

# Missing a golden opportunity? An analysis of publication trends by income level in the Directory of Open Access Journals 1987–2020

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**Abstract:** The growing prevalence of the gold open access model can exacerbate the monoculture of research and inequality in knowledge production. This study examines publication trends in the Directory of Open Access Journals (DOAJ) journals by countries' income level from 1987 to 2020. By combining article metadata from journals listed in the DOAJ with World Bank country income data, this analysis examines the trends visible in plots of historical open access publication data. In 2020, the number of articles published in DOAJ journals by authors affiliated with high-income countries exceeds the sum of the other income categories. Article processing charge waivers seem to have more impact on high- and low-income countries than middle-income countries. The results show that the gold open access model has not been able to improve the extremely low number of open access articles from low-income regions. In addition, authors in middle-income countries publish in gold open access DOAJ journals at lower rates than authors based in other economic regions. The gold open access model is disadvantageous to researchers outside of high-income countries, highlighting the importance of supporting the diamond open access model as a potential means of improving global equity and epistemic diversity in knowledge production.

**Keywords:** APC waiver, article processing charges, gold open access

## INTRODUCTION

The gold open access model is becoming one of the most common business models under which new open access articles are being published (Jurchen, 2020; Piwowar et al., 2019), although this varies between different areas of research and geographic regions (Gumpenberger et al., 2013; Hadad & Aharony, 2022; Momeni et al., 2021; Segado-Boj et al., 2022; Wang et al., 2018).

The model's growing popularity highlights the importance of examining its effects on global inequity and epistemic diversity in knowledge production.

The gold open access model can exacerbate the monoculture of knowledge production, calling to mind previous findings that Western male faculty members are overrepresented in positions of power among the world's top sociology departments (Demeter & Toth, 2020). Article processing charges (APCs) may

benefit those who are affiliated with resourceful institutions and funding agencies, most of which are located in high-income countries. Meanwhile, the pursuit of international competitiveness in research and higher education globally has led to changing research and academic publishing practices in lower income regions, including the preference for international journals (Berger, 2021; Mills et al., 2021).

Will the prevalence of the gold open access model silence researchers in lower income regions? Given the broad range of economic situations faced by authors around the world, it is reasonable to believe that APCs would have different average effects on authors in higher income countries than on those in less affluent ones. This exploratory study used journal metadata from the Directory of Open Access Journals (DOAJ) to retrieve individual article metadata from the OpenAlex academic database. The article metadata was categorized using global country income data from the World Bank. The results were then plotted in ways that allow comparisons between gold open access journals, which charge APCs, and diamond open access journals, which do not, as well as between journals that have APC waiver policies and those that do not. The visible historical trends were then discussed.

The DOAJ was created in 2003 (Directory of Open Access Journals, n.d.; Stenson, 2012) in response to the exploding number of open access journals becoming available on the internet around the early 2000s (Stenson, 2012). The directory was designed to centralize the cataloguing of journals that are entirely open access and that meet certain quality standards. Starting with a listing of just over 300 open access journals, DOAJ.org has since grown to document 18,144 journals and over 7.8 million article records at the time of writing. The directory is globally diverse, currently containing journals based in 130 different countries and written in 86 languages. The DOAJ has a clearly defined commitment to global diversity, acting as an adopting organization of the C4DISC Joint Statement of Principles (Coalition for Diversity & Inclusion in Scholarly Communications, n.d.). The directory has taken steps to combat predatory journals by updating their journal selection process over time (Marchitelli et al., 2017), as well as by educating authors about predatory journals through co-founding the Think. Check. Submit. program (Directory of Open Access Journals, n.d.; Think. Check. Submit, n.d.).

