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Research Paper

Is open access disrupting the journal business? A perspective from comparing full adopters, partial adopters, and non-adopters

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A B S T R A C T

Two decades after the inception of open access publishing (OA), its impact has remained a focal point in academic discourse. This study adopted a disruptive innovation framework to examine OA's influence on the traditional subscription market. It assesses the market power of gold journals (OA full adopters) in comparison with hybrid journals and closed-access journals (partial adopters and non-adopters). Additionally, it contrasts the market power between hybrid journals (partial adopters) and closed-access journals (non-adopters). Using the Lerner index to measure market power through price elasticity of demand, this study employs difference tests and multiple regressions. These findings indicate that OA full adopters disrupt the market power of non-adopting incumbents. However, by integrating the OA option into their business models, partial adopters can effectively mitigate this disruption and expand their influence from the traditional subscription market to the emerging OA paradigm.

1. Introduction

Over the past 20 years, the open access (OA) movement has profoundly transformed academic publishing (Solomon & Björk, 2012a; Tennant et al., 2016; Piwowar et al., 2018). This movement enables articles to be freely accessible online (Tennant et al., 2016), and is funded by author-paid article processing charges (APCs). OA is often seen as a radical shift capable of dismantling the high subscription paywalls that separate researchers from knowledge (Lewis, 2012).

Initially, the OA movement appears to be a disruptive technical change from the publisher's side (Henderson & Clark, 1990; Björk, 2011). OA redefined the focus of the academic publishing industry by introducing a new paradigm (Tidd et al., 1997; Björk, 2011). As adopters of this disruptive paradigm, OA journals enter the academic publishing market not through subscription fee competition, but by creating a "new" market sector where authors, as consumers, are willing to pay (more) for utility such as greater exposure, more citations, and increased prestige (Lewis, 2012; Wessel & Christensen, 2012). Viewing OA as a disruptive market innovation (Björk & Solomon, 2012), it can be hypothesized that journals adhering to the traditional subscription model may struggle to adopt the new paradigm and lose market power, whereas competitors who fully embrace the new model (gold journals) gradually take the lead (Henderson & Clark, 1990; Bower & Christensen, 1996; Nicholas, 2003; Spencer & Kirchhoff, 2006). Twenty years after the advent of OA, the established journals that relied primarily on subscriptions have not abandoned this model. Instead, they have integrated an OA option, creating a hybrid model. This strategy has allowed them to maintain and even grow their market power over the years, resulting in higher returns (Budzinski et al., 2020).

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This study explores whether OA has succeeded in transforming and challenging traditional academic publishing and knowledge-sharing system, which are fortified by the paywalls of traditional journals. Specifically, I test whether the emergence of OA has disrupted the businesses of traditional journals that partially or fully adhere to the old model. If OA represents a disruptive innovative change, I expect that journals that fully embrace this new paradigm (i.e., full adopters) will have a distinct market power advantage over both partial adopters (hybrid journals) and non-adopters (closed-access journals). Similarly, I expect that partial adopters (hybrid journals) will hold more market power than non-adopters (closed-access journals).

To test this hypothesis, I first calculate the market power using the inverse of the price elasticity of demand following the Lerner Index methodology (Lerner, 1934). Next, I compare the market power of full-OA journals with that of hybrid and closed-access journals, followed by a comparison of the market power of hybrid journals and closed-access journals. For this analysis, I create a unique dataset by integrating information from various sources, including (1) the Directory of Open Access Journals (DOAJ), (2) Scopus, (3) WorldCat, and (4) the list price of subscriptions and APCs from 11 publishers (Elsevier, Springer, Taylor & Francis, Hindawi, Bentham, IEEE, Brill, Karger Thieme, ACS and IOP), covering 61% of all journals in Scopus. The data comprise items published from 2019 to 2021, ultimately including 21,331 journal-year observations.

This study contributions to the academic publishing literature by: 1) It calculates the elasticity of demand in the subscription and OA markets using the Lerner Index and provides valuable insights into the academic publishing market. 2) It is the first study to compare the market power of journals in the subscription and OA markets empirically. 3) It creates an original dataset with information on subscription prices, subscription quantities, APCs, and number of articles under subscription and OA options for hybrid journals across 11 major publishers.

The following section reviews the pertinent literature on subscription prices, APCs, market power, and elasticity of demand within academic publishing. Section 3 provides an overview of the theoretical framework and introduces the derived econometric models. Section 4 presents the collected data and descriptive statistics. The results are presented and discussed in Section 5, followed by a comprehensive discussion and conclusion in Section 6.

2. Relevant literature in academic publishing

Numerous studies explain the product prices set by publishers and journals, whether by subscription prices or APCs. These studies often find a positive correlation between journal quality measured by citation-based indices and prices (Björk & Solomon, 2015; Solomon & Björk, 2012a; Wang et al., 2015; Pinfield et al., 2017; Solomon & Björk, 2012b; Björk & Solomon, 2014; Dewatripont et al., 2007; Chressanthis & Chressanthis, 1994; Petersen, 1992; Budzinski et al., 2020; Asai, 2020). For-profit journals tend to charge higher prices than nonprofit journals (Dewatripont et al., 2007; Budzinski et al., 2020; Petersen, 1992, 1990; Coomes et al., 2017; McCabe et al., 2006). However, studies have found different conclusions about the relationship between journal age and prices (Liu, 2011, 2005; Chressanthis & Chressanthis, 1994; Liu & Gee, 2017; Budzinski et al., 2020). Among OA journals, hybrid journals—those that maintain the subscription model while offering open access options—charge significantly higher APCs than full-OA journals (gold journals) (Pinfield et al., 2017; Björk & Solomon, 2014; Maddi & Sapinho, 2022; Budzinski et al., 2020).

Studies focusing on the publishers' market power are less common. Evidently, large publishers account for a significant portion of APC income (Pinfield et al., 2016, 2017). As measured by the revenue ranking, market power has a positive effect on APCs (Budzinski et al., 2020). Another indicator of market power is the positive effect of market concentration on prices. These robust effects are observed in both the subscription and OA models, as well as through various proxies, such as the shares of citations, prices, and articles (Asai, 2020; Budzinski et al., 2020; Dewatripont et al., 2007; Larivière et al., 2015).

The concept of the elasticity of demand in the context of academic publishing was first introduced by Bebensee et al. (1989), who noted that many journals lack close substitutes, resulting in relatively inelastic demand. Studies estimating the demand elasticity in academic publishing are scarce and focus primarily on OA publishing. Asai (2024) revealed a negative influence of APCs on submission demand by examining publications in Hindawi and Elsevier in 2022. Conversely, Khoo (2019) found that an increase in APCs slightly increased the volume of articles published by four major OA publishers (BMC, Frontiers, MDPI, and Hindawi) from 2012 to 2018. Additional literature suggests further patterns in the relationships between APCs and article numbers, as well as between subscription prices and factors such as circulation and number of issues. However, caution is warranted when directly interpreting these results as price elasticity of demand. Two studies found that the number of articles increases with an increase in APCs (Asai, 2020, 2023). Conversely, circulation and the number of issues generally decreased with higher subscription prices (Chressanthis & Chressanthis, 1993, 1994), although some studies reported a positive change in the number of issues with rising subscription prices (Petersen, 1990; Liu, 2011, 2005). To the best of my knowledge, no empirical studies have analyzed demand elasticity in the subscription market.

