



Choice of Open Access in Elsevier Hybrid Journals

Sumiko Asai¹

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Abstract

Open access articles in hybrid journals have recently increased despite high article processing charges. This study investigated the impacts of grants and transformative agreements on authors' choice of open and non-open access articles by comparing two article types. The samples were hybrid journals launched independently by Elsevier. The results revealed that the authors who received more grants in countries with transformative agreements were more likely to choose open access articles. By contrast, authors in developing countries were likely to publish non-open access articles. These findings imply that authors' choices depend on the funding systems and open access policies in individual countries. Consequently, open access may become a barrier to the dissemination of work for researchers who have financial difficulty choosing open access, although it enables everyone to access articles free of charge.

Keywords Open access · Hybrid journal · Transformative agreement · Grant

Introduction

Researchers have the option to make their articles open access. Although hybrid journals, which are subscriptions with open access options, often have higher article processing charges (APCs) than fully open access journals [3, pp. 121–129; 4, pp. 2185–2206; 20, pp. 6–27], the number of open access articles in hybrid journals has recently increased. However, the development of open access differs across countries. Authors from the United Kingdom (UK), Austria, Poland, the Netherlands, Sweden and the United States (US) had high proportions of open access articles in hybrid journals when compared with authors from Turkey, China, India and Iran who did not frequently choose open access [18]. Although cOAlition S, a consortium of research funders, initially declared that Plan S did not support hybrid journals, the revised guidance on Plan S implementation permitted funded authors to

✉ Sumiko Asai
asai@meiji.ac.jp

¹ School of Political Science and Economics, Meiji University, 1-1, Kanda-Surugadai Chiyoda-Ku, Tokyo 101-8301, Japan

publish their articles in hybrid journals with transformative agreements. Authors in research institutions who signed transformative agreements with publishers could publish their articles in hybrid journals at no cost or at discounted APCs. Authors in research institutions with transformative agreements are likely to submit their articles to journals covered by the agreements [6, pp. 2027–2049]. Therefore, the varied development of open access across countries may be influenced by individual countries' open access policies, including transformative agreements between research institutions and publishers.

The conversion from subscription to open access has transferred the cost from libraries to authors and research funders. Jahn et al. [8, pp. 119–135] investigated funding sources to pay APCs for Elsevier hybrid journals and found that 33.8% of the articles were financed through agreements between research funders and the publisher. Monaghan et al. [13] investigated the funding sources for APCs of fully open access and hybrid journals published by Springer Nature. They found that nearly half of the authors combined two or more funding sources for APC payments, and the sources varied across countries, reflecting differences in open access policies established by their respective governments. Their results suggest that grants from external organizations and national open access policies play an important role in an author's decision to choose open access. However, the financial flows to publish open access articles remain under-researched owing to a lack of comprehensive data.

Olejniczak and Wilson [16, pp. 1429–1450] investigated the characteristics of authors who chose open access using a regression model and found that male authors and researchers with more federal research grants were more likely to publish open access articles in APC-funded fully open access journals and hybrid journals, compared with female authors and researchers without grants. Asai [2, pp. 299–306] examined authors' choices between Elsevier's parent and mirror journals and suggested that authors were more attentive to non-price factors, such as citation scores and ability to use transformative agreements.

The present study compared the number of grants and the distribution of authors by country for open access articles in Elsevier hybrid journals with those for non-open access articles to examine the effects of grants and the use of transformative agreements on open access choice. Elsevier has a significant influence on academia as it publishes over 2600 hybrid journals and most of them have high citation scores according to the journal list and Scopus. Investigating the effects of grants and transformative agreements on authors' choice of open access in Elsevier hybrid journals is useful for discussing the healthy development of open access.

