An Unsustainable Equation: Average Article Processing Charges Exceed Swedish Average PhD Salaries

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Abstract

Open Access (OA) publishing has transformed scholarly communication by enhancing the visibility and accessibility of research. However, the rising costs of Article Processing Charges (APCs) pose significant financial challenges for researchers and institutions. In this paper, we investigated APC expenditure trends for publications from Swedish institutions, examining the relationship between total costs and publication volumes, variations in APCs among publishers, and the financial impact of gold and hybrid OA models over five years, focusing on six major academic publishers. Additionally, we explored disciplinary differences in APCs and access preferences, particularly between STEM (Science, Technology, Engineering, and Mathematics) and non-STEM fields. We sourced the publication dataset for this study from Scopus, including articles and reviews authored by researchers affiliated with Swedish institutions between 2019 and 2023. We categorized the publications using the SciVal tool and applied the Fields of Research and Development classification scheme to ensure structured and comparable disciplinary analysis. We obtained APC data from an openly available dataset and performed the analysis using a custom R script. Our findings reveal that OA publishing peaked in 2021, followed by a gradual decline, a trend likely driven by the surge in research dissemination during the COVID-19 pandemic. Total APC expenditure increased by 83%, rising from $12 million in 2019 to $22 million in 2023. Notably, the average APC exceeds the monthly average wage of Swedish PhD students, highlighting the financial burden of OA publishing. Hybrid OA models were found to be approximately 24% more expensive than gold OA models. Significant cost disparities were also observed among publishers. STEM fields incurred higher APCs than non-STEM fields, and a lack of gold OA journals in the Humanities was evident for several publishers. These findings highlight the financial strain associated with OA publishing and its uneven impact across disciplines and publishers. The study provides insights for policymakers, funding agencies, and academic institutions seeking to foster equitable and sustainable OA practices.

Keywords: open science; article processing charges; gold open access, hybrid open access, open access journal.

Introduction

The transition to Open Access (OA) publishing represents a transformative shift in academic publishing, fundamentally altering how research is disseminated, accessed, and funded. By removing paywalls, OA enhances the accessibility of scholarly work, increasing its visibility and fostering a wider dissemination across academic and non-academic audiences (Mikki, 2017; Tennant et al., 2016). OA also promotes transparency, reproducibility, and equitable access to scientific knowledge, fostering a more inclusive academic environment (Huang et al., 2024). Despite these benefits, this transition is not without challenges. There are still gaps in understanding the economic implications of APCs across different publishing models, publishers, and disciplinary domains. A key issue is the rising cost of APCs, which are often required to publish in OA journals. A primary concern among researchers and institutions is the financial burden associated with OA publishing (Kendall, 2024; Segado-Boj et al., 2022). APCs required by many OA journals often put strain on institutional budgets, which raises questions about the sustainability of this model, especially for smaller universities and underfunded researchers (Borrego, 2023; Butler et al., 2023). These costs can place a heavy burden on

researchers, institutions, and funding agencies, raising concerns about the long-term sustainability of OA publishing models (Asai, 2020; Shu & Larivière, 2024). This issue is particularly pronounced in the case of hybrid OA journals, which combine subscription-based access with an optional OA publishing route (Olsson, Lindelöw, et al., 2020). These financial pressures risk intensifying inequalities in the global research community, as authors from less funded institutions or regions may struggle to afford OA publication costs (Klebel & Ross-Hellauer, 2023). Several studies have noted the rising costs of APCs (Morrison, 2018; Pavan & Barbosa, 2018), raising concerns about the financial burden on researchers and institutions, particularly those from underfunded disciplines (Adegbilero-Iwari, 2024). These financial pressures have also been linked to growing disparities in access to OA publishing opportunities, especially for early-career researchers and non-STEM (Science, Technology, Engineering, and Mathematics) fields with limited funding (Nicholas et al., 2024).

In Sweden, OA publishing has grown significantly in the last decade, which is strongly supported by national policies, government directives, and mandates from research councils and funding agencies (SUHF, 2023). The backing provided by these initiatives puts an emphasis on the importance of open science and the principle that publicly funded research should be freely accessible to all. The Swedish Research Council, in collaboration with other key funding agencies such as Forte, Formas, and Vinnova, has mandated that research results must be openly accessible, emphasizing the principle that publicly funded research should benefit society at large (Swedish Research Council, 2022). This policy aligns with a broader commitment to ensure that publications appear exclusively in fully OA journals, enhancing the visibility and reach of Swedish research. The growing emphasis on OA in the Swedish academic landscape reflects both global trends and local priorities. As a result, OA has become a keystone of Sweden's research infrastructure, with universities and institutions actively promoting OA publishing models. Sweden provides a unique context for examining OA publishing challenges, given its strong commitment to OA and its well-established funding mechanisms for academic research. Despite these efforts, the high costs associated with OA publishing have become a growing concern (Frank et al., 2023).