3. Determination of disruptive innovation

The academic publishing market operates as a two-sided market in which scientific journals function as platforms connecting authors and readers (Rochet & Tirole, 2003; McCabe & Snyder, 2005). For readers, journals provide access to published content as a service or product, whereas for authors, the publishing service becomes the product in the transaction. Typically, in two-sided platforms, one side acts as the "profit center," generating revenue, while the other acts as the "loss leader," receiving services at little to no cost (Rochet & Tirole, 2003). In the traditional subscription model, readers need to subscribe and pay a subscription fee (the "profit center"), whereas authors generally do not pay (the "loss leader"). In the open access model, the situation is reversed; readers access content for free, and the authors pay APCs to publish their articles. Here, readers become the "loss leader" and authors become the "profit center." Thus, in the subscription model, the subscription fee is the primary source of revenue, and the number of subscribers represents the demand. Conversely, in the open access model, the APC is the primary source of revenue, and the number of article submissions indicates the demand. According to Lerner (1934) and Rochet and Tirole (2003), the market power of a scientific journal as a two-sided platform is expressed as the sum of the following:

$$\frac{P_i^R + P_i^A - MC_i}{P_i^R} = -\frac{1}{e_i^R}, \tag{1}$$

and

$$\frac{P_i^R + P_i^A - MC_i}{P_i^A} = -\frac{1}{e_i^A}. \tag{2}$$

P_i^R and P_i^A represent the price for readers (subscription fee) and for authors (APC) of the journal i. MC_i stands for the marginal cost of providing access to an additional reader and/or the marginal cost of publishing one more article for authors. e_i^R and e_i^A are the corresponding price elasticities for readers and authors. When $P = MC$ a firm has zero market power, as noted by Lerner (1934); Elzinga and Mills (2011), this holds, especially when $P < MC$. Calculating market power using the Lerner index requires a positive price, i.e., the denominators in the equations must not be zero. In a pure OA model, because P_i^R is zero and less than MC_i, the market power of a scientific journal is determined by the author-side of the market and is calculated using Equation (2). Conversely, in a pure subscription model, as P_i^A is zero and less than MC_i, market power is determined by the reader-side of the market, which is calculated using Equation (1). Given that marginal cost information is rarely available in publicly accessible databases, I calculate market power using the right-hand side of these functions, which is the negative inverse of the elasticity of demand e. Price elasticity is calculated as the ratio of the percentage change in the demanded quantity to the percentage change in price:

$$e = \frac{\partial Q/Q}{\partial P/P}. \tag{3}$$

From Equation (2) and (3), we derive the price elasticity of demand in the OA market e_{oa} using the following formula:

$$e_{oa} = e^A = \frac{\partial(NSU)/(NSU)}{\partial(APC)/(APC)}, \tag{4}$$

where NSU denotes the number of submissions and APC represents APCs. Similarly, the price elasticity in the subscription market e_{sub} is given by:

$$e_{sub} = e^R = \frac{\partial(NSB)/(NSB)}{\partial(SUP)/(SUP)}, \tag{5}$$

where NSB is the number of subscriptions and SUP is the subscription price. Notably, the price elasticity of demand (e_{oa}) in the OA market can be further refined to distinguish between full-OA journals and the OA options in hybrid journals. Similarly, price elasticity in the subscription model (e_{sub}) can be differentiated to identify whether it pertains to the subscription option in a hybrid or closed-access journal. Specifically, I introduce the following distinctions: 1) Full-OA journals: e_{gold}; 2) OA option in hybrid journals: $e_{oa,hybrid}$; 3) Subscription option in hybrid journals: $e_{sub,hybrid}$; 4) closed-access journals: e_{closed}.

In this study, I aim to determine whether the market power of hybrid and closed-access journals (partial adopters and non-adopters) is weaker than that of full-OA journals and, subsequently, whether the market power of hybrid journals is greater than that of closed-access journals. From Functions (1) to (5), I expect that

$$\begin{cases} -\frac{1}{e_{gold}} > -\frac{1}{e_{oa,hybrid}}, & \text{(a)} \\ -\frac{1}{e_{gold}} > -\frac{1}{e_{sub,hybrid}}, & \text{(b)} \\ -\frac{1}{e_{gold}} > -\frac{1}{e_{closed}}. & \text{(c)} \end{cases} \tag{6}$$

Because hybrid journals offer both an OA option (the adopting side of partial adopters) and a subscription option (the non-adopting side of partial adopters), they have positive prices and, therefore, market power in both the OA market ($-1/e_{oa,hybrid}$) and the subscription market ($-1/e_{sub,hybrid}$). If OA is a disruptive paradigm, the market power of a hybrid journal in the OA market should be superior to that in the subscription market, i.e., $-1/e_{oa,hybrid} > -1/e_{sub,hybrid}$. Consequently, full-OA journals are expected to have more pronounced market power than hybrid journals (see Equation (6a)), particularly when comparing full-OA journals with the subscription option for hybrid journals (refer to Equation (6b)). Additionally, the market power of full-OA journals is expected to surpass that of closed-access journals, as indicated by Equation (6c). Next, I examine whether the market power of hybrid journals (partial adopters) is stronger than that of closed-access journals (non-adopters). This can be expressed as follows:

$$-\frac{1}{e_{oa,hybrid}} > -\frac{1}{e_{sub,closed}}. \tag{7}$$

Notably, for hybrid journals, only the OA option embraces the new OA paradigm, whereas the subscription option does not. Therefore, the comparison of market power specifically focuses on the OA option compared to closed-access journals, as illustrated in Equation (7). Both Equation (6) and Equation (7) can be further simplified to:

$$\begin{cases} e_{gold} > e_{oa,hybrid}, & \text{(a)} \\ e_{gold} > e_{sub,hybrid}, & \text{(b)} \\ e_{gold} > e_{closed}, & \text{(c)} \end{cases} \tag{8}$$

and

$$e_{oa,hybrid} > e_{closed}. \tag{9}$$

While market power or price elasticities can be compared through difference tests, the observed differences may be influenced by factors such as product quality, market strategy of publishers or journals, and heterogeneity of disciplines. To obtain more robust results, these variables must be controlled. In addition to the difference tests, multiple regressions are implemented to account for the various control variables. Separate regressions are conducted for the OA and subscription models. This approach allows a more comprehensive analysis by isolating the impact of specific factors on market power and price elasticity in both models.

