

1 Disclosing funding sources for open 2 access publication fees: the Open APC 3 initiative

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8 ABSTRACT

9 Publication fees in open access publishing hold a prominent place on the agenda of researchers, policy-
10 makers, and academic publishers. This paper contributes to the evolving empirical basis on open access
11 funding. It describes the Open APC initiative, in which German universities and research organizations
12 share their expenditures for publication fees. As method, the initiative uses existing open data tools to
13 aggregate and disseminate institutional spending on open access publication fees. In total, 29 German
14 research organizations self-reported funding of 6,279 open access journal articles, which amounted to
15 8,039,339 €. The average payment for each article was 1,280 €, and the median payment 1,209 €. Our
16 data-set comprises only 53 articles in hybrid journals. With an indexing coverage of 99 %, the findings
17 reveal that the DOI agency CrossRef provides both comprehensive bibliographic coverage of the funded
18 open access journal literature and disambiguated names of journal titles and publishing houses. We
19 show that authority control of these bibliographic information is particularly relevant for the comparative
20 study of the economical effects of open access publishing.

21 Keywords: Open access, open access journal, scholarly publishing, publication fees, article processing
22 charges, science policy

23 INTRODUCTION

24 Publication fees, often paid by funders or universities, are a widely discussed open access business model.
25 Yet, how and to what extent these activities are effective in terms of the number of supported research
26 articles and associated costs remains under debate. This paper describes the Open APC initiative¹, in
27 which German universities and research organization share spendings on open access publication fees,
28 and how it is currently implemented. More specifically, it addresses three problem areas when studying
29 the economical effects of open access publishing: fragmentation of open access funding, variable pricing
30 schemes and the comparison across research institutions. Such an approach extends methods and improves
31 data collection activities for researchers and practitioners, as well as contribute to a better understanding
32 of factors affecting the analysis of publication fees in open access publishing.

33 The rise of open access journals matches the increasing relevance of publication fees in academic
34 publishing (Davis and Walters, 2011; Laakso and Björk, 2012; Pinfield, 2015). To cover these fees,
35 authors tend to make use of funding that grant agencies or academic institutions provide (Suber, 2012).
36 However, collecting information about what was funded is in most cases difficult. One reason why
37 payments made for open access journal publications are often hard to track is that, on the one hand,
38 they are fragmented across the budgets of funding agencies, research institutions, and libraries, and, on
39 the other hand, taken from personal budgets. Furthermore, open access funding mostly exists in higher
40 income countries, mainly to support research articles in the bio- and physical sciences (Solomon and
41 Björk, 2011). Personal budgets stand in contrast with those support structures and are likely used to cover
42 low price publication fees (Björk, 2015; Solomon and Björk, 2011). Along with the fragmentation of
43 payments, funding for open access publications lacks transparency because the parties involved - authors,

¹<https://github.com/openapc/openapc-de>

universities, funders, publishers - neither release information on who pays for what nor the costs of publishing (Björk and Solomon, 2014), a situation similar to the lack of transparency regarding journal subscriptions (Lawson and Meghreblian, 2015). It also remains unclear which factors contribute to price formation.² While fixed prices for individual articles are common, agreements between publishers and institutions often provide discounts and publishers sometimes waive publication fees for authors from low-income countries (Björk and Solomon, 2012; Lawson, 2015b). Other factors leading to a complex landscape of variable pricing schemes (Pinfield et al., 2015) include submission or page charges (Björk and Solomon, 2012). Hybrid journals substantially add to this complexity, because comprehensive offset systems to avoid paying for the same article twice, through subscription and publication fee, are rare, which, in turn, leads to the phenomena of “double dipping” in scholarly publishing (Pinfield et al., 2015).

This complex situation of fee-based open access publishing creates difficulties for researchers and practitioners alike. Because of fragmented payments, the extent of funding remains unclear. To increase transparency, some research funders have begun collecting and disclosing expenditures for open access journal articles as open data. As per definition, open data is data that “can be freely used, modified, and shared by anyone for any purpose” (Dietrich et al., 2016). Therefore, opening up information about the funding of open access journal articles promises to enhance the discussion about current and future business models in academic publishing. To our knowledge, the first research funders providing such data were the Wellcome Trust (Kiley, 2014) and the Austrian Science Fund FWF (Reckling and Kenzian, 2014), who both released data on publication fees they had funded. The British not-for-profit company Jisc followed by collecting data from higher-education institutions in the UK (Lawson, 2015a). Disclosed as publicly available spreadsheets, these data-sets self-report expenditures along with bibliographic information, including title, journal and publisher, persistent identifier to the publisher’s version, and a link to a deposit in a subject repository. Curatorial efforts focused on the disambiguation of publisher and journal titles as well as on detecting duplicates. In the case of the Wellcome Trust, crowd-sourcing data cleaning activities through a Google spreadsheet in combination with checks against bibliographic sources massively improved the spending data (see comments in Kiley (2014)).