However, comprehensive analyses of APC trends, their relationship to publication volumes, and cost disparities across major publishers and OA models remain unexplored in the Swedish context. Additionally, the variation in APCs between gold and hybrid OA models and among disciplinary domains, particularly between STEM and non-STEM fields, has not received attention. These gaps hinder the development of reasonable and sustainable OA publishing frameworks, particularly in countries like Sweden, where national policies emphasize open science and publicly funded research mandates. Hence, we investigated the following research questions:

RQ1: How have APCs and publication volumes changed during a five-year period?
RQ2: How are total costs related to the number of publications during this period?
RQ3: How do APCs differ among six major publishers?
RQ4: How do APCs differ between gold and hybrid open access publishing models?
RQ5: How do APCs differ across disciplinary domains, particularly STEM versus non-STEM fields?

By addressing the above-mentioned research questions, we investigate trends and patterns in APCs for publications affiliated with Swedish institutions over a five-year period (2019–2023), focusing on six major academic publishers. Our analysis examines the financial dynamics of OA publishing, comparing the average costs associated with gold OA and hybrid OA models.

We also explore disciplinary differences in APCs and the availability of gold OA and hybrid OA options, shedding light on the complex interplay between publishing costs, access, and academic disciplines. In this context, our goal is to provide empirical insights into the dynamics of APCs and offer evidence-based guidance to policymakers, funding agencies, and academic institutions for developing publication strategies that ensure the financial sustainability and inclusiveness of OA publishing.

Data and Methodology

Data for this study were retrieved from the Scopus database (Elsevier, 2025b) consisting of the metadata information of all articles and reviews authored by researchers affiliated with Swedish institutions between 2019 and 2023. Our dataset of Sweden-affiliated publications included 85,593 documents, of which approximately 71% (60,485) were identified as either gold OA or hybrid OA publications (see Table 1). Gold OA refers to publications that are freely available under an OA license, often accompanied by upfront APCs, while hybrid OA includes articles from subscription-based journals made OA through the payment of APCs. The dataset was cleaned to harmonize publisher names. For instance, Springer Nature, Springer, and Springer Science and Business Media Deutschland GmbH were all unified under the single name Springer. A similar standardization process was applied to other publishers.

Publications categorized in Scopus as 'hybrid gold OA' were treated exclusively as hybrid OA. If a publication was assigned multiple access types, such as 'green OA; hybrid gold open,' we classified it as hybrid OA. For cases where access types included combinations like 'bronze OA; green OA,' we retained both classifications as 'bronze or green OA.' Gold OA publications were kept unchanged in their original classification.

Table 1 presents the distribution of publications by six publishers categorized by access type—gold OA, hybrid OA, bronze or green OA and non-OA—along with a grand total for each publisher and access types. This categorization enables us to see the differences between open and non-OA trends among the publishers. Elsevier and Springer have relatively smaller shares of gold OA, reflecting their primary reliance on hybrid OA. In contrast, MDPI and Frontiers hold the largest shares of gold OA articles, as these publishers primarily operate under the gold OA model. Gold OA and hybrid OA account for 36% and 35% of the total publications in the table, respectively. Together, Swedish researchers published approximately 81% of their works as OA with these six publishers between 2019 and 2023. In this paper, we considered only the gold OA and hybrid OA publications to investigate the research questions.

Table 1: Distribution of publications between publishers and access types (2019 – 2023).

Publishers	*Gold Open Access*	*Hybrid Open Access*	*Bronze or Green Open Access*	*Non-Open Access*	*Grand Total*
Wiley	2,212	7,266	3,145	2,470	15,093 (18%)
Springer	1,967	9,717	865	3,182	15,731 (18%)
Elsevier	4,689	12,953	5,207	10,239	33,088 (39%)
Frontiers	6,324	-	-	-	6,324 (7%)
MDPI	12,944	-	-	-	12,944 (15%)
PLoS	2,413	-	-	-	2,413 (3%)
Grand Total	30,549 (36%)	29,936 (35%)	9,217 (11%)	15,891 (18%)	85,593

We used the SciVal tool (Elsevier, 2025a) to classify publications based on the major Fields of Research and Development (FORD) classification, as recommended by the Organization for Economic Co-operation and Development (OECD, 2015). This subject classification ensures consistency in grouping publications into relevant subject categories: Agricultural Sciences Engineering and Technology, Humanities, Medical Sciences, Natural Sciences, and Social Sciences, allowing for a more detailed understanding of APC variations across disciplines.