Throughout this article, four country income categories are used based on data from the World Bank:

1. High-income countries (HICs), currently including Chile, New Zealand, Sweden
2. Upper-middle income countries (UMICs), currently including China, Iraq, Mexico
3. Lower-middle income countries (LMICs), currently including India, Kenya, Ukraine
4. Low-income countries (LICs), currently including Afghanistan, Ethiopia, Rwanda

Additionally, as UMICs and LMICs are often mentioned together in the findings, the term 'middle-income countries'

### Key points

- The gold open access model is disadvantageous to researchers outside of high-income countries.
- Between 1987 and 2020, nearly 70% of Directory of Open Access Journals (DOAJ) articles were published in gold open access journals.
- Over 80% of DOAJ articles by authors from high- and low-income countries were published in gold open access journals in 2020.
- Less than 70% of DOAJ articles by authors from middle-income countries were published in gold open access journals in 2020.
- In 2020, authors in low-income countries only accounted for just over 1% of articles published in DOAJ journals.
- Further studies are required to understand the factors impacting authors in middle-income countries such as national research policy, the development of open research infrastructure, and the lack of readily available article processing charge discounts and waivers.

(MICs) will be used to refer to the combination of both groups where appropriate.

## LITERATURE REVIEW

The number of gold open access articles published in the journals indexed by the DOAJ has nearly doubled between 2015 and 2020 (Crawford, 2021), with funding mandates and transformative agreements expected to drive a further increase in the volume of open access articles generally, including those in hybrid journals. In a recent study, Morrison et al. (2022) found that while the global average APC has only increased slightly from 2011 to 2021, the per-article average APC has increased from 904 USD to 1626 USD, indicating that many authors are opting for journals with higher APCs. Meanwhile, Zhang et al. (2022) observe that the estimated global APC revenue among major publishers has exceeded 2 billion USD annually, driven by sharp increases in APC expenses in six countries: the United States, China, the United Kingdom, France, the Netherlands and Norway.

There are indications that authors in HICs have a large advantage in terms of funding options for APCs and that levels of institutional resources and average APC expenses are related (Klebel & Ross-Hellauer, 2022). Solomon and Björk (2012, 2013) examine this difference by comparing the reported sources of APC funding between authors based on their country's gross national product (GNP). Authors based in countries with a GNP of greater than 25,000 U.S. Dollars (USD) chiefly paid for APCs using money from institutional funding and grants/contracts.

In comparison, authors based in countries with lower GNPs most commonly paid for APCs with personal funds. A variety of other factors are also likely to give certain authors an advantage in the open access publication market. Olejniczak and Wilson (2020) report that the likelihood for an author to publish an article as gold open access increases if the author is male, employed at a prestigious institution, associated with a STEM discipline, has access to better research funding, and is more advanced in their career stage.

Despite the fact that a large percentage of authors in lower income countries appear to pay for APCs out of pocket, Nabyonga-Orem et al. (2020) point out that many researchers in African countries may be unable to pay for an APC. Even with a waiver that reduces an APC by 50%, some authors would need to pay from 1 to 6 months of their annual income in order to publish an article. Solomon and Björk (2012, 2013) find that APC waivers do not seem to be able to close the funding gap between higher and lower GNP countries, as only 14% of authors in lower GNP countries had their fee waived, a percentage comparable to the 12% of high GNP authors who also received waivers.

### APC waiver

Previous studies show that many publishers offer between 8% and 13% of their yearly budgets or APC profits to waive or subsidize APCs (Burchardt, 2014; Ware & Mabe, 2015). A total of 83% of journals that responded to a survey conducted by M. Smith et al. (2016, p. 33) indicated that they only give waivers to between 1% and 10% of the authors who publish with them. Despite the presence of an APC waiver policy, there can be significant problems with the geographic diversity of authors participating in open access journals. For example, Smith et al. (2021) find that almost no submissions to a set of Elsevier's open access journals were eligible for an APC waiver, possibly due to a policy disqualifying articles which have an international co-author based in a waiver-ineligible country. Furthermore, authors in some lower income countries were only offered a waiver for part of the APC, despite likely needing further economic help.