The open access landscape in Germany, which is the focus of this paper, shares the general problems of in-transparency regarding funding schemes and costs as discussed above. The Deutsche Forschungsgemeinschaft (DFG), the largest research funder in Germany, has been encouraging open access publishing since years. It launched its “Open-Access Publishing” program in 2009 that has strongly influenced the support of open access publication fees through funds managed by university libraries.³ With this program, the DFG aims to help universities to establish support structures for publishing in open access journals where authors are requested to pay a publication fee. To reduce administrative burdens, grantees agree not only to reimburse the bills on behalf of the researchers they support, but also to look for ways to improve the handling of those financial transactions. Examples include central invoicing schemes and related agreements between university libraries and publishers. Grantees are also required to report the institutional publication output and their fees paid for open access journal articles to the DFG on a regular basis, and to present the university-wide strategy to sustain the funds when DFG’s initial support runs out lately in 2019. The DFG enforces a set of criteria grantees have to comply with, leading to similar implementations for supporting open access publishing across German universities: these criteria exclude sponsoring of articles in hybrid journals, and the funding of articles whose publication fee exceeds 2,000 € (excluding VAT) (Fournier and Weihberg, 2013). Research institutes organized in the Fraunhofer-Gesellschaft, Helmholtz-Gemeinschaft, Leibniz-Gemeinschaft, and Max-Planck-Gesellschaft are not eligible for this funding program, contributing to the diversity of schemes in Germany. In response, some organizations have adopted similar processes to support authors. The Max-Planck-Gesellschaft operates their long-lasting open access activities, including handling spending and publisher agreements centrally, through the Max Planck Digital Library (Schimmer et al., 2013; Sikora and Geschuhn, 2015), while the Leibniz-Gemeinschaft set up a dedicated open access fund in 2016.

The growing share of articles published in fee-based open access journals in recent years has led to calls for an unified approach towards funding of publication fees. The Allianz der Wissenschaftsorganisationen⁴, representing all major research organizations in Germany, thus marks transparency as a major means to

²These might include article processing, impact, rejection rates, management and investment, and profit margins. See Noorden (2013) for a general discussion and Gumpenberger et al. (2012) and Björk and Solomon (2015) for discussions of journal impact and quality.

³Guidelines for the funding program can be found here: http://www.dfg.de/formulare/12_20/

⁴http://www.dfg.de/en/dfg_profile/alliance/index.html

sustain an “adequate open access publication system” (Bruch et al., 2015). However, there are various ways to achieve this goal. The existing approaches in Austria and the United Kingdom have one institution in charge to collect and analyze the data. The history of the Open APC initiative is rather bottom-up: In May 2014, Bielefeld University Library began to share its expenditures for publication fees. The library put its approach to the working group “Electronic Publishing” of the Deutsche Initiative für Netzwerkinformation (DINI)⁵ as a basis for discussion, and invited others to participate. Reflecting the increasing demand for publicly available data, contributions from Universität Regensburg and Universität Hannover followed soon after. As of writing, 29 universities and research institutes voluntarily reported their data to the Open APC initiative to be included into a unified data-set of all expenditures.

The aim of this study was to examine how much German universities and research organisations spent on open access publication fees until 2015. Drawing on self-reported data that German institutions openly shared through the Open APC initiative, the analysis focused on the amount of institutional payments for publication fees, and compared these findings with those from related Austrian and British initiatives. We also asked how thoroughly self-reported articles were indexed in CrossRef, a DOI minting agency for scholarly literature, and analysed how institutional spending per articles was distributed over publishers and journal titles.

METHODS AND MATERIALS

We used cost data released by the Open APC initiative on May 13, 2016, to analyse expenditures on publication fees by German universities and research organisations. In addition to administrative data about the amount paid per article including value added tax, the reporting institution, and the year of invoicing, we used information about whether an article was published in a fully or hybrid open access journal as well as the recorded DOI.