We obtained APC data from a publicly available dataset by Butler et al. (2024b), which provides APC values across six major publishers. To utilize the information conveyed by this dataset, we considered the same six publishers: Elsevier, Frontiers, MDPI, PLoS, Springer, and Wiley (see Table 1). The dataset reported the cost of APCs in US dollars and covered the same five-year period as the publication data considered in our study. Moreover, we utilized ISSN as a base for identifying the journal and corresponding publishers and matched the ISSN with the APC data for any kind of calculations done in this paper. This step was vital for accurate comparisons. We conducted the analysis using the R programming language (R Core Team, 2024) for data processing, statistical analysis, and visualization.

It is challenging to investigate the costs of individual journals due to variations in pricing practices and the lack of transparency in bundled subscription models (Björk & Solomon, 2015). To address these difficulties, we used list prices for our analysis. These are publicly stated baseline prices set by publishers, often used as a standard reference point for pricing comparisons and analysis, as they provide a more standardized and comparable benchmark across publishers and are important components of market dynamics (for a recent game-theoretical discussion on this topic, see Haan et al., 2023). Ultimately, our approach, which focuses on analyzing APCs using list prices and excludes discounts and other negotiations, illustrates the projected maximum burden faced by Swedish universities when covering APCs.

Earlier studies have explored various aspects of APCs and their implications. For example, Solomon & Björk (2016) examined APC expenditures by universities in the USA and Canada, using the Web of Science (WoS) as the basis for publication data and employing subject mapping between Scopus and WoS. Butler et al., (2023) focused on APC revenues generated by six major publishers for gold and hybrid journals, also using WoS for publication data. Similarly, Pavan & Barbosa (2018) explored the economic sustainability of scientific journals that publish in OA. They collected APC data from the Directory of Open Access Journals and publishers' websites, classifying Brazilian-affiliated publications based on WoS subject categories. The publications were organized into specific subject areas and one multidisciplinary category. In our study, we retrieved Swedish-affiliated publications from Scopus and categorized them using the FORD classification, while incorporating tested APC data from Butler et al. (2024b). The FORD classification provides a high level of granularity, allowing for precise categorization of research outputs. Furthermore, it is often aligned with national research priorities and funding policies, making it a suitable framework for our analysis. This methodological approach contributes to the study of APCs by utilizing data available in Scopus and the categorization offered by the FORD classification.

Results

We investigated APCs and publication volumes focusing on trends and patterns. We assessed whether APCs have grown, plateaued, or fluctuated, and how these changes relate to the rise in publications in OA journals. Figure 1 presents a comparative analysis of the total APCs incurred and the number of publications produced annually during the period 2019–2023. The figure illustrates trends in APC expenditures alongside publication outputs, highlighting any

correlations or disparities between the two variables over time. This data provides insights into the financial investments associated with OA publishing and the resulting research outputs, offering a basis for evaluating the cost-effectiveness and sustainability of the current publishing practice in Sweden.

We found significant changes in APCs from 2019 to 2023, with an 83% increase from $12 million in 2019 to $22 million in 2023 (see Figure 1). The most notable surge occurred between 2020 and 2021, with a 40% increase from $15 million to $21 million, primarily attributed to the implementation of transformative agreements (Widding, 2024) that converted traditional subscription costs to OA fees which is in line with the findings of Borrego et al., (2021) and Olsson et al., (2020). We found that OA publishing peaked in 2021 (8.4 thousand), followed by a moderate decline in 2022 (8.3 thousand), and a further decrease in 2023 (7.7 thousand). This pattern was significantly influenced by the global COVID-19 pandemic response, which indicates rapid research dissemination (Kim & Atteraya, 2023; Nane et al., 2023).

The above-mentioned findings suggest that the scholarly publishing landscape experienced a substantial transformation, driven by both institutional policy changes and extraordinary global circumstances. These results have significant implications for research funding allocation, institutional budgeting, and the future sustainability of OA publishing models. The observed trends highlight the need for continued monitoring of publishing costs and careful consideration of funding mechanisms for scholarly communication.

We examined the relationship between total costs and the number of publications, analyzing how variations in publication volume impact overall expenditure on APCs. A Pearson correlation analysis revealed a strong positive correlation between total costs and number of publications ($r = 0.85$, $p = 0.03$). The correlation coefficient indicates that as total costs increase, the number of publications tends to increase as well, with approximately 72% of the variance shared between these variables ($r^2 = 0.72$).