Methodology and Target Journals

This study used Scopus to extract journals as Scopus indexes more Elsevier journals than Web of Science. It compiled 100 Elsevier hybrid journals published in 2021 and 193 in 2022 that met the following requirements. These journals published 60 or more open access articles each year. Elsevier publishes journals on behalf of academic societies, universities and other research institutions, such as the *Japanese*

Dental Science Review, in addition to the journals that Elsevier launched independently, such as *Atmospheric Environment*. However, authors of journals published on behalf of these research institutions often belong to countries where the organizations are located. Therefore, this study excluded journals published on behalf of academic societies, universities and other research institutions to avoid a bias in author distribution. When a journal is published on behalf of an academic society, university and other research institution, Elsevier provides information about the research institution that commissions the journal publication on the journal's website. If this information was lacking, this study considered the journal to be independently launched by Elsevier. Elsevier is the largest academic publisher as measured by the number of journals it publishes [10, pp. 149–155]. Moreover, approximately 70% of its hybrid journals indexed in Scopus were launched independently by Elsevier. Thus, targeting Elsevier permits securing a wide selection of samples. Articles published in 2021 were collected from November 10 to November 17, 2022. The articles published in 2022 were compiled from January 7 to January 28, 2023. It is worth mentioning the time of data collection as the number of articles may change owing to article withdrawal or other reasons.

Scopus reports the academic disciplines in accordance with the All Science Journal Classification (ASJC). Table 1 lists the number of hybrid journals and the proportion by ASJC-based academic disciplines. Although the proportions of journals in engineering, environmental science, agricultural and biological sciences, materials science and psychology differ for two years, the distribution of other disciplines' journals' number is roughly the same for the period.

Table 1 Number of journals by discipline and its proportion (%)

Discipline	2021	2022
Medicine	20 (20.0)	37 (19.2)
Social science	17 (17.0)	35 (18.1)
Engineering	12 (12.0)	51 (26.4)
Environmental science	9 (9.0)	0 (0.0)
Agricultural and biological sciences	8 (8.0)	22 (11.4)
Biochemistry, genetics and molecular biology	6 (6.0)	9 (4.7)
Energy	5 (5.0)	8 (4.1)
Chemistry	4 (4.0)	7 (3.6)
Materials science	4 (4.0)	4 (2.1)
Physics and astronomy	4 (4.0)	7 (3.6)
Arts and Humanities	3 (3.0)	5 (2.6)
Psychology	3 (3.0)	0 (0.0)
Mathematics	2 (2.0)	5 (2.6)
Neuroscience	2 (2.0)	0 (0.0)
Earth and planetary sciences	1 (1.0)	0 (0.0)
Computer science	0 (0.0)	3 (1.6)
Total	100 (100)	193 (100)

The proportion of journals (%) is mentioned within parentheses

Scopus reports the number of grants and funding sponsors for individual journals. This study compiled the number of grants and open and non-open access articles from Scopus. On average, individual hybrid journals published 119 and 122 open access articles in 2021 and 2022, respectively. The mean number of non-open access articles in 2021 was 1101; in 2022, it was 871. In 2022, the number of hybrid journals with 60 or more open access articles and the proportion of open access articles in a journal increased. These findings indicate that open access in hybrid journals has spread over the past two years. The latest citation scores available in 2022 is the CiteScore for 2021. The means of the CiteScores in 2020 and 2021 are high at 12.28 and 10.88, respectively. This indicates that Elsevier hybrid journals are frequently cited. The mean APCs applicable in 2021 and 2022 are US\$3557 and US\$3531, respectively. The correlation coefficients between APCs in 2021 and CiteScores in 2020 and between APCs in 2022 and CiteScores in 2021 are 0.591 and 0.543, respectively. This reveals that frequently cited journals charge higher APCs. This positive relationship aligns with the results of previous studies that investigated the APCs for leading publishers [3, pp. 121–129; 4, pp. 2185–2206; 20, pp. 6–27].