Data collection in this study involved obtaining cost data from related open data initiatives. To compare self-reported spending on open access publishing by Germany universities and research organisations with that of other initiatives, we reviewed the openly available spreadsheets from the Wellcome Trust (Kiley, 2014), the Austrian Science Fund FWF (Reckling and Kenzian, 2014) and Jisc. For analysis, we obtained the amount of overall spending on publications fees, as well as on charges to publish in fully open access journal articles. In the case of FWF, we gathered the cost information from accompanying reports. We used the spreadsheet data to summarize Wellcome Trust’s and Jisc’s spending, and converted the prices from GBP to Euro in accordance with the average Euro foreign exchange reference rates provided by the European Central Bank.

Instead of re-using publisher and journal information contained in the Open APC data-set, we fetched bibliographic metadata for each article from CrossRef on May 19, 2016, on the basis of the reported DOI’s. Although the Open APC initiative gathered metadata representing publishers and journals from CrossRef as well, this information was retrieved at the time when the participating institutions submitted the cost information. However, CrossRef regularly updates metadata to represent ongoing mergers of publishing houses or name changes. A prominent example in this regard was the merger of the two large publishing houses Springer Business + Media and Nature Publishing Group announced on May 6, 2015, that now operates as Springer Nature. To reflect these changes in academic publishing, we decided to retrieve updated metadata from CrossRef for the whole Open APC data-set.

As a client, we used the R package rcrossref (Chamberlain et al., 2016), developed and maintained by the rOpenSci initiative⁶, to access CrossRef’s REST API. We requested the XML-based format `application/vnd.crossref.unixsd+xml`, which distinguished full and abbreviated journal titles as well as the media types of ISSN’s, the International Standard Serial Number used to identify journals. It also contained disambiguated publisher information, thus avoiding confusion about naming of publisher houses other studies were faced with when working with self-reported data (Woodward and Henderson, 2014). In cases where no bibliographic information could be obtained, we used the Open APC values. Since CrossRef is not the only registration agency for DOI’s, but also the agencies DataCite and Medra mint DOIs for scholarly work, we furthermore obtained the DOI agency for each article with the help of the rcrossref client.

⁵<http://dini.de/english/ag0/e-pub0/>

⁶rOpenSci: <https://ropensci.org/>

RESULTS

Cost Data

On May 13, 2016,⁷ the Open APC initiative covered 7,417 articles whose publication fees were centrally paid by 30 German universities and research institutions until 2015. The number of supported open access journal articles grew over the years (see Figure 1). While one institution disclosed 5 payments made in 2005, the majority shared their expenditures from 2013 onwards. With 1,999 articles, the year 2015 was best represented in our data-set. However, 27 institutions contributed their cost data for 2015 at the time of this analysis, suggesting that there exists a time lag between payments made and reporting these spending to the Open APC initiative.