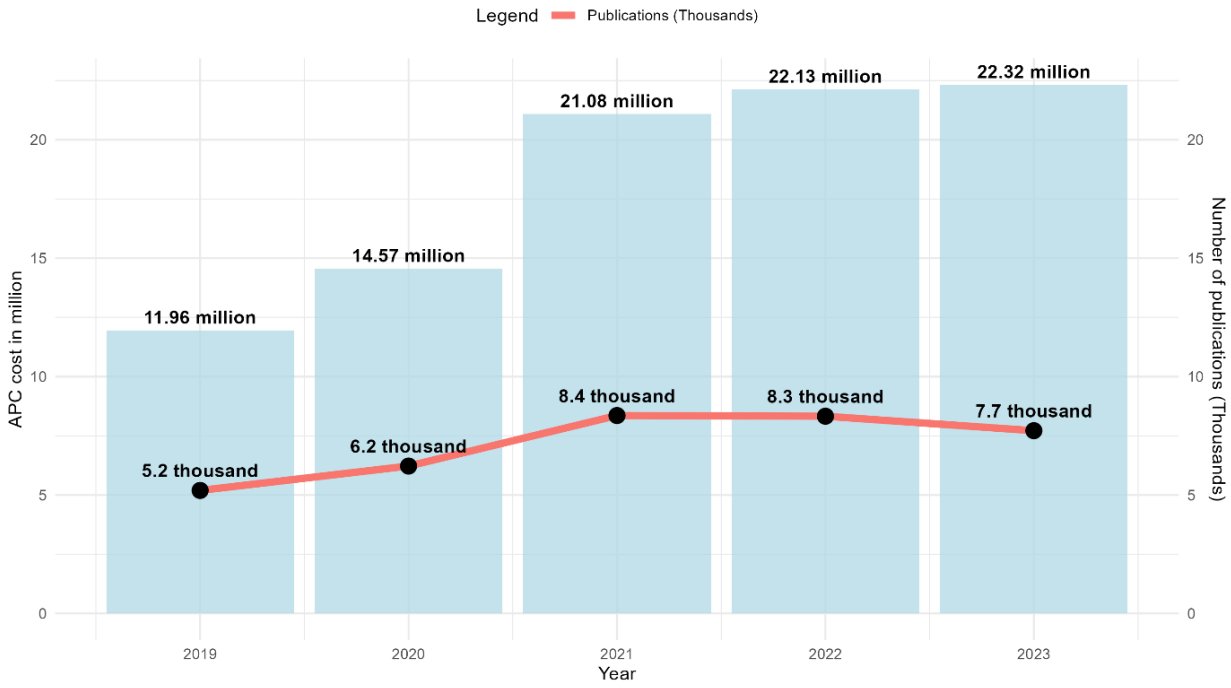

Figure 1: Total APCs and number of publications during 2019-2023.

The relationship was found to be statistically significant at the 0.05 level, suggesting this association is unlikely to have occurred by chance. Therefore, it can be predicted that 72% of the variation in the number of publications is attributable to APC costs, while the remaining 28% is influenced by other factors, such as research quality, efficiency, or access to additional resources that are not directly related to cost (Björk & Solomon, 2015; Rowley et al., 2017; Xu et al., 2023). These results show the complex nature of publication dynamics and stress the importance of considering both financial and non-financial factors in academic output.

Furthermore, we examined the variations in APCs across six major publishers. Figure 2 illustrates the total APCs paid to six major publishers from 2019 to 2023. The data highlights trends in APC expenditure for each publisher over the five-year period, showcasing variations in costs and identifying patterns in publisher-specific spending. According to Figure 2, Elsevier dominates APC expenditure, reaching $38 million, which accounts for 41% of the total APC market. This significant financial dominance emphasizes Elsevier's established position as a key player in the scholarly publishing landscape. MDPI, with $23 million (24%), and Frontiers, with $17 million (18%), exhibit consistent and notable increases in APC costs, indicating their rapid market expansion and growing influence in the OA publishing sector. Similarly, Wiley ($8 million; 9%), Springer ($4 million; 5%), and PLoS ($3 million; 4%) are emerging as notable competitors, reflecting their strategic investment in OA publishing models. These findings highlight the evolving dynamics of the APC market, where Elsevier continues to maintain its dominance, while MDPI and Frontiers solidify their positions as key challengers.

Meanwhile, Wiley, Springer, and PLoS are gradually increasing their presence, highlighting a diversified growth across different publishers. This trend aligns with previous studies, suggesting a competitive shift in the global scholarly communication market as publishers adapt to the growing demand for OA (Borrego, 2023; Halevi et al., 2024). These findings provide insights into how the APC market is shaping the broader academic publishing ecosystem.

