than in the area of non-academic use and knowledge transfer.

The second characteristic of open access considered here is the emergence of new open access business models. These models are very diverse, evidenced by the rough division of the open access field into different colour types—green, gold, diamond. The business models entail a whole range of possible changes, for example in the area of peer review. It is therefore possible that a change in open access business and publishing models influences the **quality of scholarly publications** (→ subsection 4.2). However, no such effect was found in the present study. The same applies to the impact area **productivity of the publishing system** (→ subsection 4.4): If open access has an effect in this field, it must be due to changes in business models and publishing processes. It is conceivable, for example, that new types of journals such as so-called mega journals have an impact on productivity. Such an effect of open access could not be clearly identified with respect to publication volume. However, a positive effect of open access on publication speed has been reported.

Probably the most obvious change with respect to business models lies in the impact area **economic impact on the publication system** (→ subsection 4.7). A general conclusion on the overall effect of open access on the cost-benefit assessment of the scholarly publishing system could not be drawn in this study. The only clear empirical evidence shows that there are no differences between the sales figures of traditionally published books and those of print books published in parallel with open access editions. However, even without empirical evidence, it is obvious that open access can reduce costs for access to publications (e.g. by reducing distribution costs) and that new costs are incurred elsewhere (e.g. for hosting). Certain open access business models rely on APCs, i.e. fees charged by publishers to authors for an open access publication. These APCs are a barrier particularly for researchers outside of higher

education institutions or in certain regions of the world. As can be seen in the impact model, open access thus has two conflicting effects on equality: Free access to scholarly publications increases the diversity of users—inside and outside academia. On the other hand, open access business models based on APCs lead to a decrease in the diversity among authors, thereby reinforcing **inequality in the science system** (→ subsection 4.6).

## 6.2 Recommendations

Based on the results of this study, we propose the following measures, which are summarised in Table 1.

Recommendation	Targeted at
<b>R1 Expand open access further</b>	<b>academic community; libraries; publishers; political institutions</b>
<b>R2 Close research gaps:</b> a) Academic careers b) Open access & gender c) Financially disadvantaged research performing organisations d) Relations between impact areas	<b>researchers; research funding organisations</b>
<b>R3 Conduct further research:</b> a) Open Access Citation Advantage b) Quality of scholarly publications c) Speed of publication d) Effects of APCs e) Economic effects	<b>researchers; research funding organisations</b>
<b>R4 Overcome inequalities:</b> a) Support alternative open access business models b) Improve APC waivers	<b>libraries; science policy ; research funding organisations; publishers</b>

### **6.2.1 Recommendation R1: Expand open access further**

The empirical results presented in this study clearly support measures for a transition to open access: only one avoidable negative side-effect was identified; all other effects of open access are favourable for science and society or at least not negative. It is therefore recommended that measures be taken to further increase the share of open access in the scholarly publishing system.

Such measures require cooperation between libraries and publishers in providing additional open access options, as well as incentives and recommendations from political institutions, for example in the form of funding for open infrastructure. Participation in supporting open access infrastructures should be recognised as an important contribution by researchers in research assessment. Furthermore, individual researchers and academic institutions are called upon to continue their commitment to open access; libraries can support these efforts by providing information and advice and by operating publishing infrastructures.

### **6.2.2 Recommendation R2: Close research gaps**

In section 5, topics were identified for which no or almost no relevant literature could be found:

- a) Research on the effects of open access on academic careers may help to alleviate researchers' concerns about open access and thereby increase the proportion of open access publications.
- b) Research on gender-specific effects of open access could show whether open access reduces (or promotes) gender differences in publishing behaviour.
- c) Research on the effects of open access on members of financially disadvantaged institutions would allow for greater differentiation, for example with regard to reception opportunities (access and subsequent events such as citations) or possible barriers to participation (e.g. due to APCs).
- d) Research on relations between open access effects validates theoretical models and thus contributes to the understanding of the underlying effects of these mechanisms. This supports the reliability of the current state of research and provides empirical grounds for open access measures.

In order to close these research gaps, researchers need to address these topics; research funding organisations can contribute to this with funding programmes that are tailored to answer the above-mentioned research questions.

### **6.2.3 Recommendation R3: Conduct further research**

In the results on the fields of impact in section 4, a need for further research was identified, in particular on

- a) Open access citation advantage
- b) Effects of open access on the quality of scholarly publications
- c) Effects of open access on the speed of the publication process
- d) Effects of APCs on the diversity of authors
- e) Economic effects of open access

There is a large body of literature on the open access citation advantage; still, further studies are needed that systematically consider the influence of confounding factors and resolve the existing ambiguity in the state of research. Concerning the impact area of economic effects, studies are particularly needed that are based on current data and that are transferable to the German science system, or that focus specifically on the German system. There are relatively few studies on the other mentioned effects; further research would substantiate the existing empirical findings. Overall, further research in all of these areas would increase the reliability of the state of research and thereby supports decision making on open access measures with empirically based information.

Further research in these areas requires continued attention from researchers; funders can contribute to this second recommendation with suitable funding programmes.