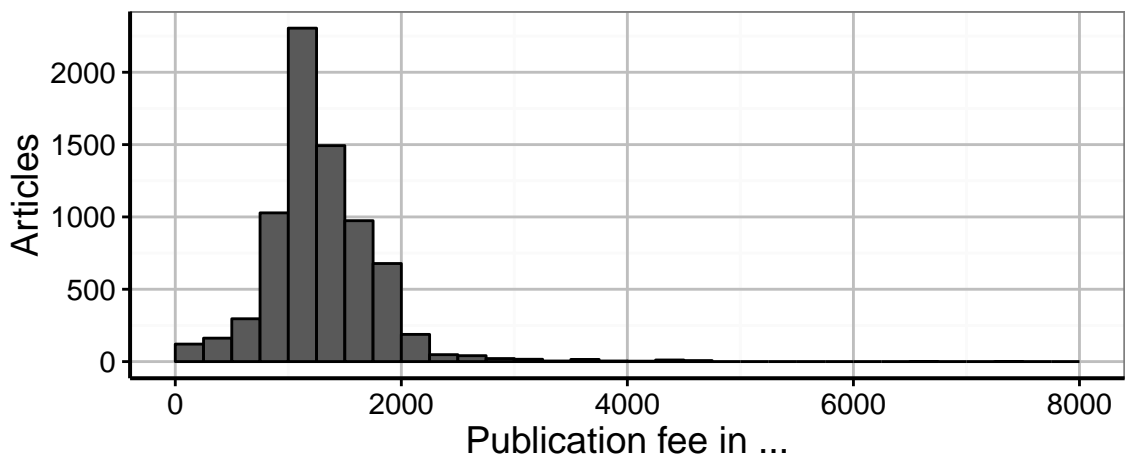


Figure 1. Histogram APC

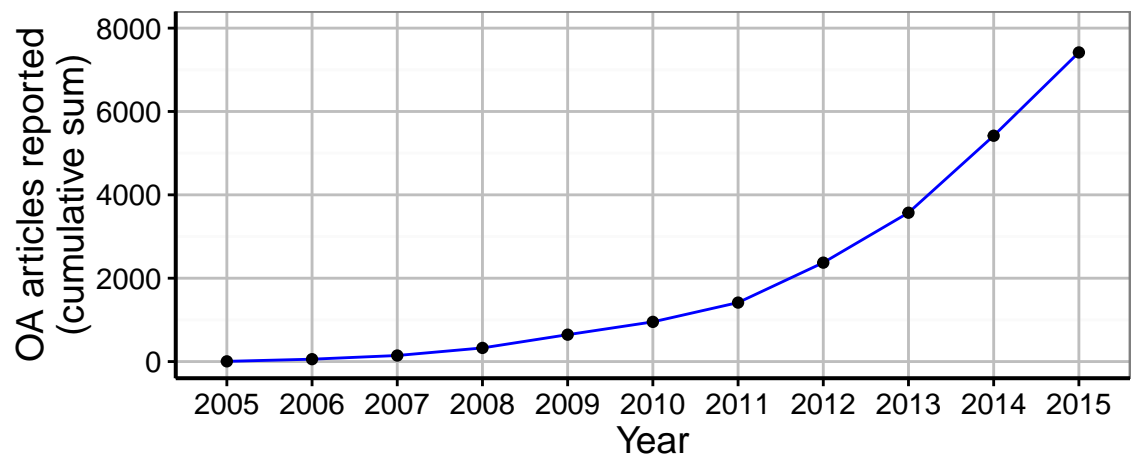


Figure 2. Growth of Open APC Initiative

Among all articles, fees amounted to 9,627,537 € including VAT, the average payment was 1,298 € and the median value 1,231 €. Figure 2 shows the large price variation among the articles. The disclosed publication fees ranged from 40 € to 7,419 €. However, the average price paid varied somewhat during the period 2011 and 2014 (1239 - 1289 €). We also observe that 6,996 (94%) of the publication fees were paid in accordance with the DFG price cap of 2,000 €. Whereas related open data initiatives in Austria and the United Kingdom reported a large share of spending for hybrid journal articles, the situation in Germany is different: only 60 articles in hybrid journals were reported by 3 out of 30 research institutions, accounting for 0.81 % of the overall payments.

⁷The data is openly available on GitHub. The following analysis is based on version 2.1.13 of the dataset, available at <https://github.com/OpenAPC/openapc-de/tree/v2.1.13>.