Results

Table 2 presents a summary of the statistics for the variables. The variable *Article* represents the number of open and non-open access articles in a journal. The large standard deviations for *Article* indicate that the number of open and non-open access articles varies across journals. Therefore, this study calculated the number of grants per article by dividing the number of grants by the number of articles, which is defined as the variable *Grant*. The mean number of grants per open access article in 2021 (2.05) is larger than that per non-open access article (1.30). Similarly, Table 2 shows that open access articles in 2022 are more frequently funded compared with non-open access articles. For *Article* and *Grant*, the null hypothesis that the mean (median) is equal between open and non-open access articles is rejected at the 1% significance level. This implies that the two

Table 2 Summary statistics of variables

	Year 2021 (N=100)				Year 2022 (N=193)			
	Open access		Non-open access		Open access		Non-open access	
	Article	Grant	Article	Grant	Article	Grant	Article	Grant
Mean	119***	2.05***	1101	1.30	122***	1.84***	871	1.29
Median	95***	1.86***	676	1.22	90***	1.73***	551	1.24
Max	861	6.46	6683	3.10	1344	4.97	6895	2.73
Min	68	0.63	113	0.31	60	0.53	60	0.35
SD	94	0.93	1158	0.45	113	0.70	1027	0.40

SD: standard deviation

***1% significance level

article types have different characteristics. There are two possible reasons for the large number of grants per open access article. First, the authors must pay APCs to publish open access articles in APC-funded journals unless the charges are waived by the publisher's policy for authors in low-income countries or transformative agreements. The means of APC list prices for the 100 and 193 journals are more than US\$3500, as mentioned in the "Methodology and Target Journals" section above. If APCs are not discounted or waived, it may be difficult for authors without grants to choose open access. Second, several funders, such as cOAlition S, mandate that researchers publish their work in open access journals. Therefore, the authors of the funded studies choose open access because of mandates from the research funders.

China had the largest number of authors who published non-open access articles in 2021 and 2022. Hence, there is a possibility that the Chinese funding system brought about a lower number of grants per non-open access article (compare Table 2). However, in 2021, this hypothesis was rejected because the mean number of grants per non-open access article by Chinese authors (2.07) is larger than the mean per non-open access article (1.30) at the 1% significance level. Similarly, in 2022, the mean number of grants per non-open access article by Chinese authors (1.87) is larger than the mean for all non-open access articles (1.29) at the 1% significance level. Moreover, the mean number of grants of Chinese authors for non-open access articles in 2021 (2.07) is larger than the mean number of grants per open access article (2.05). These findings indicate that Chinese authors use grants more frequently than other authors to publish non-open access articles. Therefore, Chinese authors do not cause a smaller number of grants per non-open access article.

As the number of articles differs across journals, the distribution of authors by country using the aggregated data for all journals may be biased. Therefore, this study investigated the top three countries with the largest numbers of authors in individual journals using the following procedure. First, this study listed the countries with the largest number of authors of open and non-open access articles for 100 journals in 2021. Second, it counted how many of the 100 selected journals belonged to each country. Similarly, it made lists of countries with the largest number of authors of open and non-open access articles for 193 journals in 2022. Further, the number of journals by country was counted for the 193 journals. Third, for individual journals in 2021 and 2022, countries with the second- and third-largest number of authors were listed, and the number of journals by country was aggregated using the same procedure. Table 3 shows that 11 countries have journals with the largest number of authors of open access articles, and the US has 22 journals with the top authors in 2021. Of the 11 countries, seven had transformative agreements with Elsevier in 2021, according to the Efficiency and Standards for Article Charges (ESAC). The total number of journals in the seven countries with transformative agreements was 73 out of the 100 journals in 2021. Although the UK ranks second, it should be noted that the transformative agreement between Jisc, a non-profit organization in the UK, and Elsevier has been effective since January 2022. However, research institutions and funders in the UK provided dedicated funds for open access [13]. Therefore, authors in the UK could publish open access articles using dedicated funds instead of transformative