Figure 3 illustrates the distribution of APCs across six major publishers, comparing costs between gold and hybrid OA publishing models. The figure highlights the average APC (the dash line) for each publisher within these two categories, providing a clear visualization of cost disparities.

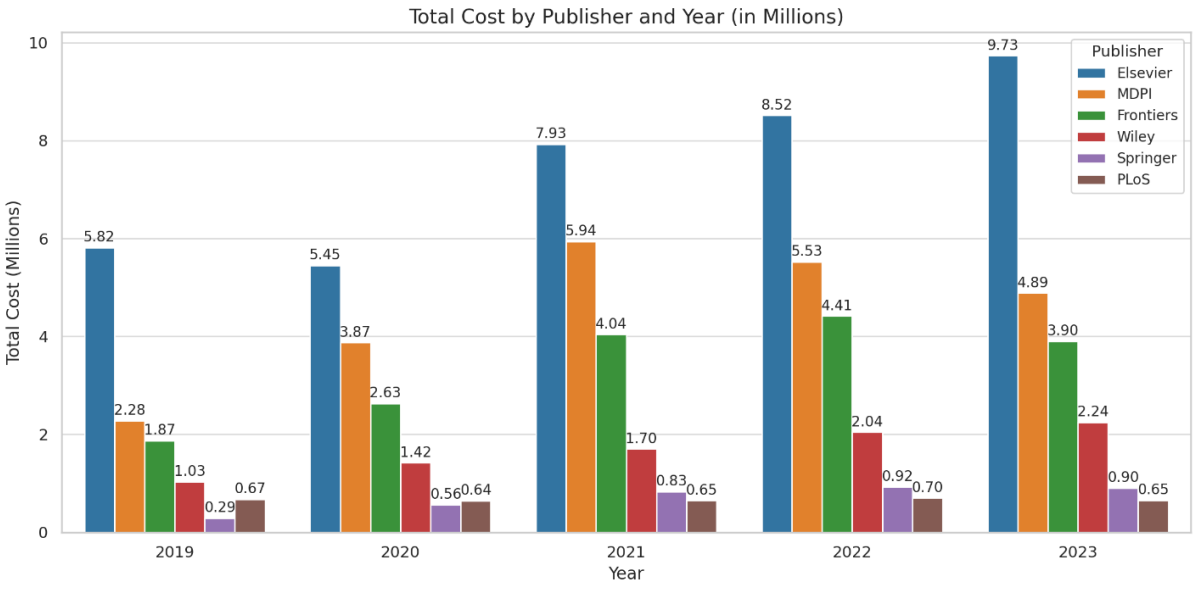

Figure 2: Total APCs by six major publishers from 2019 to 2023.

Furthermore, we examined the differences in APCs between gold and hybrid OA models and their average publishing costs. Notably, hybrid OA models consistently exhibit higher APCs compared to gold OA models across most publishers (Mittermaier, 2015). The data emphasizes significant variation in APCs among publishers, suggesting potential differences in pricing strategies. We found that APCs for gold OA range from $1,750 to $3,100, with an average cost of $2,900, offering relatively lower and more variable pricing. In contrast, hybrid OA is characterized by consistently higher costs, with APCs ranging from $2,600 to $4,950 and an average of $3,800. This makes hybrid OA approximately $900 (24%) more expensive per article than gold OA. This cost disparity reflects established trends in the scholarly publishing industry, where hybrid journals charge significantly higher APCs compared to fully OA journals.

Early-career researchers, such as PhD students, often face significant financial barriers, as the average cost of publishing a single article in a gold ($2,900,) or hybrid OA ($3,800) journal even exceed the average monthly salary of a PhD student in Sweden which is around $2,850 (SCB, 2023). PhD students are often affiliated with universities or funded through grants and scholarships. However, this financial support does not always cover APCs. University scholarships or doctoral funding schemes primarily support living expenses, tuition, and research activities, rather than publication costs. APCs are frequently excluded from standard research budgets unless specifically requested or allocated in advance (Wang, 2024). Competitive research grants that cover APCs are typically awarded to senior researchers or principal investigators, leaving PhD students to navigate the publication process with limited financial autonomy. Even when institutional OA agreements or funds exist, they may only apply to selected journals or be subject to annual caps, making access inconsistent. Consequently, early-career researchers may find it challenging to publish in reputable gold or hybrid OA journals, despite producing high-quality research (Nicholas et al., 2024).