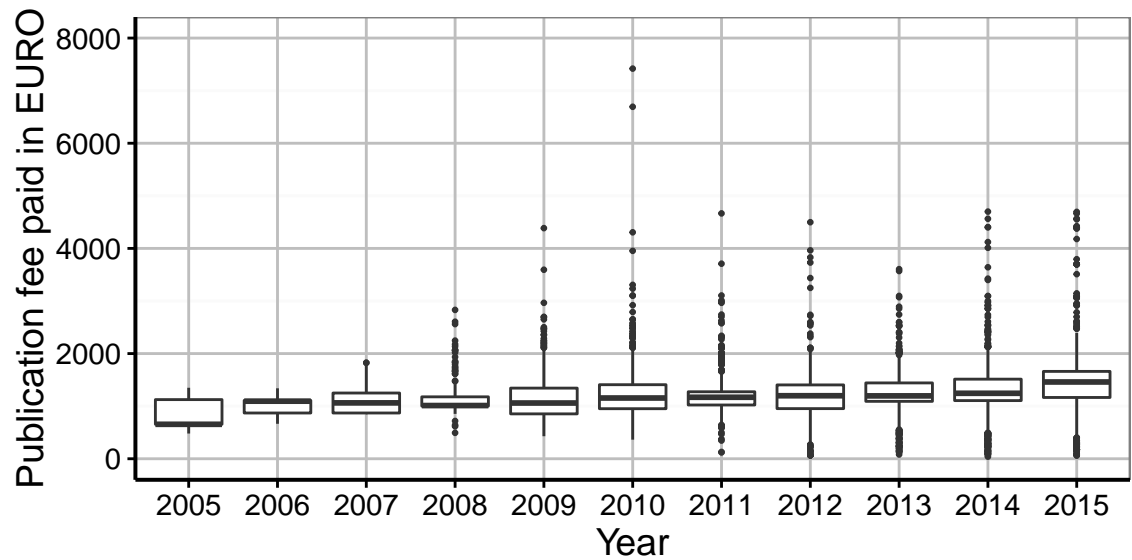


Figure 3. Payments per year

162 The number of APC payments per institutions varied considerably (see Table 3). With 2,856 reported
 163 articles, the Max Planck Society contributed 39 % of the overall submissions. In contrast, the two
 164 universities of technology, TU Clausthal and TU Ilmenau, who recently begun to set up support structures
 165 for fee-based open access journal articles, shared payments made for four articles each.

Table 1. Institutions self-reporting expenditures for open access publications (in €)

Institutions	Articles funded	Total	Mean	Median	Minimum	Maximum
MPG	2,856	3,661,120	1,282	1,168	69	7,419
Goettingen U	650	883,918	1,360	1,354	180	4,695
KIT	426	523,166	1,228	1,243	69	3,731
Regensburg U	399	503,205	1,261	1,207	77	4,403
Muenchen LMU	365	463,491	1,270	1,299	496	2,023
TU Muenchen	308	390,086	1,267	1,386	131	2,122
Bielefeld U	262	322,815	1,232	1,234	142	2,103
Giessen U	243	326,082	1,342	1,247	81	4,498
Konstanz U	221	302,659	1,369	1,380	40	2,072
Heidelberg U	215	308,348	1,434	1,500	60	2,042
Wuerzburg U	207	286,543	1,384	1,447	105	2,514
Leipzig U	173	243,873	1,410	1,471	341	2,055
FZJ - ZB	158	196,869	1,246	1,177	370	3,700
TU Dresden	130	175,723	1,352	1,415	200	2,193
Duisburg-Essen U	114	136,911	1,201	1,214	238	1,982
FU Berlin	106	142,671	1,346	1,292	220	2,000
GFZ-Potsdam	106	126,520	1,194	1,065	223	4,403
Bayreuth U	92	105,725	1,149	1,200	82	2,059
Bochum U	71	93,546	1,318	1,438	100	2,042
Hannover U	69	90,259	1,308	1,241	149	2,159
MDC	69	145,256	2,105	1,800	491	4,700
TU Chemnitz	36	37,826	1,051	1,142	78	2,123
Kassel U	35	35,550	1,016	1,142	150	1,861
Hamburg TUHH	24	32,789	1,366	1,466	300	2,027
Potsdam U	24	32,128	1,339	1,386	916	2,116

Institutions	Articles funded	Total	Mean	Median	Minimum	Maximum
Bamberg U	22	23,663	1,076	1,009	90	2,010
TU Ilmenau	13	13,053	1,004	986	178	2,077
Dortmund TU	9	8,238	915	900	155	1,738
TU Clausthal	8	6,999	875	918	181	1,724
INM - Leibniz-Institut für Neue Materialien	6	8,505	1,418	1,492	237	2,454

CrossRef indexing

Along with the price information, participating institutions were required to identify funded articles by their DOI. They were reported for 7,373 out of 7,417 articles. Of those, `my_apc %>% filter(indexed.in.crossref == TRUE) %>% nrow()` were indexed in CrossRef, representing `my_apc %>% filter(indexed.in.crossref == TRUE) %>% nrow() / my_apc %>% nrow() * 100 %` of all funded publications. The reasons why articles identified by a DOI were not registered with CrossRef differed. Some journals were not indexed by CrossRef at the time of our study but by the DOI agencies DataCite (Journal of new frontiers in spatial concepts published by KIT Scientific Publishing) and Medra (DIE ERDE: Journal of the Geographical Society of Berlin). In other cases, either the DOI did not refer to the full text despite the fact that the journal was indexed on a regular basis (compare <http://doi.org/10.1186/1471-2105-13-S19-S7> with <http://bmcbioinformatics.biomedcentral.com/articles/10.1186/1471-2105-13-S19-S7>) or the resource type could not be retrieved, although the DOI resolves (<http://doi.org/10.1186/s12885-015-1795-7>).