Table 3 Countries with the top three authors in 2021

Open access articles			Non-open access articles		
The first	The second	The third	The first	The second	The third
US (22)	US (24)	Germany (16)	China (54)	US (39)	UK (19)
UK (19)	UK (17)	Netherlands (16)	US (43)	China (18)	Germany (13)
Netherlands (17)	Netherlands (12)	UK (14)	Canada (2)	UK (17)	US (11)
Spain (14)	Germany (11)	US (11)	UK (1)	India (7)	Australia (10)
Sweden (10)	Spain (9)	Spain (11)		Iran (4)	India (8)
Norway (5)	China (6)	Sweden (7)		Italy (4)	South Korea (7)
China (4)	Switzerland (4)	Australia (4)		Germany (3)	Canada (6)
Poland (4)	Austria (4)	Finland (3)		Australia (2)	China (6)
Germany (3)	Italy (3)	Switzerland (3)		Brazil (2)	Brazil (4)
Japan (1)	Sweden (3)	Austria (2)		France (2)	France (4)
Switzerland (1)	Japan (2)	Canada (2)		Japan (1)	Iran (4)
	Australia (1)	China (2)		South Korea (1)	Spain (3)
	Finland (1)	Denmark (2)			Italy (2)
	Poland (1)	Italy (2)			Hong Kong (1)
	South Africa (1)	France (1)			Japan (1)
	South Korea (1)	Ireland (1)			Poland (1)
		Japan (1)			
		Norway (1)			
		Poland (1)			
100 73%	100 60%	100 62%	100 43%	100 42%	100 32%

The number of journals is presented within parentheses

Bold text indicates countries with transformative agreements

The values in the bottom row are the total number of journals and the percentage of journals in which the country with the largest (second and third) number of authors had transformative agreements

agreements. The proportions of journals with the second- and third-largest numbers of authors in countries with transformative agreements were 60 and 62%, respectively.

For non-open access articles in 2021, China had 54 journals with top authors. Among the first-ranking countries of non-open access articles, only the US had a transformative agreement and the proportion of journals was 43%. Brazil, India and Iran appeared only in the column for non-open access articles, indicating that authors in these countries are likely to choose non-open access. The proportions of journals with the top three authors for non-open access articles in countries with transformative agreements ranged between 32 and 43%, which were lower than those for open access articles. It seems that authors in countries with transformative agreements are likely to choose open access articles.

Table 4 lists the countries with the top three authors in 2022. The authors in the UK, Spain, the US and the Netherlands with transformative agreements are likely to publish open access articles. For journals with the largest number of authors of open access articles, 8 of the 12 countries have transformative agreements, and the number of journals accounts for 86%. By contrast, for the first rank in non-open access articles, China, without transformative agreements,

Table 4 Countries with the top three authors in 2022

Open access articles			Non-open access articles		
The first	The second	The third	The first	The second	The third
UK (58)	UK (57)	Germany (26)	China (119)	US (85)	Australia (31)
Spain (50)	US (39)	US (25)	US (66)	China (26)	Germany (25)
US (35)	Spain (23)	UK (23)	Australia (3)	India (24)	US (23)
China (17)	Germany (17)	Netherlands	UK (3)	UK (21)	UK (16)
Netherlands	Netherlands	(21)	Canada (1)	Australia (8)	Canada (15)
(16)	(17)	China (20)	France (1)	Canada (5)	India (14)
Poland (5)	China (16)	Spain (12)		Brazil (4)	Italy (14)
Germany (4)	Denmark (5)	Poland (11)		Germany (4)	France (13)
Norway (3)	Sweden (4)	Sweden (11)		Iran (4)	China (11)
Switzerland	Japan (3)	Switzerland		South Korea	South Korea
(2)	Poland (3)	(11)		(4)	(10)
Finland (1)	Austria (2)	Finland (7)		France (2)	Brazil (9)
Japan (1)	Italy (2)	Denmark (5)		Italy (2)	Iran (7)
Sweden (1)	Norway (2)	Australia (4)		Japan (2)	Japan (1)
	Canada (1)	Italy (4)		Israel (1)	Netherlands (1)
	Portugal (1)	Norway (3)		Spain (1)	Poland (1)
	South Korea	South Korea			Saudi Arabia (1)
	(1)	(3)			Taiwan (1)
		Canada (1)			
		France (1)			
		Hungary (1)			
		Ireland (1)			
		Portugal (1)			
		South Africa			
		(1)			
		South Arabia			
		(1)			
193 86%	193 78%	193 66%	193 37%	193 62%	193 42%

The number of journals is presented within parentheses

Bold text indicates countries with transformative agreements

The values in the bottom row are the total number of journals and the percentage of journals in which the country with the largest (second and third) number of authors had transformative agreements

According to the ESAC, Poland did not have a transformative agreement with Elsevier in 2022, but it did in 2021

has the highest share of authors in 119 journals. For non-open access articles, the proportion of journals in the first-ranking countries that have transformative agreement is only 37%.