While market power or price elasticities can be compared through difference tests, the observed differences may be influenced by factors such as product quality, market strategy of publishers or journals, and heterogeneity of disciplines. To obtain robust results, it is essential to control for these variables. In addition to difference tests, multiple regressions were implemented to consider various control variables. Separate regressions are run for the OA and subscription model[1]:

$$NSU_{i,t} = \alpha + \beta_{oa} APC_{i,t} + \beta X + \epsilon \tag{10}$$

and

$$NSB_{i,t} = \alpha + \beta_{sub} SUP_{i,t} + \beta X + \epsilon, \tag{11}$$

where $NSU_{i,t}$ and $APC_{i,t}$ are the number of submissions and APC of journal i in year t under the OA model (see Equation (10)); $NSB_{i,t}$ and $SUP_{i,t}$ are the number of subscribing libraries and subscription price of journal i in year t under the subscription model (see Function (11)). X comprises all control variables, including citations, as a proxy for journal quality, a binary variable indicating whether the journal experienced any merger or acquisition activities or publisher changes in the observation year, a binary variable indicating whether the journal is affiliated with one of the top 10 publishers, whether the journal is associated with a for-profit or university publisher, a dummy variable for the observation year, and 28 discipline indicators as defined by Scopus. As the number of published articles should influence the journal readers' subscription decisions, the number of articles is also included as a control variable in Equation (11). ϵ is the disturbance term. When Equations (10) and (11) are log-transformed, in the OA scenario:

$$\beta_{oa} = \frac{\partial \ln(NSU_{i,t})}{\partial \ln(APC_{i,t})} \approx \frac{\partial(NSU_{i,t})/(NSU_{i,t})}{\partial(APC_{i,t})/(APC_{i,t})}, \tag{12}$$

and, under the subscription model:

$$\beta_{sub} = \frac{\partial \ln(NSB_{i,t})}{\partial \ln(SUP_{i,t})} \approx \frac{\partial(NSB_{i,t})/(NSB_{i,t})}{\partial(SUP_{i,t})/(SUP_{i,t})}. \tag{13}$$

The parts on the right side of Equations (12) and (13) are the same as those of Equations (4) and (5). We can infer that β_{oa} and β_{sub} can be regarded as e_{oa} and e_{sub}, respectively, after excluding possible covariance from other factors. Thus, more robust results of the comparison between e_{oa} and e_{sub} presented in Equations (8) and (9) can be obtained through:

$$\begin{cases} \beta_{gold} > \beta_{oa,hybrid}, & \text{(a)} \\ \beta_{gold} > \beta_{sub,hybrid}, & \text{(b)} \\ \beta_{gold} > \beta_{closed}, & \text{(c)} \end{cases} \tag{14}$$

and

$$\beta_{oa,hybrid} > \beta_{closed}. \tag{15}$$

4. Data

Journal information, including citations, number of articles, OA status, disciplines, and publisher names, is extracted from Scopus. As information on the number of submissions is not available, I use the number of published articles as a proxy[2]. In this study,

[1] As mentioned at the beginning of this section, in Equation (10)—in the OA scenario—the authors are the consumers of the OA publishing service, with the APC representing the product price and the number of articles indicating the demand from the authors. Conversely, in Equation (11)—in the subscription scenario—the consumers are the readers or subscribers, the subscription fee constitutes the product price, and the number of subscriptions or subscribing libraries represents the demand.

[2] Given that the reputation of journals takes years to establish and remains relatively stable over time (Chressanthis & Chressanthis, 1994; Liu, 2011; Liu & Gee, 2017), the acceptance rate of journals can be considered constant within a short time period. To calculate the price elasticity of demand, instead of using the absolute number of submissions, we require the percentage change in the number of submissions over a specified period, for instance, a one-year percentage change: $(NSU_{i,t} -$

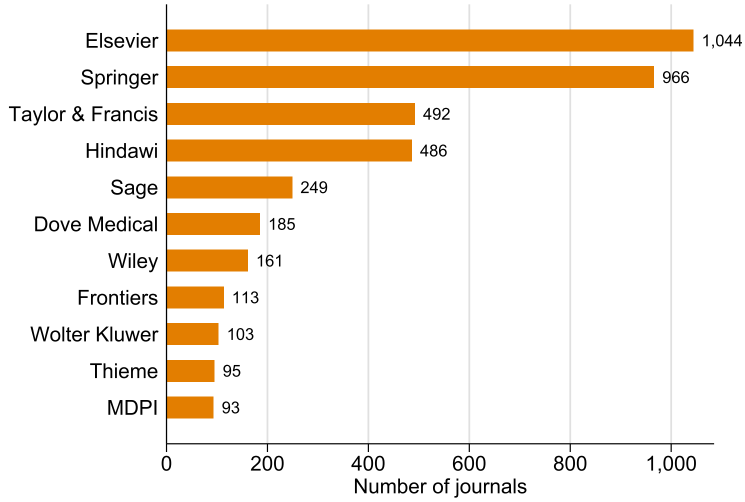


Fig. 1. Number of OA journals of the 11 largest publishers in OA sample.

citations (with a 5-year citation window) and OA status are initially determined at the article level, then aggregated to the journal level. At the article level, Scopus provides information on the corresponding Creative Commons licenses obtained for each article. By aggregating articles with specific OA statuses, as indicated by these licenses, I can identify the number of articles published through official OA models, which typically involve APCs. This allows me to distinguish these articles from those available through other OA outlets, such as journal data archives. Additionally, for hybrid journals, I can differentiate OA articles from those published under subscription options. By using citations at the article level rather than journal-level indexes, such as the Journal Impact Factor (JIF) or Source Normalized Impact per paper (SNIP), the analysis can more accurately identify the benefits authors gain from paying for OA publishing in the demand function. Data on pricing and demand for both OA and subscription markets are collected independently. APC information is obtained from the Directory of Open Access Journals (DOAJ), which forms the OA journal sample for this study. The subscription data are gathered from WorldCat. As subscription prices are manually collected from publisher websites, selecting which publisher information to include requires careful consideration. To reflect the academic publishing market landscape, I incorporate data from publishers across different tiers, including the largest, mid-sized, and smaller-sized publishers among the top 25 publishers ranked by share in Scopus. For the subscription market, the data include Springer, Elsevier, and Taylor & Francis as the largest publishers; Hindawi, Bentham, IEEE, Brill, and Karger as mid-sized publishers (ranking 14–18 by share in Scopus); and Thieme, ACS, and IOP as smaller-sized publishers (ranking 22–24 in Scopus). In total, 11 publishers from the largest 25 publishers in Scopus are included in the current sample, covering 61% of all journals in Scopus. Information about whether the publishers are for-profit or university presses is gathered from their respective websites. All information gathered related to the years 2019–2021. The main analysis comprises a dataset of 21,339 journal-year observations.

Fig. 1 depicts the number of journals affiliated with the 11 largest publishers with nonzero APCs for OA journals in the current sample. These publishers are those with more than 50 OA journals in their dataset. Elsevier and Springer stand out as possessing considerably more journals than the other publishers. Interestingly, the sizes of Taylor & Francis and Hindawi appear to be comparable, despite Hindawi being classified as a mid-sized publisher in the data. This can be attributed to Hindawi's status as a full-OA publisher.