In a similar vein, Nabyonga-Orem et al. (2020) argue that policies which disqualify authors from receiving waivers due to collaborating with an author in a higher income country are unfair because they may not be receiving financial support from that co-author. Such policies are likely to disincentivize international collaboration. In addition, the use of a country's income level as a means of determining who should receive APC waivers can lead to a lack of support for authors whose yearly incomes are too low to be able to afford an APC and whose governments do not offer financial support for APCs. Indeed, many African countries are MICs, potentially putting authors in those countries in positions where they might only qualify for a partial waiver. Such partial waivers may still end up causing these authors to be burdened with APCs that are far too costly for them to pay out of pocket. However, many still manage to do so, as is evidenced by the findings of Solomon and Björk (2012, 2013).

### Participation by country income level

Studies examining the relationship between open access publishing models and a country's or institution's income level are emerging. Iyandemye and Thomas (2019) found that the number of open access articles published by authors based in HICs was much higher than those of UMIC, LMIC and LIC authors in biomedical research literature. However, LIC authors published a surprisingly high proportion of their articles in open access journals, while the open access publication rates of authors in MICs lagged behind. They speculate that this phenomenon may be influenced by factors including APC waiver policies aimed at LIC authors, a strong open access culture among some LIC researchers, good support from funders, and high rates of international collaboration. However, other articles argue that international collaboration with authors in countries with higher income levels may actually be detrimental due to it potentially disqualifying LIC authors from receiving APC waivers (Nabyonga-Orem et al., 2020; Smith et al., 2014).

In a study examining the effects of closed access journals flipping to become open access, Bautista-Puig et al. (2020) found that after journals became open access, the proportion of HIC authors participating in these journals fell, while the proportion of UMIC authors rose. The switch had little effect on the proportions of authors based in LMICs and LICs. Most recently, in an analysis of articles published in three types of open access and subscription journals in history, economics, science and technology and indexed in Scopus, Asai (2021) found that authors in LICs are more inclined to publish in gold open access journals than authors in UMICs and LMICs, and that authors in MICs are less likely to publish open access articles in hybrid journals compared with authors in HICs. These studies show that the effects of gold open access journals, APCs and waivers still demand further investigation. This study provides new insights by examining the publication trends using the DOAJ dataset that covers a wider range of disciplines.

### METHOD

This study examined the differences in open access publication patterns between countries with different levels of *per capita* gross national income. Countries were grouped into historical income classifications as defined by the World Bank: World Bank Analytical Classifications dataset (The World Bank Group, n.d.). The four income classifications were HICs, UMICs, LMICs and LICs. Income classifications were based on the calendar year in which the income data was collected, rather than the World Bank's fiscal year. World Bank income classifications are recorded for calendar years from 1987 to 2020. Thus, this study limited its scope to articles published within that range of years.

The DOAJ was chosen as the source of journal metadata for this study. All journals listed in the DOAJ were analysed. Metadata for all articles published in DOAJ journals were collected from the OpenAlex academic database (Priem et al., 2022).

The initial dataset included some articles that were first published behind a paywall, then retrospectively made open access. Including these articles in the analysis would make it impossible to determine if the observed trends were caused by articles that were open access at the time of initial publication. To ensure that the articles under consideration for this study were originally published as open access, information about the journal's open access history was used. Any article that was published before the year in which its journal started to publish all contents under an open licence was removed from consideration. At the journal level, each journal is treated as having a grace period within the confines of the year in which that journal switched to open access. During this grace period, all articles are treated as having always been open access.

As APCs are charged per article, the article was chosen as the unit of measure for this study. This allows the dataset to be discussed in terms of the number of articles associated with any particular country or country income category, rather than the number of authors, the number of research institutions and so on. For each article, the countries associated with the authors' research institutions were counted using the whole counting method (Gaufriau et al., 2008). In whole counting, each unique country is counted once for each individual article. If one article had 10 authors who were affiliated with Ireland and one author who was affiliated with Brazil, both Ireland and Brazil would be counted once for that article. If an author was affiliated with multiple institutions, all the countries of their affiliated institutions would be included in the analysis using the whole counting method. This method of counting means that a single article could be represented on multiple lines in a graph. For example, if an article has at least one author from an LIC and at one from an HIC, then that article would be part of the calculations of both the LIC and HIC lines.

