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The impact of transformative agreements on publication patterns: An analysis based on agreements from the ESAC Registry

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ABSTRACT

"Transformative agreements" are agreements made between publishers and institutions that were intended to transform the traditional subscription-based scholarly publishing system to open access. Some publishers and institutions have argued that these are the best option, yet, they are increasingly being called into question. Not only does the transition remain incomplete, they create negative effects on researchers without access to an agreement or funding to pay an article processing charge. This research project sought to address the question of whether transformative agreements increase the number of open access publications. In April 2022, we retrieved 370 transformative agreements from the ESAC Transformative Agreement Registry, of which 72 met our inclusion criteria. At that time, agreements in the ESAC Registry were heavily weighted towards Europe. We retrieved publications from the Web of Science Core Collection, and screened these to ensure that they were authored by researchers at participating institutions and published in hybrid open access journals covered by the agreement. Using the Unpaywall API, we determined the open access status of each item. Through this process, we identified 156,053 publications that met inclusion criteria. In this article, we examine changes in publication patterns at an aggregate level and per agreement.

Keywords:

INTRODUCTION

A “transformative agreement” (TA) is a contract between a publisher and an institution that is advertised as a way to transform the existing, primarily subscription-access-based, scholarly publishing system to full open access (OA). There are many models, but the term “TA” is most commonly used to describe “read-and-publish” or “publish-and-read” agreements. In these agreements, the institution pays one fee to the publisher that conceptually consists of two fees: one for access to the publisher's subscription-access publications and one for OA publishing of works with a corresponding author from the institution. In effect, as transformations to full OA have been

rare, these agreements are intended to be a way to increase the amount of literature from the participating institution's authors published OA in hybrid journals.

This article examines a set of TAs—from ones listed in the Efficiency and Standards for Article Charges (ESAC) registry—to measure their effects on publication patterns. The agreements in the registry are heavily weighted towards those from European institutions and organizations. We start with an overview and history of TAs, their positive and negative effects, and past studies of agreements. A description of our data source and methodology follows. We analyze the data to identify changes in publishing before and during agreements and discuss our results in the context of the current OA landscape.

LITERATURE REVIEW

History of transformative agreements

TAs have their roots in "hybrid" open access journals. In 2004, Springer created its Open Choice (hybrid) model, which allowed authors to choose to pay a fee to make their article open in an otherwise closed journal (Springer Nature, 2004). This was the first of the largest commercial publishers to offer this model and the article processing charge (APC) price was set at $3000 USD (Björk, 2012). Björk reported in 2012 that there was little uptake in OA publishing in hybrid journals (Björk, 2012). However, the 2012 "Finch report" put the United Kingdom on a path towards hybrid open access, believing that it would be "both effective and sustainable over time" (Finch, 2012). UK funding bodies provided millions of pounds to pay for hybrid APCs (Jisc Collections Content Strategy Group, 2018).

The concept behind TAs, initially described as "offsetting" agreements, was that as more of the publisher's output is being published OA, the "publish" portion of the fee would increase and the "read" portion of the fee would decrease. The first TAs included the Royal Society of Chemistry's "Gold for Gold" program in 2012 and agreements between IOP Publishing and Austrian institutions and Springer and the Association of Universities in the Netherlands (VSNU) in 2014 (Borrego et al., 2021; IOP Publishing, 2014).

The TA concept was lauded in a white paper published by authors from the Max Planck Digital Library (MPDL) (Schimmer et al., 2015). Schimmer, Geschuhn, and Vogler argued that there is "enough money in the system" to fund a full flip from subscription to OA publishing (Schimmer et al., 2015). An estimated $10 billion US is spent annually on scholarly publishing, and 60% of the market is controlled by five publishers (Farley et al., 2021).

The ESAC Initiative was founded shortly before the white paper was published, in 2014, and is currently managed by MPDL. In support of TAs, ESAC provides guidelines, references of various sets of negotiation principles, and a registry in which participants in agreements can provide information about their agreement.

In 2018, cOAlition S, a group of research and funding agencies, primarily from Europe, released Plan S, which called for immediate open access to publications resulting from research they funded, starting in 2020. This implementation date was later moved to 2021. One of the 10

Principles of Plan S stated that the funders do not support hybrid publishing, except as part of transformative arrangements, and only for a limited time (*Plan S Principles*, n.d.). cOAlition S confirmed that it will end support for transformative arrangements, which include TAs and Transformative Journals, at the end of 2024 (*cOAlition*, 2023).

There has been an increase in the number of agreements in the ESAC registry each year, with a significant increase after the release of Plan S. Agreements registered are primarily from consortia and institutions in Western Europe, with 5% of the total number of agreements from institutions in North America as of November 2023 (*ESAC Transformative Agreement Registry*, 2023).

The Impact of Transformative Agreements

Previous research has considered the impact of specific TAs on publication patterns, as well as if and how TAs align with open access principles. In a progress report on offsetting agreements in the UK, Lawson estimated that the value of the agreements to be around 19.5 million GBP between 2015 to 2017 (Lawson, 2019). However, he noted that this is cost avoidance, not cost savings, and that the agreements have not reduced the overall costs of publishing.

More recently, the organizers of the 16th Berlin Open Access Conference (B16) reported on their perspective in their 2023 "Together for Transformation" Conference (*OA2020*, 2023). They point to the increased number of articles published OA in hybrid journals through TAs as a sign that the agreements are successful. However, they temper their endorsement of TAs as the solution with the argument that institutions must move past TAs to other types of open publishing agreements.

Indeed, many agreements do not live up to ESAC's five guidelines for TAs:

1. Transformative agreements are temporary and transitional.
2. Authors retain copyright.
3. Agreements must be transparent.
4. Transformative agreements aim to constrain costs of scholarly communication and foster equity in scholarly publishing.
5. Transformative agreements should govern service and workflow requirements for publishers to ensure that the needs of authors and administrators are addressed.

(*Guidelines for Transformative Agreements*, n.d.)

Lawson noted in 2019 that the UK's agreements were further entrenching the "dysfunctional nature of the subscription market" and were not leading to a full flip of journals to open access and that they "are not a good long-term solution" (Lawson, 2019). Plan S will end support for hybrid publishing, including via TAs in 2024. In addition to TAs, cOAlition S introduced "Transformative Journals" as a type of Transformative Arrangement (cOAlition S, 2019). This program was intended to speed the process of flipping hybrid journals to full OA. However, the progress report for 2022 demonstrates limited success, as only 1% (26) of journals enrolled in the program flipped to OA and 68% failed to meet required levels of OA content and were removed from the program. More recently, the Swedish consortium stated that they "don't find the transformative agreements

sustainable for the future" because they are costly and have not succeeded in flipping to OA as promised (Widmark, 2021).