Fig. 2 shows the 11 publishers selected for subscription market data. The number of journals illustrated in the graph encompasses journals of various models: gold, hybrid, and closed access. Springer leads with 5,755 journals, followed by Taylor & Francis and Elsevier. Hindawi, Bentham, IEEE, and Brill, each with approximately 260–570 journals in their dataset, represent mid-sized publishers. ACS and IOP, with fewer than 200 journals each, represent smaller-sized publishers, although they are in the top 25. Thieme's journals are slightly overrepresented in the dataset; with 298 journals, Thieme appears to be a mid-sized publisher, but it ranks at 22 in Scopus. Conversely, Karger's journals are slightly underrepresented. Despite its Scopus ranking of 18, Karger is more consistent with the smaller publishers in the current dataset.

The distribution of business models (gold, hybrid, and closed access) varies greatly from publisher to publisher (see Fig. 3). Except for Hindawi, which operates exclusively under the gold OA model for all its journals, all other publishers classified less than 35% of their journals as OA. IOP represented the largest share of closed-access journals at 22.6%. In addition to IOP, other publishers that continue to offer closed options in their journals are Springer, Elsevier, and Taylor & Francis.

$NSU_{i,t-1})/NSU_{i,t-1}$. We can derive the number of submissions for journal i by dividing the number of published articles (NAR_i) by the acceptance rate (ACR_i) of journal i, namely NAR_i/ACR_i. If the acceptance rate remains constant between $t-1$ and t for journal i, then the percentage change in the number of submissions equals the percentage change in the number of articles. This relationship can be illustrated as follows: $(NSU_{i,t} - NSU_{i,t-1})/NSU_{i,t-1} = \frac{(NAR_{i,t}-NAR_{i,t-1})/ACR_i}{NAR_{i,t-1}/ACR_i} = (NAR_{i,t} - NAR_{i,t-1})/NAR_{i,t-1}$. Thus, when calculating the price elasticity of demand over a short time period, the number of articles serves as a reliable proxy for the number of submissions.

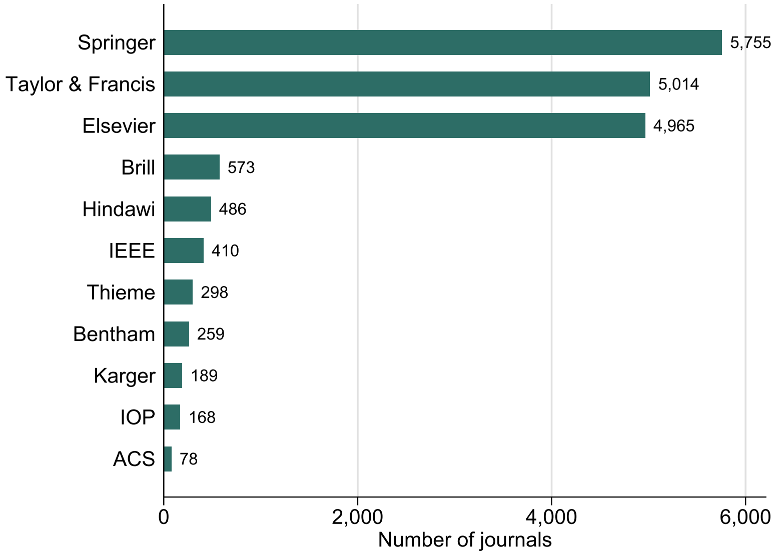


Fig. 2. Number of journals belonging to the 11 selected publishers.

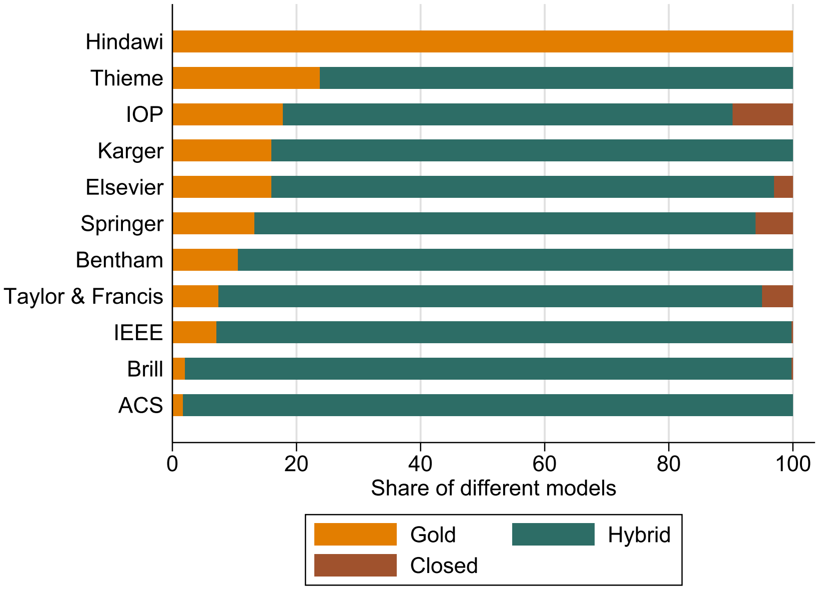


Fig. 3. Proportion of journals by business models across publishers in non-OA sample.

The average APCs for gold and hybrid journals, categorized by both big[3] and small publishers, are presented in Table 1. For each type (gold or hybrid) of journal, the second row shows the number of observations in parentheses, and the third row shows the corresponding share of the total sample. For both gold and hybrid journals, the average APCs of big publishers significantly exceed those of smaller publishers, as indicated by the asterisks in the upper-right corners of the numbers. Furthermore, regardless of publisher size, the average APCs of hybrid journals are significantly higher than those of gold journals, as denoted by the small circles in the upper-left corner of the numbers.

Table 2 displays the mean subscription prices of closed access and hybrid journals, classified by publisher size[4]. Notably, closed access and hybrid journals exhibit significantly higher average subscription prices when associated with big publishers than when

[3] The top 10 largest publishers by share in Scopus, namely Springer, Elsevier, Taylor & Francis, Wiley, Wolters Kluwer, Cambridge University Press, Oxford University Press, Sage, and Emerald.

[4] As the data for the subscription market comprises the 11 selected publishers, all of which are among the top 25 publishers in Scopus, the large publishers in this case are the three prominent ones: Elsevier, Springer, and Taylor & Francis. The smaller ones comprise the remaining eight publishers, referred to as "smaller" publishers for simplicity.

Table 1
Difference in mean APC across different publisher sizes and different OA models.

OA models	Publisher size		Total
	Big	Small	
Gold	$^{\circ\circ\circ}$2,167***	$^{\circ\circ\circ}$824***	$^{\circ\circ\circ}$1,479
	(3,114)	(3,273)	(6,387)
	49%	51%	100%
Hybrid	$^{\circ\circ\circ}$3,136***	$^{\circ\circ\circ}$2,768***	$^{\circ\circ\circ}$3,089
	(11,305)	(1,669)	(12,974)
	87%	13%	100%
Total	2,927***	1,481***	2,558
	(14,419)	(4,942)	(19,368)
	74%	26%	100%

Note: For each type of OA model, the first row shows the mean APC in US dollars; the second row depicts the number of journal-year observations; the third row demonstrates the share of journals in either type of publishers (big/small). The asterisks (*) in the upper right corner of the numbers indicate the significance level of the difference in APCs between big and small publishers within each type of OA model: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The significance level of the difference in APCs between gold and hybrid journals within each type of publishers (big/small) is denoted in the upper left corner by: $^{\circ\circ\circ}$ $p < 0.01$, $^{\circ\circ}$ $p < 0.05$, $^{\circ}$ $p < 0.1$.