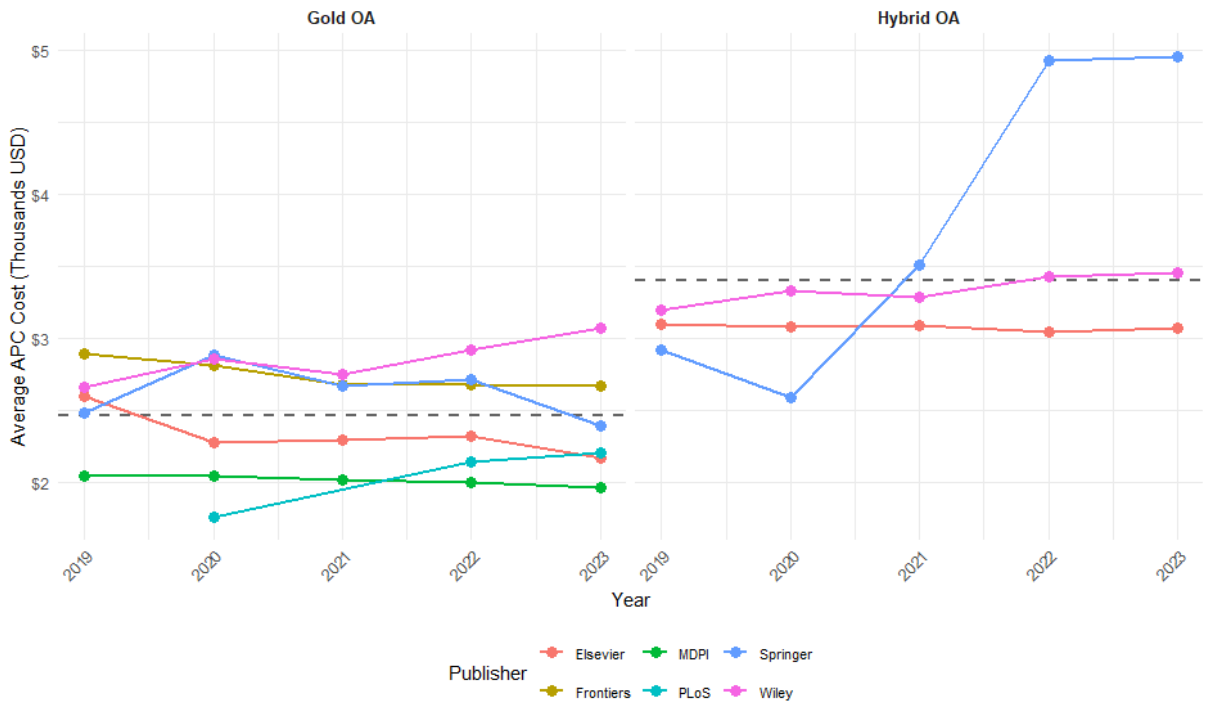

Figure 3: APCs by publishers in Gold OA and Hybrid OA with their average cost.

In this context, we argue that no researcher should have to allocate the equivalent of an entire month's salary of a PhD student just to publish their work openly. While funding mechanisms exist, the current pricing models of OA publishing challenge the fundamental principle of equitable access and place excessive financial pressure on the very researchers that open science aims to empower. This finding raise questions about the accessibility and equity of current OA publishing models, not only for researchers but also for funding agencies and institutions tasked with supporting open scholarship (Khoo, 2019).

Moreover, the higher costs associated with hybrid OA have been criticized for contributing to the so-called "double-dipping" phenomenon, where publishers charge both subscription fees and APCs for hybrid journals, adding an additional financial burden to academic institutions (Asai, 2023b). Thus, we suggest greater scrutiny and transparency in APC pricing structures and advocate for the adoption of cost-effective and reasonable publishing practices, particularly as the global academic community shifts toward OA mandates and transformative agreements.

In addition, we investigated the differences in APCs across disciplinary domains, with a particular focus on comparing STEM and non-STEM fields. Figure 4 presents the average APCs for the different publishers, categorized by the FORD classification and gold and hybrid OA publishing model. The figure illustrates how APCs vary not only between publishers but also within specific disciplines, highlighting the disparities in publishing costs for different disciplines. It also compares the average APCs between gold and hybrid OA models, revealing whether certain fields or access types are more associated with higher publishing costs.

We found that across most subject areas, hybrid OA consistently incurs higher average APCs compared to gold OA, with notable exceptions in specific disciplines such as Engineering and Technologies. This trend is largely attributed to the traditional publishing models employed by major publishers, where hybrid journals often tend to impose higher APCs to cover both subscription and OA costs (Asai, 2023a).

Figure 4: Average APCs by FORD classification by publisher and access types (2019-2023).