Additionally, recent international workshops have highlighted the negative effects that APC-based open access models and TAs have had. The OA2020 Initiative has published reports on its Global Equity in OA Publishing workshops for events in Europe and Africa and Asia and the Pacific region. The report from the Asia-Pacific workshop highlighted the need for more transparency in costs, which TAs obfuscate by tying subscription and publishing prices together. Attendees also noted corporate control of publishing that continues with read and publish agreements (Catterall & Barbour, 2023). Also in 2023, OASPA held a series of 'Equity in Open Access' workshops where participants from around the global discussed the inherent inequities in APC-based open access models (including TAs), which create barriers for authors in less wealthy countries and unfunded researchers (Legge, 2023). There have also been indications that TAs will not work globally. Researchers from South Africa, India, and Eastern Europe have described the challenges their countries would face if they moved to read-and-publish style TAs or other pay-to-publish models. There simply may not be enough money in their system to transition paying to publish models (Nazarovets & Skalaban, 2019), and researchers in these countries do not have funding to cover APCs (Alencar & Barbosa, 2022; Koley & Lala, 2022; Kowaltowski et al., 2021; Strydom et al., 2022).

Despite the concerns regarding TAs, there has been evidence of impact on publication behaviors. In a study of the effects of agreements between the German DEAL consortium and Wiley and Springer, the authors found having a TA increased the likelihood that an author would publish in a journal from one of those publishers, although the authors questioned whether this is a positive effect, as smaller publishers may be disadvantaged by TAs, which are generally offered by the largest commercial publishers (Haucap et al., 2021). Increased uptake of hybrid publishing in the journals participating in the agreement has been reported (Philipp & Mattern, 2022; Sütő, 2020). In their assessment of the Austrian Transition to Open Access (AT20A) initiative and its 24 member institutions, Pinhasi, Hölbling, and Kromp (2021) noted an increase in the number of articles published, primarily by the members of the Austrian consortium that already had higher publishing rates, throughout agreements with Springer and Wiley.

Through their investigation of OA publishing trends in six countries between 2015 and 2020, Zhang et al. reported large increases in gold and hybrid OA publishing in the Netherlands and Norway in 2018 (Zhang et al., 2022). This coincides with an increase in the number of read-and-publish agreements in those countries listed in the ESAC Registry (*ESAC Transformative Agreement Registry*, 2023). Zhang et al. also identified a decrease in the share of green OA publications around the same time (Zhang et al., 2022).

Additional studies of TAs include an analysis of the effect of TAs on journal ranking and an examination of correlations between number of TAs in the ESAC registry and annual number of publications (Moskovkin et al., 2022; Wenaas, 2022). In this project, we aim to determine whether a sample of TAs is associated with an increase in open access publication, and whether the impact may differ across agreements, disciplines, and institutions.

METHODS

Research questions

For the present study, we set out to explore these primary research questions:

- Does having a transformative agreement (TA) correlate with an increased number of articles published (per year) with the publisher?
- What fraction of the articles covered under the agreement are actually made open?

We then considered:

- Are there differences in publication patterns based by discipline?

Agreements

We downloaded the ESAC Transformative Agreement Registry on April 29, 2022 (*ESAC Transformative Agreement Registry*, 2023). At this time, the registry contained entries for 370 agreements with 52 publishers, 38 individual countries plus three agreements negotiated by Electronic Information for Libraries (EIFL) with participation from between 25 and 33 countries.

We included agreements that met the following criteria:

- Covered hybrid open access journals
- Were uncapped
- Fully waived APCs
- Started on or before January 1, 2021
- Made available the text of the agreement, either on the ESAC Registry site or one their institutional website.
- Clearly identified participating institutions, in cases where the agreement was signed by a consortium

We excluded agreements that:

- Applied to fully OA journals only
- Had a cap on the number of articles allowed per year or per contract
- Provided only a discount or otherwise partially waived the APC
- Started after January 1, 2021

We chose the January 1, 2021 cutoff date to ensure that we could gather at least one year of data during the agreement, allowing for the delay between publication and indexing.

Data Collection

We used the Web of Science Core Collection to obtain publication data for each agreement. Searches were structured as:

> (Participating institutions 'OG') AND (List of journals included in the agreement 'ISSN') AND (date range three years before the start of the agreement to 2025 'PUBYEAR')

We used the Organization-Enhanced (OG) field in creating the searches. Referring to the list of participating institutions in the agreement, we searched the "Preferred Organization Index" to identify the appropriate 'OG' term. If there was no OG (typically because it is an institution with few publications indexed in the Web of Science Core Collection), we chose not to include an 'OO' organization to avoid capturing institutions that are not part of the agreement but with a similar name. We were unable to locate a full list of participating institutions for the Projekt DEAL agreements with Wiley and Springer Nature, so we used a sample. We also used a sample for the agreements between the TIB Consortium and the Electrochemical Society, SPIE, and the Royal Society of Chemistry. See Appendix for the list of institutions in the sample.

Lists of journals were obtained from the text of the agreement, if included in what is publicly available. In cases where the publicly shared agreement did not include a list, we checked the publisher's website or the institution's website for a downloadable list. In cases where no list was accessible, we relied on the list from an agreement with the same publisher, starting in the same year, if possible. We note that between our original search creation and this article, some publishers changed their interface, replacing downloadable title lists with tools that require the user to input a journal title or subject area to find out which titles are covered by the agreement.

Original searches were run in the Web of Science Core Collection August 26-29, 2022. Data was exported as tab-delimited files in batches of 1,000 records and files were joined using OpenRefine. We ran updated searches to capture additional publication data indexed between the original search and the end of 2022. In January 2023, we re-ran the original searches and limited results to Index date from August 26, 2022 to December 31, 2022.

Data refinement

Data was cleaned, refined, and enriched using OpenRefine. After combining downloads into a single file for each of the agreements, we worked to identify corresponding author affiliation for each publication. In the Web of Science Core Collection data exports, author information is in four fields: C1, C3, RP, and EM. RP, the Reprint Address, contains names and affiliations for authors identified as the corresponding author in the item's metadata. C1 (Addresses), C3 (Affiliations), and EM (Email Address) contain information about all publication authors.