Table 2
Difference in mean subscription price across different publisher sizes and different publishing models.

Models	Publisher size		Total
	Big	Smaller	
Closed	$^{\circ\circ\circ}$4,675***	$^{\circ\circ}$1,815***	$^{\circ\circ\circ}$4,613
	(1,927)	(43)	(1,970)
	98%	2%	100%
Hybrid	$^{\circ\circ\circ}$2,297***	$^{\circ\circ}$1,330***	$^{\circ\circ\circ}$2,172
	(11,305)	(1,669)	(12,974)
	87%	13%	100%
Total	2,643***	1,342***	2,494
	(13,232)	(1,712)	(14,944)
	89%	11%	100%

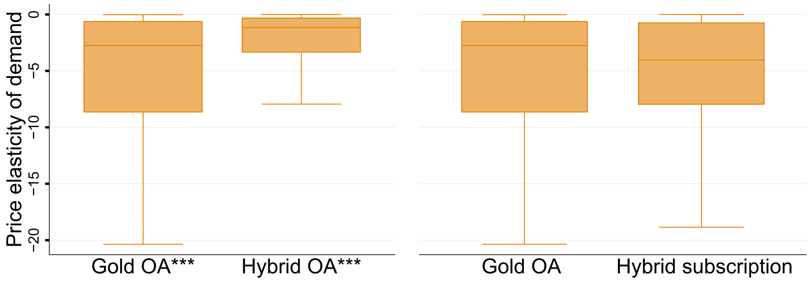
Note: For each type of publishing model (closed access/hybrid journals), the first row shows the mean subscription price in US dollars; the second row demonstrates the number of journal-year observations; the third row depicts the share of journals belonging to big or smaller publishers. The asterisks (*) in the upper right corner of the numbers indicate the significance level of the difference in subscription price between big and small publishers within each type of publishing model: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The significance level of the difference in subscription price between closed-access and hybrid journals within each type of publishers (big/smaller) is denoted in the upper left corner by: $^{\circ\circ\circ}$ $p < 0.01$, $^{\circ\circ}$ $p < 0.05$, $^{\circ}$ $p < 0.1$.

associated with smaller publishers (indicated by asterisks in the upper-right corner of the numbers). As indicated by the small circles in the upper left corner of the numbers, the mean subscription prices of closed journals significantly surpass those of hybrid journals, irrespective of publisher size.

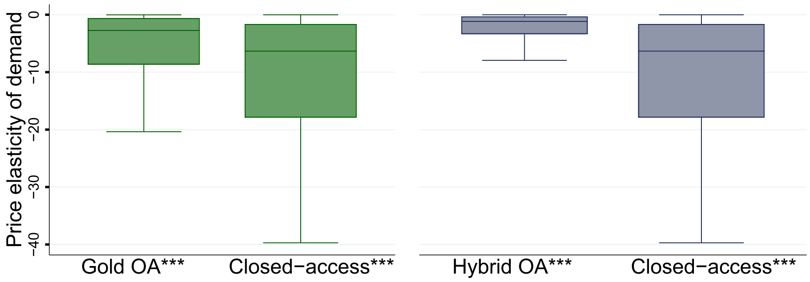
5. Results

5.1. Difference tests

Figure (4) visually represents the price elasticities of demand for the different publishing models between 2019 and 2021. This figure offers insights into the comparison of price elasticities among various groups; in Subfigure (4a), the comparison is made between gold journals (full adopters) and the OA option of hybrid journals (adopting part of partial adopters). Subfigure (4b) contrasts



(a) Gold OA and Hybrid OA **(b)** Gold OA and Hybrid subs



(c) Gold OA and Closed **(d)** Hybrid OA overall and Closed

Note: Only values of e less than zero are considered. (a) illustrates the discrepancy between all gold journals and the OA option of hybrid journals belonging to big publishers; (b) presents the comparison between gold journals overall and the subscription option of hybrid journals associated with big publishers; (c) showcases the difference of all gold journals and closed-access journals of big publishers; (d) manifests the contrast between the OA option of hybrid journals in general and the closed-journals associated with big publishers. The significance levels of the observed mean differences are indicated in the upper right corner of the x-axis labels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Fig. 4. Difference in market power across full adopters, partial adopters and non-adopters of OA.

gold journals with hybrid journals' subscription option (the non-adopting part of partial adopters). Subfigure (4c) illustrates the comparison between gold journals and closed-access journals (non-adopters). Subfigure (4d) highlights the difference between the OA options of hybrid and closed-access journals, focusing on partial adopters versus non-adopters. Negative price elasticity is generally expected[5]. The interpretation of the positive price elasticity of demand can be ambiguous as it may stem from both competitive and noncompetitive conditions (Spierdijk & Zaouras, 2017). Only negative values are included in the graph[6]. In Section 5.2, various potential influencing factors are considered to derive more precise values for demand elasticity.

When comparing medians, the significantly higher price elasticity for gold journals compared with closed-access journals indicates significantly greater market power for full adopters than for non-adopters (see Subfig. 4c). Similarly, the median price elasticity of demand for the OA option for hybrid journals significantly exceeds that for closed-access journals (see Subfig. 4d). This underlies the fact that the market power of the adopting side of partial adopters surpasses that of non-adopters. Nonetheless, as Subfigure (4b) shows, the distinction between the market power of gold journals and the subscription option of hybrid journals is not significant. Moreover, the median price elasticity for gold journals is significantly lower than that of the OA option of hybrid journals. Thus, full adopters possess lower market power than do partial adopters, as depicted in Subfig. (4a).

5.2. *Regressions*

To derive more precise values for price elasticity of demand, I incorporated potential control variables. I conduct four regressions, labeled Gold, Hybrid OA, Hybrid Subscription, and Closed, to obtain price elasticities for the four different samples (see Table 3). These samples included gold journals (full adopters), OA options in hybrid journals (the adopting side of partial adopters), subscription options in hybrid journals (the non-adopting side of partial adopters), and closed-access journals (non-adopters). For Gold and Hybrid OA samples, the dependent variable is the number of articles, with the APC as the main independent variable. In the Hybrid Subscription and Closed samples, the dependent variable is the number of subscribing libraries, with the subscription fee as the main independent variable.

[5] Positive values in this descriptive analysis may arise for various reasons, including the short observation period and potential influence of other factors.

[6] Excluding positive values leaves 146 entries for gold journals (32% of 462), 320 for the OA option of hybrid journals (35% of 916), 1,823 for the subscription option for hybrid journals (42% of 4,362), and 112 for closed-access journals (40% of 285).

Table 3
Regression estimated price elasticity of demand.