### **6.2.4 Recommendation R4: Overcome Inequalities**

In subsection 4.6, it was reported that the empirical literature confirms a negative effect of APCs in the context of open access on the participation of certain groups of authors in the scholarly publishing system. Two types of measures are recommended to counter this undesirable side effect of open access on inequality:

- a) Only specific open access business models rely on APCs and cause the resulting negative side effects. The proportion of APC-free alternatives, so-called *diamond open access*, should therefore be increased. This recommendation primarily addresses libraries, funding organisations, and science policy makers. These are able to negotiate contracts and provide funds to sustainably finance APC-free open access options; they are also able to pass policies in such a way that they are not exclusively tailored to APC-based open access publishing.
- b) In order to support authors and institutions that cannot afford paying APCs, exceptions should be provided that (at least partially) waive APCs for this group of authors (“fee waivers”). This recommendation primarily addresses publishers, who should adapt their business models accordingly and create transparency in this regard. As the literature on the impact area “inequality in the science system” emphasises, the effectiveness of such measures must be reviewed and ensured.

### 6.3 Limitations

It must be acknowledged that the results of this study are subject to some limitations: Firstly, this study is a *scoping review*, which is mainly reflected by the fact that only a selection of the available literature could be analysed in detail.

Secondly, with additional effort and additional researchers, the *inter-rater reliability*—the agreement between evaluators—in this study, for example, in the sorting of the literature—could have been assessed or increased. A more detailed analysis of the methodological quality of each empirical study examined could have been carried out.

Overall, the results of this study must be considered preliminary findings that could be verified in detailed follow-up studies on each impact area.

### 6.4 Concluding remarks

This study analysed a selection of 61 studies in seven fields on the effects of open access. For only one aspect, it was possible to empirically support an undesirable side effect of open access, and this was not caused by open access per se, but by a specific implementation. All other aspects of open access—for example in the area of use or diversity of users—were assessed as positive, or no relation with the open access status could be established—as in the area of quality of research. Reservations about open access can therefore be considered to have been refuted. The empirical results summarised in this study should therefore be considered as a clear confirmation of the ambitions in the



academic sector to continue and expand the efforts for the transformation of the publishing system towards open access beyond the various current activities of German academic organisations.<sup>25</sup> Further meta-scientific monitoring of this process, especially with regard to aspects that have received little attention to date, remains desirable and promising.

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<sup>25</sup> See also Wissenschaftsrat (2022).

## Annex

### A Details on the literature research

#### A.1 Search queries

The following queries were used to search the specialist databases between 13 and 16 September 2021; the results were updated again on 23 December 2021:

##### **Dimensions:**<sup>26</sup>

("free text in title and abstract")

("open access" AND ( publish\* OR publication ) AND ( impact OR effect\* OR advantage\* )) NOT ("is an open access article" OR "This is an open access" OR "This article is published with open access" OR "OSA Open Access Publishing Agreement" OR "This article is an open access publication" OR "Open Access under" OR "Open Access tinder" OR "Open Access wider" OR "an open access article under the CC" OR "animal\*" OR "major clinical study")

→ 2,565 results

##### **Library, Information Science and Technology Abstracts:**<sup>27</sup>

(limited to "Scholarly (Peer Reviewed) Journals")

(TI ("open access" AND ( publish\* OR publication ) ) AND TI ( impact OR effect\* OR advantage\* )) OR ( AB ("open access" AND ( publish\* OR publication ) ) AND AB ( impact OR effect\* OR advantage\* )) NOT TI(protocol)

→ 673 results

##### **Scopus:**<sup>28</sup>

TITLE-ABS-KEY ( ("open access" AND ( publish\* OR publication ) AND ( impact OR effect\* OR advantage\* )) AND NOT ("is an open access article" OR "This article is published with open access" OR "OSA Open Access Publishing Agreement" OR "This article is an open access publication" OR "Open Access under" OR "Open Access tinder" OR "Open Access wider" OR "an open access article under the CC" OR "animal\*" OR "major clinical study" ) ) AND ( EXCLUDE ( DOCTYPE , "er" ) OR EXCLUDE ( DOCTYPE , "ed" ) OR EXCLUDE ( DOCTYPE , "no" ) OR EXCLUDE ( DOCTYPE , "le" ) )

→ 2,188 results

26 <https://www.dimensions.ai>

27 <https://www.ebsco.com/de-de/produkte/datenbanken/library-information-science-and-technology-abstracts>

28 <https://www.scopus.com>

### **Web of Science:**<sup>29</sup>

(TS=(( "open access" AND ( publish\* OR publication ) AND ( impact OR effect\* OR advantage\* )) NOT ("is an open access article" OR "This is an open access" OR "This article is published with open access" OR "OSA Open Access Publishing Agreement" OR "This article is an open access publication" OR "Open Access under" OR "Open Access tinder" OR "Open Access wider" OR "an open access article under the CC" OR "animal\*" OR "major clinical study")) NOT (DT==(EDITORIAL MATERIAL OR "CORRECTION"))

→ 1,791 results

## **A.2 Error analysis**

The terms explicitly excluded in the search queries were checked in a separate search to see whether they led to false-negative results. A manual review of the excluded titles revealed no titles relevant to the present study. It must be recognised that due to the large number of titles, there is still a residual risk of false negatives.

## **A.3 Extension via Open Access Tracking Project (OATP)**

The OATP is a particularly extensive, collaborative collection of news, commentaries, and scholarly publications on the topic of open access. Contributors can assign keywords—so-called tags—to articles of OATP, which enables browsing the collection by topic. There were two focal points in the expansion of the corpus via the OATP: Firstly, a general search for further empirical literature via the tag "oa.case", which for the most part contains references to empirical studies.

Secondly, the corpus was expanded for each of the impact areas defined in the previous step using suitable tags. These tags were used: "oa.altmetrics", "oa.journalism", "oa.law", "oa.medicine", "oa.news", "oa.quality", "oa.south", "oa.speed", and "oa.usage".

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29 <https://www.webofscience.com/wos/woscc/advanced-search>

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