The process of identifying the corresponding author is inexact due to the way data is available from the Web of Science Core Collection and because there can be multiple

corresponding authors and/or corresponding authors can have multiple affiliations. We relied on the Reprint Address (RP) and Email Address (EM) fields in our determination. If there was one email address in EM, we assigned the corresponding author affiliation based on the email domain. In cases where the email address was not affiliated with an institution (e.g., a Gmail domain) or there were multiple email addresses in EM, we referred to the RP field.

If there was one author with one institutional affiliation listed in the RP field, we assigned the corresponding author to that institution. If there was one author with multiple affiliations, we assigned the corresponding author based on the first affiliation, based on the assumption that the author would list their primary affiliation first. However, if only one of the affiliations was covered by the agreement, we assigned the item to that institution, assuming that the author would indicate this affiliation in the publisher's system. In instances where there were multiple corresponding authors, whether they had one or multiple affiliations listed, if one author had an affiliation with an institution participating in the agreement, we assigned the article to that institution. When there were multiple participating institutions listed, we assigned the corresponding author affiliation to the first institution.

Whether medical centers are included depends on the agreements. Unless the agreements explicitly included researchers from medical centers, we chose to exclude items for which the only affiliation listed is for a medical center, with no indication of faculty or other employment status at the university. This is based on our knowledge of academic medical centers, where authors with affiliation to only the medical center are often ineligible for participation in agreements unless also directly employed by the university. Item-level eligibility was also assessed based on the publication types permitted in each agreement. Some TAs allowed only original research, while others included review articles, letters to the editor, and other publication types.

Next, we retrieved data from the Unpaywall API for open access status and publication date. While this data appears in the Web of Science Core Collection export (EY, PY, EA, PD), there is inconsistency in how it is reported. There is also inconsistency in the data provided through the Unpaywall API due to differences in publisher definition of “published”, but we assume that the date the publisher provides is the one that is applicable for determining eligibility under a TA, which generally apply to hybrid open access articles accepted after the agreement start date (*Data Format*, n.d.). Unpaywall reports OA status by determining the “most open” version of an article (Priem, 2021). Because we were focusing on hybrid OA articles, the additional details in Web of Science's OA field were not relevant.

This analysis matches the period of time prior to the agreement with the length of the agreement, up to three years. This means that an agreement of two years is compared to the two years prior to the agreement, while an agreement of one year is compared to the period of one year prior to the agreement. A publication may be counted more than once if it could be covered under more than one agreement. For example, a publication with two corresponding authors covered by two different agreements would be considered for both agreements.

To identify differences in publication patterns based on discipline, we mapped the Web of Science category or categories of each publication to the six major subject codes outlined by the Organisation for Economic Cooperation and Development (OECD)’s Field of Science and Technology (FOS) Classification (Hernandez, 2021). FOS is a broad classification system that aligns with research and development priorities. It does not rely on a specific discipline or publisher, such as taxonomies from Clarivate or Elsevier, or controlled vocabularies such as

Medical Subject Headings. Where an article was assigned to more than one FOS Classification, it was counted in both.

FINDINGS

We identified 74 agreements that met our inclusion criteria. Of these, two were found to be extensions of previous agreements and as such were combined with those previous agreements, resulting in 72 agreements with 27 different publishers. All agreements began between 2019 and 2021, with 8 beginning in 2019, 19 beginning in 2020, and 45 in 2021. Of the 72 agreements, the majority (46, 64%) were three-year agreements, while 10 were two-year agreements, 8 were one-year agreements, 5 were four-year agreements, and 3 were five-year agreements. The majority of the agreements were with consortia (63/72, 87.5%) rather than individual institutions (9/72, 12.5%).

Of the 72 agreements, 59 were from institutions or organizations based in Europe, while 6 were from North America, 4 were from Asia, and 3 were from Africa. Germany was the most well represented country, participating in 13 of the 72 agreements (18.1%). This was followed by Ireland (9/72, 12.5%), Sweden (8/72, 11.1%), and the Netherlands (7/72, 9.7%). Given underrepresentation of non-European countries in this sample, care should be taken against generalizing the results to other settings.

Table 1. Agreement demographics.

Publisher	Organization (Country)	Institutions Included in Sample	Journals		Agreement Start and End Dates
			Included in Agreement	Indexed in Web of Science	
Association for Computing Machinery	California Digital Library (USA)	12	59	47 (79.7%)	01/01/2020 - 31/12/2020
Association for Computing Machinery	IReL (Ireland)	7	59	47 (79.7%)	01/01/2020 - 31/12/2022
Association for Computing Machinery	Iowa State University (USA)	1	59	47 (79.7%)	01/01/2020 - 31/12/2022

Association for Computing Machinery	KAUST (Saudi Arabia)	1	59	47 (79.7%)	01/01/2020 - 31/12/2022
Association for Computing Machinery	SANLiC (South Africa)	4	59	47 (79.7%)	01/01/2021 - 12/31/2023
Brill	UKB/SURF (Netherlands)	9	319	173 (54.2%)	01/01/2020 - 31/12/2021
Brill	University of Vienna (Austria)	1	303	168 (55.4%)	01/01/2020 - 31/12/2020
Brill	Bibsam Consortium (Sweden)	12	287	166 (57.8%)	01/01/2021 - 31/12/2023
Cambridge University Press	Bibsam Consortium (Sweden)	27	341	315 (92.4%)	01/01/2019 - 31/12/2021
Cambridge University Press	California Digital Library (USA)	10	341	315 (92.4%)	01/01/2019 - 31/12/2021
Cambridge University Press	Max Planck Digital Library (Germany)	1	341	315 (92.4%)	01/01/2019 - 31/12/2021
Cambridge University Press	CARLIGH (Ghana)	6	341	315 (92.4%)	01/01/2020 - 31/12/2022
Cambridge University Press	CRUI-CARE (Italy)	34	341	315 (92.4%)	01/01/2020 - 31/12/2022
Cambridge University Press	Unit (Norway)	11	341	315 (92.4%)	01/01/2020 - 31/12/2022