Models	(1) Gold	(2) Hybrid OA	(3) Hybrid Subscription	(4) Closed
Dependent variables:	No. of articles	No. of articles	No. of subscription	No. of subscription
IV: APC	-0.041	-0.118***		
	(0.034)	(0.038)		
IV: Subscription fee			-0.314*	-2.324**
			(0.184)	(1.064)
Citations	0.684***	0.364***	-0.019	-0.277
	(0.015)	(0.016)	(0.061)	(0.243)
Merger & acquisition	0.041	0.206**	0.129	-
	(0.032)	(0.085)	(0.236)	-
Number of articles			0.071	0.166
			(0.097)	(0.410)
Year	0.185***	0.497***	0.079*	0.401**
	(0.012)	(0.013)	(0.045)	(0.177)
Big publisher	-0.036**	0.091***		
	(0.014)	(0.018)		
Elsevier			-0.026	0.154
			(0.055)	(0.340)
Springer			0.229***	0.347
			(0.055)	(0.297)
Taylor & Francis			-0.077	0.115
			(0.055)	(0.322)
For-profit	0.031	-0.120***	-	-
	(0.020)	(0.026)	-	-
University	-0.002	-	-	-
	(0.065)	-	-	-
Business, management & accounting	-0.088	0.053**	0.065	0.493
	(0.068)	(0.027)	(0.078)	(0.507)
Engineering	-0.015	0.050**	0.037	0.302
	(0.033)	(0.022)	(0.072)	(0.304)
Mathematics	-0.053	0.118***	-0.116	-0.031
	(0.044)	(0.024)	(0.081)	(0.298)
Medicine	-0.020	0.045**	-0.004	0.093
	(0.022)	(0.019)	(0.060)	(0.292)
Multidisciplinary	-0.043	-0.150	-0.461	-2.711**
	(0.060)	(0.119)	(0.374)	(1.145)
Nursing	-0.056	0.092*	-0.160	0.032
	(0.055)	(0.051)	(0.162)	(0.450)
Constant	-0.102***	-0.457***	-0.333	-1.032
	(0.039)	(0.089)	(0.320)	(1.249)
Observations	1,816	4,615	6,646	511
R2 (adj)	0.612	0.350	0.014	0.019

Notes: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. All numeric variables are log-transformed and normalized by removing their means within the respective journals. A total of 28 discipline variables, as defined by Scopus, are included in all models. Only those showing significant effects are displayed in the table. Missing values ("-") indicate variables excluded due to multicollinearity. To control journals from big publishers and to avoid multicollinearity, Models (1) and (3) include a dummy variable for the top 10 publishers, while Models (2) and (4) through (6) include dummy variables for Elsevier, Springer, and Taylor & Francis, respectively.

These regressions include control variables, such as citations, dummy variables for merger and acquisition activities, year, discipline, affiliation with the top ten publishers, and affiliation with for-profit and university publishers. However, collinearity means that not all control variables can be included in all models. The binary variables for *for-profit* and *university* coexist only in Model (1) for gold journals. Exclusion due to multicollinearity is marked by a dash ("-") in Table 3. The subscription data samples (Hybrid Subscription/Model 3 and Closed/Model 4) comprised 11 well-known publishers. The inclusion of the *big publisher* dummy causes multicollinearity issues. Therefore, in Models (3) and (4), this is replaced by dichotomous variables for the top three publishers: Elsevier, Springer, and Taylor & Francis. All cardinal variables undergo logarithmic transformation. To address heterogeneity across journals, each cardinal variable is normalized by removing the mean of that variable within its respective journal. The price elasticity of demand is reflected in the coefficients of *APC* in Models (1) and (2) and the coefficients of *subscription* in Models (3) and (4). All coefficients are negative, but that in Model (1) is not statistically significant. For the subscription samples, the coefficients indicate that a 1% increase in the subscription fee results in a 0.31% decrease in subscriptions for hybrid journals (see -0.314 in Model 3) and a 2.32% decrease for closed-access journals (refer to -2.324 in Model 4). Demand is less elastic for the OA option than for subscriptions in hybrid journals. Model (2) shows that when APCs increase by 1%, the number of articles decreases by 0.12%. The insignificant coefficient for gold journals in Model (1) suggests that the elasticity of demand for gold journals is not significantly different from

Table 4
Wald tests of price elasticity of demand across models.

Models	Gold vs. Hybrid OA (1)	Gold vs. Hybrid sub. (2)	Gold vs. Closed (3)	Hybrid OA vs. Closed (4)	Hybrid sub. vs. Closed (5)
Coeff.	−0.041 > −0.118 ($\beta_{gold} > \beta_{oa,hybrid}$)	−0.041 > −0.314 ($\beta_{gold} > \beta_{sub,hybrid}$)	−0.041 > −2.324** ($\beta_{gold} > \beta_{closed}$)	−0.118 > −2.324** ($\beta_{oa,hybrid} > \beta_{closed}$)	−0.314 > −2.324** ($\beta_{sub,hybrid} > \beta_{closed}$)
P-values	0.234	0.137	0.021	0.025	0.047

Notes: The coefficients are the regression coefficients of *APC* (Model 1 and 2) and *subscription* (Model 3 and 4) shown in Table 3. Significance levels for the Wald test results are indicated as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The elasticity comparisons across different samples are presented as follows: Column (1) compares gold journals (β_{gold}) and the OA option in hybrid journals ($\beta_{oa,hybrid}$); Column (2) compares gold journals (β_{gold}) with the subscription option in hybrid journals ($\beta_{sub,hybrid}$); Column (3) compares gold journals (β_{gold}) with closed-access journals (β_{closed}); Column (4) compares the OA option in hybrid journals ($\beta_{oa,hybrid}$) with closed-access journals (β_{closed}); and Column (5) compares the subscription option in hybrid journals ($\beta_{sub,hybrid}$) against closed-access journals (β_{closed}).

zero, making it the least elastic among the four samples. Wald tests are conducted to determine whether the differences between these four demand elasticities are significant (see Table 4). The results show that the demand elasticities for gold and hybrid journals, under either the OA or subscription option, are not significantly different (Columns 1 and 2 in Table 4). Demand for gold and hybrid journals, including both OA and subscription options, is significantly less elastic than that for closed-access journals (Columns 3 to 5). This finding indicates that the market power of gold and hybrid journals is significantly greater than that of closed-access journals. However, there was no significant difference between the market power of gold journals and that of hybrid journals.

For the control variables in Table 3, citations correlate positively with the number of articles but do not have a clear relationship with the number of subscriptions. This result is logical, as authors aim to achieve more citations when choosing where to publish, whereas subscription decisions are influenced more directly by factors such as existing subscription portfolios, library budgets, and agreements with publishers. Mergers and acquisitions seem to coincide with APC increases in hybrid journals. Hybrid journals affiliated with the top 10 publishers charged higher APCs. However, affiliation with the top 10 publishers did not significantly affect gold journal pricing. Notably, Springer charges significantly higher subscription fees for its hybrid journals than other publishers. When the journal price is based on marginal costs, we should not observe different pricing across disciplines. If the pricing strategy depends on a competitive environment, we would expect different pricing behavior across disciplines. The higher price variance observed for hybrid OA journals suggests that their APC pricing strategy is competition oriented. For example, when a disciplined market is competitive, the journals charge lower APCs; however, in less competitive and more concentrated markets, higher APCs are levied. Additionally, both APCs and subscription fees increased significantly from 2019 to 2021.