Tables 3 and 4 show similar trends. First, authors in countries with transformative agreements are more likely to publish open access articles than those in countries without such agreements. Second, most authors who chose open access in Elsevier hybrid journals were from high-income countries, as classified by the World Bank, consistent with Asai [3, pp. 24–34]. By contrast, Brazil, India and Iran, which are upper-middle-income and lower-middle-income countries, appeared only in the column for non-open access articles. Additionally, China, with the largest number of authors of non-open access articles, belongs to the upper-middle-income country

group. Thus, it seems that the choice of open access relates to the economic level of the authors' countries. Third, the number of countries in the non-open access article column is smaller than that in the open access article column. Authors of non-open access articles tend to be concentrated in specific countries, such as China. Since 2000, the Chinese government has expanded research and development expenditures [12, pp. 656–669]. In response to the Chinese government policies, the number of articles published by Chinese authors has significantly increased and overtaken that of US authors [5, pp. 1649–1655; 22, p. 390]. A high concentration of non-open access article authors by country in Tables 3 and 4 was partly caused by publishing many articles by Chinese authors.

Discussion and Conclusion

Regarding the relationship between grants and citation scores, this study found that the correlation coefficient between the mean number of grants per article in a journal in 2021 and the CiteScore for the journal in 2020 was 0.416. Similarly, the correlation coefficient between the mean number of grants in 2022 and the CiteScore in 2021 was 0.524. These positive correlations indicate that journals with more funded articles have higher citation scores, which is consistent with the results of previous studies [[1 pp. 123–127; 7, p. 217; 14, 15, pp. 1931–1951; 19, pp. 7859–7874]. The general criteria for allocating grants to researchers include their achievements measured by the number of articles in prestigious journals and the scores representing authors' evaluations, such as the h-index [17, pp. 58–70; 23]. Therefore, authors who have already received grants and acquired more citations from funded studies are likely to win new grants. Through this process, the funding system produces the Matthew effect—scholars who have previously been successful are more likely to succeed again. In addition to the fact that obtaining grants leads to new grants, implementing open access through grants may contribute to the wide dissemination of research because of free access. As a result, choice of open access might increase citation scores for the funded articles.

This study found that authors who acquired more research grants in countries with transformative agreements were more likely to choose open access. The results imply that authors' choice of open access depends on the research and development and open access policies in their respective countries. Many research funders in high-income countries provide authors with grants that can be used to pay APCs. By contrast, as low-income countries generally do not provide sufficient grants [11, pp. 637–646; 21, pp. 489–498], the authors are unlikely to publish in APC-funded journals because of financial limitations [9, pp. 14–16]. Moreover, most transformative agreements involve research institutions in developed countries according to ESAC, authors in developing countries do not have the opportunity to waive or reduce APCs under transformative agreements. Although several publishers waive APCs for authors in low-income countries from the perspective of social contribution, these authors amount to less than 1% of the total [3, pp. 24–34]. Open access seems to create barriers against research dissemination from developing countries,

although it removes a financial obstacle to acquiring articles. Therefore, we should not be over-optimistic that open access will resolve various academic problems.

This study has some limitations. First, a publisher often signs a transformative agreement with a consortium of many universities in a country; it rarely contracts with a university. Therefore, when a transformative agreement was reached in a country, this study assumed that authors in the country could use the transformative agreement. However, to examine the effects of the agreements precisely, it is appropriate to check whether individual authors belong to research institutions or consortiums with transformative agreements. Second, this study investigated Elsevier hybrid journals only. Therefore, the results cannot be generalized to other publishers. Moreover, this study extracted journals with 60 or more open access articles to investigate the country with the largest number of authors for individual journals. The number of journals that meet the requirement is small at this stage. After the development of open access in hybrid journals, it is desirable to analyze more journals.

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