Cambridge University Press	Big Ten Academic Alliance (USA)	11	341	315 (92.4%)	01/01/2021 - 31/12/2023
Cambridge University Press	CISUG (Spain)	3	341	315 (92.4%)	01/01/2021 - 31/12/2021
Cambridge University Press	Consortium of Swiss Academic Libraries (Switzerland)	9	332	307 (92.5%)	01/01/2021 - 31/12/2023
Cambridge University Press	CzechELib (Czech Republic)	2	341	315 (92.4%)	01/01/2021 - 31/12/2022
Cambridge University Press	IReL (Ireland)	9	411	385 (93.7%)	01/01/2021 - 31/12/2025
Cambridge University Press	Jisc (UK)	95	341	315 (92.4%)	01/01/2021 - 31/12/2024
Cambridge University Press	KAUST (Saudi Arabia)	1	192	186 (96.9%)	01/01/2021 - 31/12/2023
Cambridge University Press	KoBSON (Serbia)	3	341	315 (92.4%)	01/01/2021 - 31/12/2021
Cambridge University Press	SANLiC (South Africa)	12	341	315 (92.4%)	01/01/2021 - 31/12/2023
Company of Biologists	IReL (Ireland)	9	3	3 (100%)	01/01/2020 - 31/12/2022
Company of Biologists	CSIC Spanish National Research Council	98	3	3 (100%)	01/01/2021 - 31/12/2023

	(Spain)				
Company of Biologists	Max Planck Digital Library (Germany)	1	3	3 (100%)	01/01/2021 - 31/12/2023
Walter de Gruyter	Unit (Norway)	4	304	176 (57.9%)	01/01/2021 - 31/12/2023
The Electrochemical Society	TIB Consortium (Germany)	1	4	2 (50%)	01/01/2021 - 31/12/2021
EDP Sciences	Max Planck Digital Library (Germany)	1	1	1 (100%)	01/01/2021 - 31/12/2022
Elsevier	Bibsam Consortium (Sweden)	39	1857	1692 (91.1%)	01/01/2020 - 31/12/2022
Elsevier	VSNU/NWO (Netherlands)	36	1857	1692 (91.1%)	01/01/2020 - 31/12/2024
Elsevier	CRUE-CSIC Alliance (Spain)	55	1857	1692 (91.1%)	01/01/2021 - 31/12/2024
Emerald	Bibsam Consortium (Sweden)	27	310	290 (93.5%)	01/01/2021 - 31/12/2023
Emerald	IReL (Ireland)	9	310	290 (93.5%)	01/01/2021 - 31/12/2023
Hogrefe	German Academic Consortium (Germany)	62	29	27 (93.1%)	01/01/2021 - 31/12/2023

IOP Publishing	Bibsam Consortium (Sweden)	13	58	53 (91.4%)	01/01/2021 - 31/12/2023
IOP Publishing	IReL (Ireland)	8	56	52 (92.9%)	01/01/2021 - 31/12/2024
IOP Publishing	Eindhoven University of Technology (Netherlands)	1	56	52 (92.9%)	01/01/2021 - 31/12/2023
IOS Press	UKB/SURF (Netherlands)	12	85	62 (72.9%)	01/01/2019 - 31/12/2022
IOS Press	Bibsam Consortium (Sweden)	15	71	57 (80.3%)	01/01/2021 - 31/12/2023
IWA Publishing	TU Delft and Wageningen University (Netherlands)	2	10	10 (100%)	01/01/2019 - 31/12/2021
John Benjamins Publishing	KU Leuven (Belgium)	2	88	41 (46.6%)	01/01/2021 - 31/12/2021
Karger	Consortium of Swiss Academic Libraries (Switzerland)	4	59	59 (100%)	01/01/2020 - 31/12/2022
Karger	JULAC (Hong Kong)	2	59	59 (100%)	01/01/2021 - 31/12/2023
Microbiology Society	IReL (Ireland)	10	4	4 (100%)	01/01/2021 - 31/12/2023
Oxford University Press	Unit (Norway)	10	330	309 (93.6%)	01/01/2020 - 31/12/2022

Portland Press	CSIC Spanish National Research Council (Spain)	98	5	5 (100%)	01/01/2021 - 31/12/2022
Portland Press	Max Planck Digital Library (Germany)	1	5	5 (100%)	01/01/2021 - 31/12/2023
Royal Irish Academy	IReL (Ireland)	8	6	2 (33.3%)	01/01/2021 - 31/12/2023
Royal Society of Chemistry	EISZ (Hungary)	5	38	38 (100%)	Agreement #1: 01/01/2019 - 31/12/2019; Agreement #2: 01/01/2020 - 31/12/2020
Royal Society of Chemistry	Consortium of Swiss Academic Libraries (Switzerland)	9	38	38 (100%)	Agreement #1: 01/01/2019 - 31/12/2020; Agreement #2: 01/01/2021 - 31/12/2023
Royal Society of Chemistry	Max Planck Digital Library (Germany)	1	35	35 (100%)	01/01/2021 - 31/12/2022
Royal Society of Chemistry	TIB Consortium (Germany)	1	35	35 (100%)	01/01/2021 - 31/12/2023
Royal Society of Chemistry	Unit (Norway)	3	45	42 (93.3%)	01/01/2021 - 31/12/2022

Rockefeller University Press	Max Planck Digital Library (Germany)	1	3	3 (100%)	01/01/2021 - 31/12/2022
Sage	Bibsam Consortium (Sweden)	33	959	785 (81.9%)	01/01/2020 - 31/12/2022
Sage	Jisc (UK)	83	971	794 (81.8%)	01/01/2020 - 31/12/2022
Sage	Unit (Norway)	23	1748	1469 (84%)	01/01/2020 - 31/12/2022
Sage	VSNU-UKB (Netherlands)	14	1805	1488 (82.4%)	01/01/2020 - 31/12/2021
Sage	Canadian Research Knowledge Network (Canada)	57	1895	1552 (81.9%)	01/01/2021 - 31/12/2023
Sage	Consortium of Swiss Academic Libraries (Switzerland)	13	411	385 (93.7%)	01/01/2021 - 31/12/2022
Sage	IReL (Ireland)	8	1809	1481 (81.9%)	01/01/2021 - 31/12/2023
Springer Nature	Projekt DEAL Consortium (Germany)	23*	2036	1764 (86.6%)	01/01/2020 - 31/12/2022
SPIE	KAUST (Saudi Arabia)	1	8	8 (100%)	01/01/2021 - 31/12/2023

SPIE	Max Planck Digital Library (Germany)	1	8	8 (100%)	01/01/2021 - 31/12/2023
SPIE	TIB Consortium (Germany)	1	8	8 (100%)	01/01/2021 - 31/12/2023
Thieme	KEMOE (Austria)	4	287	166 (57.8%)	01/01/2021 - 31/12/2023
The Royal Society	Bibsam Consortium (Sweden)	9	8	8 (100%)	01/01/2021 - 31/12/2021
The Royal Society	IReL (Ireland)	9	8	8 (100%)	01/01/2021 - 31/12/2023
The Royal Society	Ohio State University (USA)	1	8	8 (100%)	01/01/2021 - 31/12/2021
Wiley	Projekt DEAL Consortium (Germany)	10*	1379	1295 (93.9%)	01/01/2019 - 31/12/2022
Wiley	VSNU-UKB (Netherlands)	14	1386	1300 (93.8%)	01/01/2021 - 31/12/2023

* Based on a sample of all members. List of sample members available in the Appendix.