6. Discussion and conclusion

Two decades after the emergence of OA publishing, its impact remains a central topic of discussion. Some scholars argue that shifting from subscription fees to APCs does not necessarily make academic publishing more affordable or supportive to open science. They highlight significant variations in charges across different publishers and journals (Pinfield et al., 2017; Björk & Solomon, 2014; Maddi & Sapinho, 2022; Budzinski et al., 2020). Others contend that OA does not prevent established incumbents from reaping monopolistic rents in academic publishing, suggesting that major publishers continue to exert considerable market power (Asai, 2020; Budzinski et al., 2020; Larivière et al., 2015). This study employs the concept of disruptive innovation to develop a more systematic perspective on the impact of OA. It compares the market power of full-OA adopters with that of partial adopters and non-adopters. Using Lerner's definition of market power, a series of mean difference tests and regressions were conducted using Lerner's definition of market power. The findings reveal that both full-OA adopters and partial adopters exhibit greater market power than non-adopters. However, full adopters do not have more market power than partial adopters, even when compared to the subscription options of hybrid journals. This suggests that OA disrupts the market power of both incumbents and traditional businesses. Nevertheless, the situation changes once incumbents integrate an OA option into their publishing repertoire and transition to a hybrid model. Through this transition, established incumbents extend their market power from traditional business to an innovative paradigm, securing monopolistic rent in academic publishing.

The finding that hybrid journals do not generate less profit than the sole subscription model is unsurprising given the existing research on APC pricing for hybrid and gold journals. However, the lack of studies investigating OA along with the traditional subscription model leaves the impact of OA on traditional publishing largely unexplored. The revelation that OA disrupts the obsolete pure-subscription business model is an understated merit of OA. In addition, this study confirms the high demand for gold journals among scholars. Although hybrid journals typically charge higher prices, gold journals do not enjoy less market power than hybrid journals when defined by price elasticity of demand.

Therefore, several noteworthy issues must be addressed. This study examines disruptive innovation through a comparative analysis of market power. Although the literature frequently discusses comparisons based on sales volume and market share (Christensen & Bower, 1996; Bessen et al., 2020), the reader market (subscription model) differs fundamentally from the author market (OA model). Comparing the market shares of these two distinct markets is akin to comparing apples to oranges. Hence, a direct comparison of market power was more suitable and relevant for this analysis.

As an increasing number of countries and consortia enter into transformative agreements (TAs) (Borrego et al., 2021), this becomes more relevant. By including binary variables indicating the top 10 or top 3 publishers in the regressions, the analyses can partially exclude idiosyncrasies related to large publishers. While this exclusion ensures, to a certain extent, that there are no confounding influence from TAs, it also means that the estimated price elasticity of demand or market power does not reflect situations related to TAs. To examine scenarios without any TAs at all and with TAs, an additional case study of Springer in Germany is presented in Appendix A as a robustness check[7]. This case study includes: 1) a comparison of the price elasticity of demand between gold journals and OA hybrid journals for Springer (a TA publisher) in Germany and 2) a comparison of the price elasticity between Springer journals and other journals without TAs in Germany. The results confirm that: 1) in a scenario without TA publishers, the results remain consistent and 2) in a scenario with only Springer journals (journals under TAs in Germany), the findings do not significantly deviate from the main results, demonstrating robustness (for more details of the Springer case in Germany, refer to Appendix A).

In addition to TAs, most libraries receive discounted prices or acquire bundles as consortia members (Coomes et al., 2017). Additionally, OA journals often offer discounts to various stakeholders on specific occasions[8]. As subscription prices are manually collected from publisher websites, there is a concern about potential overestimation. However, the use of public pricing is not unprecedented in scientific analysis and is supported by previous research (Coomes et al., 2017). In this study, overestimating the price is not problematic, as price elasticity focuses on the share of price change rather than the absolute price value or change.

The R-squared values in the regression models for Hybrid Subscription and Closed Access (Models 3 and 4 in Table 3) are relatively low at 0.014 and 0.019, respectively. Thus, the regression models for the subscription market explain only a modest amount of the variance in subscriptions. As the focus is on estimating price elasticity—the marginal effects of subscription fees on the number of subscriptions—the relatively high unexplained variance should not raise fundamental concerns. Understandably, subscription decisions depend on various factors, including library budgets, existing subscription portfolios, and ongoing agreements with different publishers. However, a more comprehensive regression model with higher explained variance would be beneficial. If feasible with the available datasets, future studies should incorporate actual subscription prices, library budgets, indicators of bundles and pricing packages, as well as longitudinal data to improve the accuracy of comparing the price elasticity of demand across full-OA, hybrid, and closed-access journals.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used DeepL and Chat GPT to improve sentence phrasing and grammar. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

CRediT authorship contribution statement

Xijie Zhang: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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Appendix A. Robustness for transformative agreements: the Springer case in Germany

Germany established transformative agreements (TAs) with three major publishers during the specified periods: Wiley (2019–2023 and 2024–2028), Springer (2020–2023 and 2024–2028), and Elsevier (2023-2028) (DEAL Konsortium, 2022). Under these agreements, nearly all research institutions in Germany can freely access and publish articles at little or no cost in most journals from these publishers (DEAL Konsortium, 2022). Despite the availability of bundled pricing or Publish and Read Fee (PAR Fee) information, estimating the average publication cost per article (adjusted APC) becomes less relevant when scholars perceive publishing in TA-affiliated journals as essentially free, given that agreements are already in place between publishers and consortia. Consequently, incorporating such an average PAR Fee into authors’ demand function may not be beneficial.

However, TAs encourage scholars to publish more in these journals, potentially boosting demand for the corresponding OA channels. Therefore, using listed APCs prior to TAs could overestimate price elasticity, suggesting less elasticity than what actually exists. Thus, this case study does not aim to estimate price elasticity of demand under TA conditions. Instead, it seeks to 1) compare results from scenarios without TA journals to those from the main analyses and 2) assess changes in price elasticity under scenarios featuring only TA journals, reflecting potentially increased demand, and evaluate the extent of overestimation that may occur when TA journals are included.

[7] Germany has TAs with three publishers from 2019: Wiley (2019–2023 and 2024–2028), Springer (2020–2023 and 2024–2028), and Elsevier (2023–2028) (DEAL Konsortium, 2022). This provided a plausible setting for testing scenarios without TA journals by excluding journals from any of these three publishers. Considering that the current dataset covers information from 2019 to 2021, and that Springer became a TA publisher in Germany in 2020, if TAs significantly drive OA publishing demand, analysis of the change in demand from 2019 to 2021 would make this clear.