Cost data by publisher and journal

We used the DOI to automatically fetch publisher and journal names for each article from the CrossRef REST API. Table 4 shows the top ten publishers in terms of payments made that represent 92 % of the spending for publication fees. In total, payments were made to 139 publishing houses. In comparison with data from the UK, full open access publishers have a greater share on total spending. Pinfield et al. (2015), for instance, reported remarkably lower numbers for the open access publishers MPDI AG, Copernicus GmbH, and Hindawi Publishing.

Table 2. Publication fees paid per publisher (in €)

Journal	Articles funded	Total	Mean	SD	Median	Range
Springer Nature	2,167	2,948,697	1,361	387	1,385	80.92 – 4403
Public Library of Science (PLOS)	1,680	2,243,128	1,335	321	1,207	555.66 – 2790.27
Frontiers Media SA	906	1,186,283	1,309	424	1,142	77.35 – 4179
Copernicus GmbH	841	1,160,450	1,380	658	1,277	69.12 – 7418.88
IOP Publishing	677	699,137	1,033	228	953	374.77 – 1950
MDPI AG	208	236,729	1,138	453	1,177	154.43 – 2054.68
Hindawi Publishing Corporation	120	125,495	1,046	538	947	174.99 – 2225.22
The Optical Society	111	176,665	1,592	392	1,626	498.62 – 3731.09
Wiley-Blackwell	78	126,148	1,617	467	1,601	490.58 – 3065

Journal	Articles funded	Total	Mean	SD	Median	Range
Oxford University Press (OUP)	64	118,225	1,847	793	1,741	297.5 – 4498.2
Other	565	606,578	1,074	840	922	40 – 4699.61

Most of the funding of publication fees in Germany went to the publisher Springer Science + Business Media, especially profiting from the merge with the former full open access publisher BioMed Central. In contrast, other established publishing houses such as Elsevier and Wiley-Blackwell rank lower, presumably because they mostly publish hybrid journals, which were not well represented in our data-set at the time of the study. Table 4 also illustrates the variation across and within publishers, which confirms earlier findings (Pinfield et al., 2015).

Table 3. Publication fees paid per journal (in €)

Journal	Articles funded	Total	Mean	SD	Median	Range
PLOS ONE	1,433	1,745,513	1,218	130	1,198	748.71 – 1808.8
New Journal of Physics	673	693,322	1,030	225	953	374.77 – 1856.4
Atmospheric Chemistry and Physics Discussions	281	437,903	1,558	776	1,403	233.86 – 7418.88
Frontiers in Psychology	271	363,794	1,342	429	1,142	77.35 – 2122.81
BMC Genomics	135	179,592	1,330	205	1,276	920 – 1926
Biogeosciences Discussions	127	187,716	1,478	548	1,313	663.55 – 3641.47
BMC Bioinformatics	113	142,680	1,263	217	1,244	655 – 1661.24
Frontiers in Plant Science	107	126,763	1,185	408	1,106	551.04 – 2380
Atmospheric Measurement Techniques Discussions	107	143,782	1,344	585	1,203	428.4 – 3709.44
Frontiers in Human Neuroscience	106	140,065	1,321	415	1,106	575 – 2000
Other	4,064	5,466,407	1,345	557	1,350	40 – 4699.61

Prices also varied within single journals. Based on the number of articles paid for, Table 5 illustrates the top ten out of 732 journals. Payments to these ten journals represent 45 % of all payments. In the case of Atmospheric Chemistry and Physics Discussions, the price range can be explained by the fact that this journal charges per page and also takes the submission's file format into consideration.

The data-set finally confirms the leading role of “mega-journals” in open access publishing, including the multidisciplinary PLOS ONE and the journals New Journal of Physics, Atmospheric Chemistry and Physics Discussions and Frontiers in Psychology, all of which publish contributions from all branches of their respective discipline. In general, an estimated 14 out of more than 10,000 journals registered in

DOAJ in 2015 accounted for up to 15–20 % of all articles published in full open access journals (Björk, 2015).