We retrieved 419,995 publications from the Web of Science Core Collection. Of these, 263,942 publications were excluded because they did not have a corresponding author from a participating institution, were not an eligible publication type (as defined by the original agreement), were not published in an eligible hybrid journal, or were published outside of the time period of interest. Through this process, we identified 156,053 publications which would have been covered by a TA. Of these, there were 155,869 publications associated with a single agreement and 184 publications that were associated with two agreements. Of the 155,869 publications associated with a single agreement, 146,730 (94.1%) were from Europe, 8,781 (5.6%) from North America, 273 (0.2%) from Africa, and 85 (0.05%) from Asia. Of the 184 publications associated with multiple agreements, 154 (83.7%) were exclusively European, 2 (1.1%) were exclusively North American, and 2 (1.1%) were exclusive to Africa. 9 (4.9%) involved agreements

from both Europe and Africa, 16 (8.7%) from both Europe and North America, and 1 (0.5%) publication was associated with agreements from North America and Africa.

We first considered whether there was an increase in the number of articles published, regardless of OA status. Because the time period before the agreement was matched to the time during the agreement, these numbers should be comparable and indicate whether there was an increase in overall publishing volume. In the period prior to the agreement, the mean number of publications per institution was 78.6 (0 – 1541), compared to 82.3 (0 – 1802) publications during the agreement. A Wilcoxon signed-rank test found that this difference was not statistically significant ($p = 0.19$).

The majority of publications were hybrid (61,976, 39.7%), followed by closed (54,617, 35.0%), green (31,967, 20.5%), bronze (6,859, 4.4%), and gold (634, 0.4%). When comparing hybrid and closed publications before and during TAs, we found an odds ratio of 9.58 (95% CI 9.33-9.84), meaning that the odds of a hybrid publication are almost 10 times higher than a closed publication when a TA is in effect.

Table 2. Total number of hybrid and closed publications during and prior to the agreements.

Publication Period	Hybrid Publications	Closed Publications
During	50,183	16,796
Prior	11,793	37,821

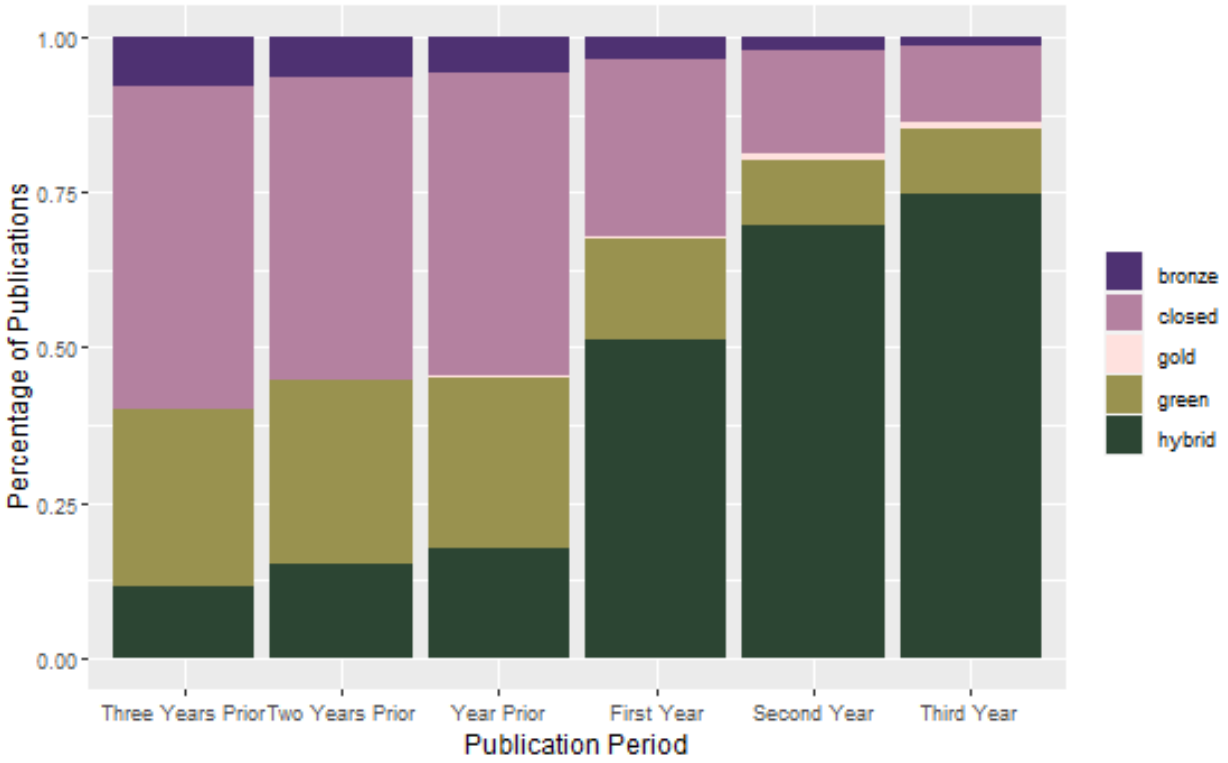

Figure 1. Percent distribution of OA status for all agreements, for the three years prior and three years of the agreement.

When comparing the proportion of publications across the years before and during the agreement (Figure 1), the overall proportion of hybrid publications increased from 17.8% (5,476 / 30,831) of publications in the year prior to the agreement to 51.4% (17,598 / 34,241) of publications in the first year of the agreement. Conversely, closed publications decreased from 48.9% (15,072 / 30,831) the year prior to 28.6% (9,808 / 34,241) in the first year of the agreement, and green publications decreased from 27.5% (8,482 / 30,831) to 16.1% (5,523 / 34,241) during that same time period. It should be noted that, because Unpaywall assigns one OA status based on its hierarchy of the "best" version, it is possible that some of the hybrid, gold, and bronze publications also have a version available via green open access (e.g., in an OA repository). The presence of gold journal publications in our results is due to changing journal publishing practices during an agreement, sometimes referred to as flipping.