[8] For example, APC waivers are provided for authors from low-income countries, and discounts are available for editors and reviewers publishing with journals they have supported under special conditions.

Table 5
Regression estimated price elasticity of demand.

Dependent variables: Number of articles	(1) Gold (others)	(2) Hybrid OA (others)	(3) Gold (Springer)	(4) Hybrid OA (Springer)
APC	-0.069	-0.126**	0.134	-0.199
	(0.062)	(0.052)	(0.163)	(0.244)
Citations	0.464***	0.129***	0.497***	0.131***
	(0.024)	(0.018)	(0.024)	(0.026)
Merger & acquisitions	-0.005	0.036	0.018	0.207
	(0.050)	(0.247)	(0.073)	(0.217)
Year	0.172***	0.294***	0.124***	0.582***
	(0.020)	(0.021)	(0.026)	(0.056)
Big publisher	0.027	0.095***		
	(0.023)	(0.027)		
For-profit	-0.042	-0.113***		
	(0.033)	(0.034)		
Decision sciences	-0.073	-0.026	-0.064	-0.192*
	(0.177)	(0.085)	(0.215)	(0.108)
Economics, econometrics & finance	-0.124	0.002		-0.120*
	(0.144)	(0.044)		(0.066)
Environmental science	-0.006	0.083*	0.046	-0.020
	(0.057)	(0.045)	(0.079)	(0.060)
Medicine	-0.003	-0.027	0.005	0.133***
	(0.038)	(0.027)	(0.038)	(0.042)
Multidisciplinary	-0.022	-0.157	-0.003	0.631*
	(0.071)	(0.247)	(0.154)	(0.370)
Physics & astronomy	-0.013	0.027	-0.056	0.143*
	(0.071)	(0.044)	(0.102)	(0.083)
Psychology	0.387***	0.035	0.080	0.083
	(0.144)	(0.051)	(0.127)	(0.069)
Social sciences	-0.011	0.025	-0.145**	-0.068
	(0.073)	(0.040)	(0.073)	(0.054)
Constant	-0.065	-0.184	-0.077	-0.561**
	(0.062)	(0.249)	(0.081)	(0.224)
Observations	715	1,556	508	1,357
R2 (adj)	0.406	0.155	0.508	0.122

Notes: Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Models (1) and (2) exclude journals published by Wiley, Springer, or Elsevier. Models (3) and (4) exclusively feature journals published by Springer. These analyses include only journals containing articles authored by German researchers. All numeric variables are log-transformed and normalized by removing their means within the respective journals. 28 discipline variables, as defined by Scopus, are included in all models. Only those showing significant effects are displayed in the table. Models (3) and (4) include only journal information from Springer. Therefore, publisher binary variables such as *big publisher* and *for-profit* are excluded from these models. Additionally, Springer has only one gold journal in the field of Economics, Econometrics & Finance, but the number of articles for this journal is not available.

The TA landscape in Germany provides a unique opportunity to explore scenarios that exclude TA journals, specifically by excluding journals from Wiley, Springer, and Elsevier. With data covering 2019 and 2021 and Springer joining as a TA publisher in Germany in 2020, any impact of TAs on OA publishing demand would likely manifest in the analysis of changes from 2019 to 2021. After excluding journals affiliated with Wiley, Springer, and Elsevier, the analysis focuses on 715 gold journals and 1,556 hybrid journals in which German researchers published OA articles between 2019 and 2021. During this period, German scholars published OA articles in 508 gold journals and 1,357 hybrid journals published by Springer.

The estimation results are presented in Table 5 and Table 6. In Table 5, Models (1) and (2) exclude journals published by Wiley, Springer, and Elsevier. Models (3) and (4) exclusively feature journals published by Springer. Models (1) and (3) analyze gold journals, whereas Models (2) and (4) consider the OA options in hybrid journals. Only the coefficient of APC in Hybrid OA (others) for the sample without TA journals is significant (see Model 2 in Table 5), indicating that the price elasticities of gold journals without TAs and Springer journals (gold and hybrid) are not significantly different from zero (Models 1, 3, and 4 in Table 5).

In Table 6, the elasticity comparisons from different samples are displayed as follows: Column (1) shows comparisons between gold and hybrid journals with no TAs, Column (2) compares gold journals with no TAs to gold journals from Springer, Column (3) compares hybrid journals with no TAs to hybrid journals from Springer, and Column (4) compares gold journals to hybrid journals from Springer. The outcomes suggest that, in scenarios without TA journals, the price elasticity of demand between gold and hybrid journals is not significantly different (Column 1, Gold vs. Hybrid others), supporting the main findings of the study. To examine the potential overestimations introduced by the Springer sample compared with the sample without TA journals, the price elasticity between gold journals in the two samples is compared (Column 2), as is the elasticity between hybrid journals (Column 3). When both p-values exceed 0.1, it indicates that estimations from TA journals do not significantly differ from those without TA journals. Therefore, expected overestimation does not appear to be significant. Moreover, while the coefficient of gold journals under Springer (0.134 in Model 3, Table 5 and Column 2, Table 6) is higher than that of the sample without TA journals (-0.069 in Model 1, Table 5 and Column 2, Table 6), the expected overestimation is not statistically significant. Conversely, the coefficient of hybrid journals

Table 6
Wald tests of price elasticity of demand across models.

Models	Gold vs. Hybrid (others) (1)	Others vs. Springer (gold) (2)	Others vs. Springer (hybrid) (3)	Gold vs. Hybrid (Springer) (4)
Coeff.	$-0.069 > -0.126$ ($\beta_{gold,others} > \beta_{hy,others}$)	$-0.069 < 0.134$ ($\beta_{gold,others} < \beta_{gold,Spr}$)	$-0.126 > -0.199$ ($\beta_{hy,others} > \beta_{hy,Spr}$)	$0.134 > -0.199$ ($\beta_{gold,Spr} > \beta_{hy,Spr}$)
P-values	0.491	0.375	0.763	0.301

Notes: The coefficients are the regression coefficients of *APC* shown in Table 5. Significance levels for the Wald test results are indicated as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The elasticity comparisons across different samples are presented as follows: Column (1) compares gold journals ($\beta_{gold,others}$) and hybrid journals ($\beta_{hy,others}$) without TAs; Column (2) compares gold journals without TAs ($\beta_{gold,others}$) with gold journals from Springer ($\beta_{gold,Spr}$); Column (3) compares hybrid journals without TAs ($\beta_{hy,others}$) with hybrid journals from Springer ($\beta_{hy,Spr}$); and Column (4) compares gold journals from Springer ($\beta_{gold,Spr}$) with hybrid journals from Springer ($\beta_{hy,Spr}$).

under Springer (-0.199 in Model 4, Table 5 and Column 3, Table 6) is lower than that of the sample without TA journals (-0.126 in Model 2, Table 5 and Column 3, Table 6), indicating that the anticipated overestimation does not occur for hybrid journals. This demonstrates that concerns about the potential overestimations from the inclusion of TA journals may not be justified. Finally, with the Springer sample, the market power of gold and hybrid journals does not significantly differ (see Column 4 of Table 6).

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