DISCUSSION

The Open APC initiative extends existing methods to disclose spending on open access publication fees. Our workflow benefits from openly available tools and the social coding platforms GitHub, both of which are well established and suited to increase transparency in research (Peng, 2011; Ram, 2013). For 99 % of the articles, CrossRef provided bibliographic information, which substantially contributed to a uniform data-set about formerly fragmented payments made for open access articles.

Although CrossRef disambiguates journal titles and publisher names and is therefore an authority-controlled source for open access journal literature, derivations from CrossRef metadata curation as well as the context of aggregation must be made clear. In particular, problems persist on how to deal with name changes and ongoing mergers. For example, the publisher Public Library of Science (PLOS) has changed its acronym from “PLOS” to “PLOS”, which CrossRef metadata reflects from 2015 onward. We therefore normalized all PLOS journal titles in order to secure unique reference to these journals. Another publisher affected is “The Optical Society,” formerly “Optical Society of America”. Because the ownership of publishing houses can become combined, dealing with mergers is also essential to make cost data comparable. Jisc data, for instance, differentiate between the full open access publisher BioMed Central and the traditional publisher Springer, concluding that “traditional publishing houses” lean on the hybrid model (Pinfield et al., 2015). This stands in stark contrast to our approach, in which CrossRef metadata reflects the merger of BioMed Central and Springer, resulting in Springer Science + Business Media to be the best represented publisher for articles in full open access journals in the Open APC data-set. Another approach for ensuring unique reference, but that we have not evaluated yet, is to use CrossRef’s identifiers for journals and publishers instead.⁸

Because of the dynamic landscape of academic publishing and its representation in CrossRef’s data curation efforts, it is important to consider the time-frame of metadata aggregation. In our case, we re-used metadata shortly after the data submission. However, for some cost analysis – for instance to prepare negotiations with publishers on future schemes to fund open access journal articles – it could be more feasible to re-normalize the complete data. The CrossRef API provides incremental metadata updates that can be used to assess the current potential of future funding. While licensing information is incompletely covered in the CrossRef index so far, and therefore not analyzed in our study, the growing importance of facilitating text mining may result in more and more publishers sharing this information with CrossRef in the future.

Participation is voluntary. Therefore, not all institutions in Germany that provide central funding of publication fees contribute cost data to this initiative. In a qualitative survey that also asked why German institutions are reluctant to share their cost data through the Open APC initiative one institution feared that increase in transparency would allow publishers to adjust prices in their favor. Others pointed out that the workload to produce such a data-set could be too extensive (Deppe, 2015).

While there may still be institutions that have no overview of their APC spending, we would like to emphasize that reporting data that is already available within an institution to the Open APC initiative should not lead to much additional work. The central incentive of this initiative is to make it as easy as possible to submit data to it. Being able to combine that data into one standardized data-set increases transparency and comparability, and gives institutions a better understanding of the overall development of open access publishing. In particular, we cannot see the harm of increased transparency; in fact, not knowing how much is spent is undoubtedly a disadvantage in dealing with publishers.

Extending the data template to include information about funders or whether special agreements with publishers applied as suggested by Pinfield et al. (2015), would even increase the efforts needed to participate. However, with the growing demand for action in areas like the large-scale transition of toll-access journals to open access (Schimmer et al., 2015), an updated data template could help institutions to better comply with these policy developments in the future. From our experience, another barrier to participate is the lack of skills in version control: the data submission itself is not always made directly by the institutions. Instead, they sent files to Bielefeld University Library with the request to make them available on GitHub on their behalf.

⁸We would like to thank Martin Fenner for pointing this out to us. See also the CrossRef API documentation https://github.com/CrossRef/rest-api-doc/blob/master/rest_api.md

252 Future work needs to focus on analyzing the cost data. Of particular interest are questions concerning
 253 the coverage of central funding schemes in comparison with open access publication output in general,
 254 and the use of other means to cover publication fees in particular. The Open APC initiative does not cover
 255 personal budgets or make price reductions explicit, but studies suggest that there is a possible gray area
 256 (Björk, 2015; Björk and Solomon, 2012; Lawson, 2015b). Existing study designs could be re-applied
 257 to examine the relationship between price on the one hand, and indexing coverage, journal prestige or
 258 management costs on the other (Björk and Solomon, 2015, Pinfield et al. (2015); Walters and Linvill,
 259 2011). This, in turn, helps to address the central question of future business models in scholarly publishing
 260 from an international perspective (Pinfield et al., 2015).

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