Further, we found Springers´ APCs for hybrid OA to be significantly higher across all subject areas, which emphasizes the association with hybrid publishing models. Interestingly, the availability of gold OA journals varies by discipline. For instance, in Humanities, gold OA options are limited, with publishers like PLoS and Springer being among the few that offer fully OA journals in this field. This limited availability can constrain researchers' options and influence their publishing decisions, particularly in fields where hybrid models dominate the OA landscape. Fields such as Agricultural Sciences, Medical Sciences, and Natural Sciences often incur higher APCs compared to disciplines like Social Sciences and Humanities (See Figure 4).

The above-mentioned disparities highlight the unequal financial burdens faced by researchers, which are shaped by publishing practices and market dynamics within their respective disciplines. The higher costs of hybrid OA, coupled with limited gold OA options in certain disciplines, pose challenges for researchers, especially those with constrained budgets or from underfunded institutions (Morillo, 2020; Perianes-Rodríguez & Olmeda-Gómez, 2021).

Such cost variations stress the importance of developing field-specific OA publication strategies to ensure equitable access to OA publishing opportunities. Furthermore, the differential pricing between gold and hybrid OA raises questions about the sustainability of the current publishing ecosystem. This calls for greater advocacy for affordable OA models, increased support for fully OA journals, and transparency in APC pricing to foster a more inclusive scholarly publishing environment.

Discussion

We investigated the evolving landscape of APCs and publication volumes in the context of OA publishing, focusing on Sweden's research output over a five-year period. Our findings address key research questions, providing a comprehensive understanding of the financial and disciplinary dynamics of OA publishing. In *RQ1*, we investigated the dynamics of APCs and publication volumes over five years to identify trends and shifts that could inform publishing practices. We found that between 2019 and 2023, APC expenditures grew by 83%, with the most significant increase of 40% occurring between 2020 and 2021 due to transformative agreements. OA publishing peaked in 2021, driven by the need for rapid research dissemination during the COVID-19 pandemic, before declining moderately in the following years. The findings demonstrate that transformative agreements have accelerated the transition to OA but also contributed to rising APC costs, highlighting the financial implications of such policies (Inchcoombe et al., 2022; Widmark, 2024).

To address *RQ2*, we analyzed the relationship between total APC costs incurred and the volume of publications during the observed period, aiming to uncover patterns in expenditure efficiency. Our analysis demonstrated a strong positive correlation between total APC costs and the number of publications, indicating that as APC costs increase, the number of publications also tends to rise. The correlation coefficient suggests that approximately 72% of the variance in publication volume can be explained by total APC costs. These findings highlight a direct and statistically significant relationship between the financial investment in APCs and the increase in publication output, emphasizing the economic implications of OA publishing (Björk & Solomon, 2015).

Moreover, answering *RQ3*, we investigated APC variations among six major publishers to explore economic disparities across publishing platforms. Significant disparities in APCs were observed among the six major publishers. Elsevier leads the APC market, accounting for 41%

and demonstrating its dominant role in scholarly publishing. MDPI (24%) and Frontiers (18%) are rapidly expanding, showing significant growth in market influence. Wiley (9%), Springer (5%), and PLoS (4%) are also emerging as notable competitors, reflecting a diversification of the APC market with increasing contributions. These differences highlight variations in publishers' pricing strategies and their implications for authors and institutions (Asai, 2020; Budzinski et al., 2020).

Furthermore, in *RQ4*, we evaluated the differences in APCs between gold and hybrid OA publishing models, providing insights into the financial implications of each model. We found significant disparities between gold and hybrid OA models. Gold OA journals typically charge lower APCs, averaging $2,900, whereas hybrid OA journals charge consistently higher fees, averaging $3,800—a 24% premium. This pricing structure particularly impacts early-career researchers, as both models exceed the average monthly salary of PhD students in Sweden ($2,850), highlighting significant barriers in academic publishing (Green, 2019; L. Zhang et al., 2022). Simultaneously, there are established industry practices in which traditional subscription-based publishers maintain dual revenue streams, which also affect institutional library budgets.

In *RQ5*, we analyzed APC variations across disciplines, emphasizing differences between STEM and non-STEM fields. We found that the availability and costs of gold OA journals vary significantly across disciplines, impacting researchers' publishing decisions. In fields like the Humanities, gold OA options are limited, with publishers such as Springer and MDPI offering some of the few fully OA journals. This scarcity contrasts with hybrid models that dominate the OA landscape in all disciplines. Further, disciplines like Agriculture, Medical Science, and Natural Sciences face higher APCs compared to fields like the Humanities, or the Social Sciences. These disparities create unequal financial burdens for discipline-specific researchers and institutions with limited budgets (Morillo, 2020; X. Zhang et al., 2020). The above findings emphasize the need for transparent pricing, reasonable funding mechanisms, and policies that support sustainable and inclusive OA publishing strategies across all disciplines.