Publication patterns differed between disciplines. While all six subject categories in the FOS classification system showed increases in hybrid publications and decreases in closed publications following the establishment of an agreement, these trends varied in scale (Figure 2). The social sciences showed the largest change, with hybrid publications increasing from 18.4% (1,905 of 10,351) of social sciences publications in the year before an agreement to 53.3% of publications in the year following an agreement (6,202 of 11,636). This was followed by natural sciences, which saw an increase from 20.9% (2,148 of 10,273) of publications to 52.2% of publications (6,081 of 11,640) Engineering/technology and medical/health sciences showed slightly more moderate transitions with increases of 2,667 and 3,056 hybrid publications

respectively. Agricultural sciences and humanities showed more modest changes and overall lower publication volume, growing from 283 agricultural sciences and 200 humanities publications in the year prior to an agreement to 712 and 879 hybrid publications in the year following an agreement. This may be explained by disciplinary portfolios of the agreements and/or the selection of journals indexed in the Web of Science Core Collection.

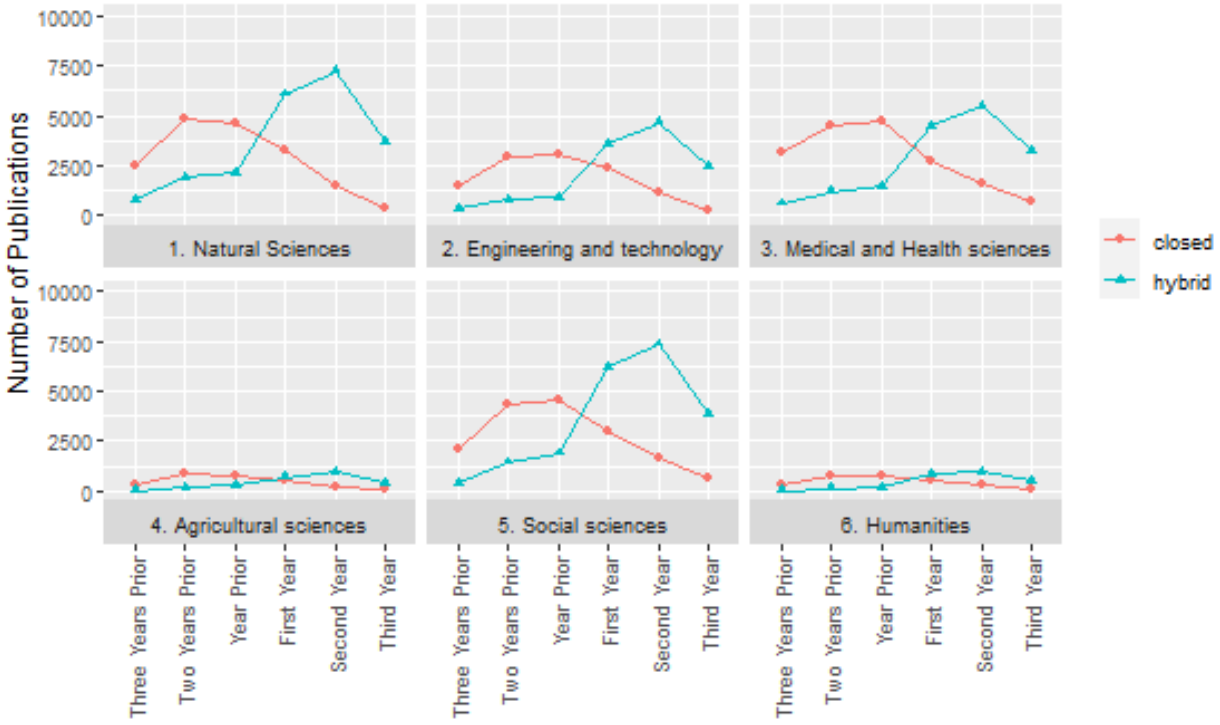

Figure 2. Publication patterns in the three years before and during the agreement for the 6 disciplines in the FOS classification system.

While the overall odds ratio for our sample was statistically significant, examination of individual agreements found that not all agreements or institutions participating in agreements paralleled these results. Of the 72 agreements in our study, 44 were found to have statistically significant odds ratios while 28 did not. Of those that did see a statistically significant difference when comparing the period before to the period during an agreement, 41 of these showed an increase in the odds of a hybrid publication while 3 showed an increase in the odds of a closed publication.

Examining the underlying characteristics of the groups involved in these different agreements, we found that agreements that were associated with increased odds of hybrid publications, regardless of whether these results were statistically significant, were associated with having lower median hybrid publication rates prior to the establishment of the agreement. These agreements had a median of 28 and 1 hybrid publications per institution for agreements with and

without statistically significant differences, respectively, compared to 98 and 2 closed publications. By comparison, agreements associated with decreased odds of hybrid publication had higher median hybrid publication rates. Prior to the establishment of the agreement, these groups had 107 and 7.5 hybrid publications per institution for agreements with and without statistically significant differences, respectively, compared to 6 and 1.5 closed publications. Agreements with statistically significant outcomes had higher average publication volumes both prior to and during agreements than those without statistically significant outcomes.

Table 3. Median number of publications per institution per agreement

	Agreements with statistically significant differences (n = 44)				Agreements without statistically significant differences (n = 28)			
	Increased odds of hybrid publications (n = 41)		Decreased odds of hybrid publications (n = 3)		Increased odds of hybrid publications (n = 16)		Decreased odds of hybrid publications (n = 12)	
	Prior	During	Prior	During	Prior	During	Prior	During
bronze	18	3	0	0	2	0	0	0
closed	98	48	6	34	2	0	1.5	3
gold	0	0	0	0	0	0	0	0
green	70	23	4	3	2.5	2	1.5	2
hybrid	28	182	107	194	1	3	7.5	4

In addition to the agreements explicitly noted as extensions and as such combined in our analysis, we found evidence of potential previous TAs in 12 cases. Although we could not conclude that these were the same agreement, due to lack of availability of agreement details or differing characteristics, the potential previous agreements may be a confounder. Of those 12 agreements, 8 were statistically significant (6 with increased odds of hybrid publications, 2 with decreased odds), while 4 were not statistically significant (1 with increased odds of hybrid publications, 3 with decreased odds). Removing these agreements and recalculating the overall odds ratio found an OR of 17.4 [95% CI 16.75-18.08], meaning that the odds of having a hybrid publication are over 17 times higher.