The discussion above demonstrated that APCs expenditure increased by 83% during this period, with a sharp 40% rise between 2020 and 2021. This increase was largely due to transformative agreements and the surge in publishing during the COVID-19 pandemic. While these agreements accelerated OA adoption, they also contributed to rising costs, signaling financial sustainability concerns. A strong positive correlation between total APC costs and publication volume confirms that increased financial investment leads to higher output. However, this also emphasizes the need for more cost-efficient publishing strategies. Significant disparities were found among publishers. Elsevier dominated the APC market, followed by MDPI and Frontiers. These variations reflect differing pricing models and market concentration, which influence authors' choices and institutional budgets. Additionally, hybrid OA journals charge a 24% premium compared to gold OA journals, making them a less affordable option. This dual-cost model of hybrid OA also strains institutional library funds. Disciplinary analysis revealed that researchers in STEM fields face higher APCs, while those in the Humanities and Social Sciences encounter limited gold OA options. This highlights unequal access and funding burdens across disciplines.

We argue that OA publishing has expanded in Sweden, but it is still affected by cost imbalances, the dominance of major publishers, and disparities in access across disciplines. To promote a more equitable and sustainable OA future, greater transparency in pricing, targeted funding support, and inclusive policy development are essential. To ensure a fair and sustainable OA

ecosystem, it is imperative for policymakers to implement stricter regulations on APC pricing and to demand greater transparency and accountability from publishers benefiting from public funds. One reviewer pointed out that the multinational initiative 'cOAlition S' (Schiltz, 2018) has not succeeded in limiting APC costs and that the anticipated transformation of the scholarly publishing system has yet to materialize, motivating us to consider how we should respond to this concern. We argue that since 2018, 'cOAlition S' has promoted transformative agreements as a strategy to transition scholarly publishing toward immediate OA. However, several challenges have limited their ability to control APC pricing and to fully realize a systemic transformation (Brainard, 2024). In light of this, we suggest that the Swedish government could draw lessons from the experience of 'cOAlition S'. By engaging in strategic dialogue with the publishers most frequently used by Swedish researchers. Sweden should be able to develop a more targeted approach that ensures the best return on taxpayers' money.

Limitations and Future research

This study analyzed publications with at least one author affiliated with a Swedish higher education institution. While this does not confirm that the Swedish author(s) directly paid the APCs, it is reasonable to assume that they were associated with these costs, albeit to a varying degree. Factors such as agreements between authors, institutional policies on APC payments, discounts, waivers, and other variables contribute to the varying degrees of financial responsibility. As emphasized in the data and methodology section, this study focuses on estimating the projected maximum burden faced by Swedish universities when covering APCs. However, as noted by Butler et al., (2024a), APC data collection is inherently complex and may include gaps, meaning that not all journals in this study have corresponding APC information. This limitation highlights the challenges of comprehensively mapping APC trends across publishers and disciplines. Additionally, this study includes only six publishers, though many other legitimate publishers support OA publishing. Including other publishers would likely reveal significantly higher total expenses for OA publishing.

We aim to further study encompassing Nordic countries to gain a more comprehensive understanding of regional trends in OA publishing. Additionally, a comparative analysis between the actual costs incurred under transformative agreements with publishers and the listed APCs would provide insights for policymakers. Such an approach could help assess the economic implications of current agreements and inform future strategies for sustainable OA publishing by Sweden affiliated researchers.

Conclusions

Our findings highlight the increasing financial burden associated with OA publishing, particularly within Sweden, where transformative agreements and institutional policies are reshaping the publication landscape. While these transformative agreements have accelerated the adoption of OA models, they have also significantly elevated APC expenditures, showing financial consequences for such policies. The strong correlation between APC costs and publication volumes points out the economic trade-offs involved in achieving higher research output. The predominance of major publishers, the emergence of new players, and the persistent disparities in APCs across different models and disciplines emphasize areas for negotiation and policy development. Notably, the cost of OA publishing frequently surpasses the monthly salary of a PhD student in Sweden, a fact that necessitates attention from policymakers. This issue is especially concerning given that publishers receive substantial funding from taxpayer money, yet there is an oversight regarding the pricing of OA publishing. The absence of standardized pricing mechanisms or accountability for the use of public funds enables publishers to set APCs arbitrarily, thereby creating financial barriers for researchers and

underfunded institutions. By mapping APC trends and identifying key cost drivers, this study provides insights for policymakers, institutions, and researchers to promote more equitable and sustainable OA practices. Future research could expand its scope to encompass broader geographic regions or analyze the long-term impacts of transformative agreements on publication costs and accessibility.

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