DISCUSSION

Our research found that, at an aggregate level, TAs increase the odds of hybrid publications in comparison to closed publications. However, there was variability between agreements and between disciplines. While the natural sciences and social sciences saw more dramatic increases in hybrid publishing, absolute publication volumes in the agricultural sciences and humanities were less impacted. Not all disciplines consider journal publication as their primary dissemination mechanism. For example, the arts and humanities more frequently focuses on monograph publishing. While there are some open monograph initiatives, these are not the subject of the TAs in the ESAC Registry. Moreover, TAs may exclude publication types such as review articles, which may further restrict their applicability in the humanities.

Even in cases where a TA is associated with increased hybrid publishing, this alone may not be sufficient justification for participation in an agreement. Only an individual institution can determine whether a TA offers a suitable return on investment (ROI). While our analysis is at the agreement level, the experiences of individual institutions within those agreements may vary, and statistically significant results are not inherently significant on a practical level.

In the absence of cost transparency, institutions are not able to make fully informed, evidence based open access decisions or policies. There is little information available regarding the direct costs of specific TAs or the indirect costs of negotiating, implementing, and managing these agreements. Previous research has noted that prices may be based on historical print spending (Lawson, 2019), and, as Borrego et al. (2021) note, different types of contracts can be deemed TAs, and these contracts may have different payment mechanisms, terms and conditions, and limitations, many of which are not publicly disclosed. While agreements in the ESAC registry often note "Agreement costs within the range of the previous spending level," this previous spending level is not publicly reported. Despite the lack of specific financial information shared, these agreements are frequently framed as cost neutral rather than cost saving. Costs may shift internally in the library from subscriptions to APCs, or within the institution from individual researchers to the library, but these costs remain and must be accounted for at an institutional level.

Determining how to finance TAs, particularly for consortia, is challenging. Taubert et al. analyzed OA uptake across German institutions and identified the disciplinary profile as the strongest factor in uptake of OA offers through TAs (Taubert et al., 2023). Pinhasi et al. (2021) also reported that not all members of the Austrian consortium KEMÖ felt that the cost-allocation model used was fair, and similar difficulties were reported in Italy (Capaccioni, 2021; Pinhasi et al., 2021). Suggestions for future pricing structures have included scaling costs to institution size, volume of publications, or research profile to determine equitable distribution of costs, although some larger and research-intensive institutions have voiced concern that scaling based on these measures would cause them to absorb increased publishing costs while smaller or more teaching-focused institutions could reduce subscription costs (van der Vooren, 2019).

In addition to the direct costs of a TA, an institution determining the potential benefit of an agreement must consider the indirect costs of the agreement. While there is the potential of ultimately reallocating positions to the implementation and management of TAs, and there may be future opportunities for automation, existing processes have been described as “unscalable” and “burdensome” (Geschuhn & Stone, 2017). Pinhasi, Hoelbling, and Kromp (2021) reported on issues related to managing an agreement between Wiley and the Austrian consortium KEMÖ. There was less than 80% uptake by authors in the first year of the agreement, although this increased to nearly 100% in future years, after close collaboration between the consortium and

publisher (Pinhasi et al., 2021). At the University of Vienna, Pinhasi, Blechl, Kromp, and Schubert (2018) noted challenges in achieving full uptake of APC discounts and waivers due to workflows. They highlighted the importance of correctly identifying the corresponding author affiliation and described how not all publisher websites are clearly designed and worded, sometimes misleading authors into thinking that they will have to pay a fee and thus resulting in rejecting the OA option. Two agreements are contrasted: in one, the publisher identifies eligible authors, which led to 86% uptake; in the second, authors have to identify eligibility on their own, which led to 4% uptake (Pinhasi et al., 2018). Swedish librarians Parmhed and Säll (2023, 2020) noted the lack of standardization across publisher platforms for managing TAs and described the difficulties in communicating the nuances of different agreements with researchers. It is unclear based on publication data alone whether increased resources, clarity and consistency of communication, and an existing culture of open access are associated with the success of a TA. Future research should consider how these indirect costs, alongside more transparent reporting of direct costs, can be used to determine ROI.

The ESAC Registry states that TAs should be “temporary and transitional.” The agreements included in this study are very new, beginning between 2019 and 2021. Given the relative newness of these agreements, it is not possible to determine whether any changes in publication behavior would be maintained over time or in the absence of TAs. If the aim of these agreements is to enable transition to a fully open publishing model, greater clarity about the mechanisms and models that will maintain this fully open model are necessary. Given that hybrid publishing was initially positioned as “a way to manage the inevitable transition period” between subscription-based publishing and fully open publishing, an increase in hybrid publishing rates should only be considered indicative of the uptake of this intermediate phase, rather than full adoption of open access principles (Prosser, 2003).

A statement of recommendations on the 20th anniversary of the Budapest Open Access Initiative (BOAI) places great emphasis on the systemic problems with the current scholarly publishing system and reminds readers that, "OA is not an end in itself, but a means to other ends, above all, to the equity, quality, usability, and sustainability of research" (Budapest Open Access Initiative, 2022). Among the many recommendations promoting the building of open scholarly infrastructure and realigning the academic rewards system, BOAI calls for a move away from APCs and an end to read-and-publish agreements.

> *"We should favor publishing models which benefit all regions of the world, which are controlled by academic-led and nonprofit organizations, which avoid concentrating new OA literature in commercially dominant journals, and which avoid entrenching models in conflict with these goals."*
>
> (Budapest Open Access Initiative, 2022)

The BOAI recommendations highlight the need for more equitable open access publishing models. This was a theme throughout OASPA’s 2023 ‘Equity in Open Access’ workshops and has been reported on in papers from researchers in South America, South Africa, and Eastern Europe, among others (Alencar & Barbosa, 2022; Koley & Lala, 2022; Kowaltowski et al., 2021; Legge, 2023; Nazarovets & Skalaban, 2019; Strydom et al., 2022). TAs can be criticized for maintaining and even entrenching current power dynamics. Alternative strategies, such as SciELO and Redalyc, rely on shared infrastructure rather than agreements with commercial publishers (*Redalyc*, 2023; *Scielo*, 2023). The low number of agreements from non-European countries in the

ESAC Registry, and subsequently in our analysis, may be due to the successes of these models. Federal funding agency policies that explicitly require the use of designated repositories, such as the NIH Public Access Policy, may also contribute to the slower uptake of TAs in North America (NIH, 2021). Alternative models to achieve open access, such as shared infrastructure, may ultimately prove to be a more sustainable, equitable approach to scholarly publishing.

While our project compares hybrid and closed publications, it does not consider the potential impact of TAs on other types of open access, such as green or bronze. Future research should consider hybrid and closed publication within this more complex environment, particularly in exploring the impact of hybrid publishing rates on green open access. Individual institutions assessing existing agreements or considering future agreements may wish to do so in the context of the broader range of open access publishing options, and in the context of their own definitions of and commitments to open research and scholarship.

Limitations

There are a number of limitations to the analysis presented here. First, the ESAC registry is not a comprehensive source and our results may not be generalizable to all TAs. As previously noted, the agreements in this analysis are primarily from Europe and findings may not be generalizable to all geographic areas. However, more significantly, the lack of representation in our sample is indicative of a lack of representation in TAs. Previous research has found that TAs are concentrated in Europe and the US, and may not be easily adopted in other regions due to a variety of structural factors (Bansode & Pujar, 2022). It has been previously recognized that TAs may be more feasible in Europe, as many European countries have nationwide consortia and a more centralized approach to licensing and negotiation (Earney, 2017). Scholars in South America and Asia have been vocal about the negative impacts of Plan S and its focus on TAs (Debat & Babini, 2019; Funamori, 2019).

The analysis described in this paper is based on agreements listed in the ESAC Registry as of April 2022. As of November 2023, there were an additional 489 agreements registered. While there were significant increases in the total number of agreements from Africa, Asia, Australia, and the Middle East, these still account for less than 15% of the agreements in the registry (*ESAC Transformative Agreement Registry*, 2023). Given the limited representation of non-European agreements in our sample, our findings should not be generalized to other settings. Moreover, the majority of agreements in our sample were negotiated by national consortia and large, commercial publishers, and may not be representative of the experiences of all institutions or publishers.

Our analysis is also limited by the availability and quality of publication data accessible through the Web of Science Core Collection. Not all titles for a given agreement are indexed in the database. Coverage is provided in Table 1 and varies from 33% to 100%. Furthermore, there are delays between publication and indexing in the Web of Science Core Collection. We chose search dates to address the time delay for indexing by limiting our dataset to those agreements that started at least one full year before 2022. By collecting data for articles indexed by December 31, 2022, we can be reasonably certain that we have as complete a dataset for 2021 as possible. However, there is regularly a six-month lag time between publication and indexing in Web of Science, so we anticipate that we may not have all publications from 2022. There are also

differences in average time to publication across disciplines, which may affect our results (Björk & Solomon, 2013; Haucap et al., 2021).

We had to make assumptions about corresponding authors and eligibility based on the quality of the available metadata. Using the WoS "Organizations-enhanced" field will have improved the recall of publication records, as compared to searching on a single version of an institutional name. However, the data in the Reprint Author field is not fully standardized and some name variants may not have been identified. Additionally, there can be multiple corresponding authors and authors can have multiple affiliations. For analysis, we assigned publications to just one institution, but it is possible that the assignment may not align with the publisher's definition of eligibility. Eligibility may have been based on a different author that was part of the same agreement, or eligibility may have been based on a different author covered by a separate agreement. While authors may have had their APCs covered by a TA, they may have chosen not to use that option or may not have been aware of their eligibility. Finally, many agreements started right before or during the COVID-19 pandemic. The pandemic may have had an effect on publishing. For example, in 2020, there was an increase in the number of publications, overall and for COVID-related research. It is possible that these changes could have affected publishing under these agreements (Clark, 2023; Haucap et al., 2021; Squazzoni et al., 2021).

Conclusion

Publishers continue to offer and institutions continue to sign TAs. Despite their popularity during the last decade, the ROI remains unclear. Our analysis demonstrates that, in general, TAs are associated with increased odds of hybrid publishing. However, it remains to be seen whether this is an overall positive or negative development. Because many of the agreements in our study started in 2021, we cannot say how TAs will affect publishing long term. More data, over a longer period of time, is necessary. If the TA model is to succeed in “flipping the system”, greater engagement with institutions and publishers outside of Europe and the US, as well as greater participation from a wider variety of institutions and publishers, will be necessary. Other models may ultimately be more preferable or successful. For example, diamond OA and the subscribe-to-open model would reduce complexity for authors and the libraries that manage agreements (Fuchs & Sandoval, 2013; Subscribe to Open, n.d.).

We approach TAs with the same caution expressed in the BOAI 20th anniversary statement. TAs have not as of yet led to a widespread transition from hybrid to fully open access journals; nor have many publishers defined what their financial model would be when they flip. TAs are complex and we recommend that future research consider the complete investment required for TAs, not only in terms of the direct costs of the agreements, but also the labor involved in negotiating, managing, promoting. The work we describe here is one piece of critically assessing the contribution of these agreements to furthering open scholarship and sustainable publishing models.

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APPENDIX: INSTITUTIONS SAMPLED

Springer Nature - Projekt DEAL Consortium (Germany)

1. Carl von Ossietzky Universitat Oldenburg
2. Eberhard Karls University of Tubingen
3. Free University of Berlin
4. Goethe University Frankfurt
5. Helmholtz Association
6. Humboldt University of Berlin
7. Max Planck Society
8. Ruprecht Karls University Heidelberg
9. RWTH Aachen University
10. Technical University of Darmstadt
11. Technical University of Munich
12. Technische Universitat Chemnitz
13. Universitat Siegen
14. University of Bonn
15. University of Duisburg Essen
16. University of Erlangen Nuremberg
17. University of Freiburg
18. University of Hamburg
19. University of Kaiserslautern
20. University of Lubeck
21. University of Munich
22. University of Regensburg
23. University of Stuttgart

Wiley - Projekt DEAL Consortium (Germany)

1. Leipzig University
2. Technical University of Berlin
3. Technical University of Darmstadt
4. Technische Universitat Chemnitz
5. University of Freiburg
6. University of Hannover
7. University of Mannheim
8. University of Munich
9. University of Rostock
10. University of Stuttgart

Electrochemical Society – TIB Consortium

1. University of Hannover

SPIE – TIB Consortium

1. University of Hannover

Royal Society of Chemistry – TIB Consortium

1. University of Hannover