There were more countries listed in the OpenAlex database than those that received income classifications from the World Bank. To ensure no loss of useful data, OpenAlex countries were mapped to the appropriate equivalent countries in the World Bank dataset. In the OpenAlex publication metadata, many authors' institutions did not have a machine-readable country associated with them. However, it was found that many of the unstructured text strings collected by OpenAlex to describe each author's institution contained clear indications of the institution's country.

An extraction method was designed to process the institution description strings and identify mentioned countries, making them machine-readable. Country mentions were matched using the Python implementation of the FlashText algorithm (Singh, 2017) and a large collection of country-related keywords from Countrynames Version 1.12.0 (Organized Crime and Corruption Reporting Project, 2022). The Countrynames library provides a large list of alternative names for countries in multiple languages. In order to avoid using nonspecific or erroneous country names, all keywords containing 30 or fewer characters and consisting only of lowercase letters were removed.

If the institution description string was found to contain mentions of only one country, the mentioned country was used as part of the whole counting method for that article. If multiple different countries were mentioned, the country with the most mentions was used. If two or more countries tied for the most mentions, the country was treated as unidentifiable and no country was used. To assess the accuracy of this method, a randomized sample of 200 institution strings were manually examined for mismatches with the country metadata extracted from those strings. No errors were found within this sample.

In total, the article metadata from 17,536 journals was retrieved and 6,323,484 articles met the selection criteria. Of these, 4,699,936 articles had at least one identifiable country after the country mention extraction process.

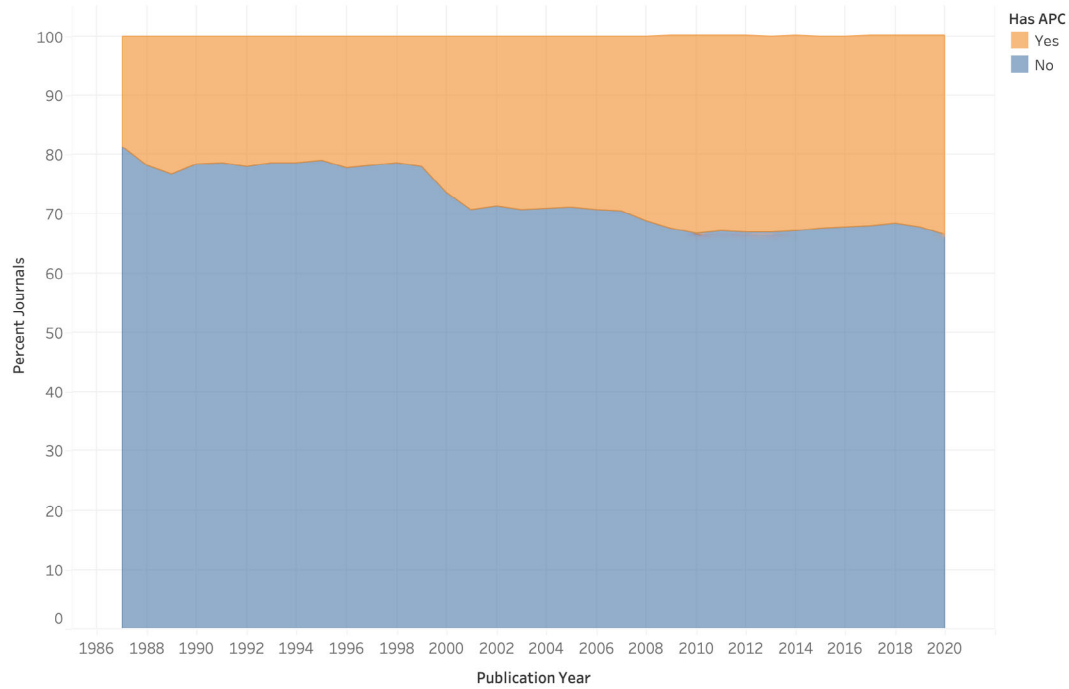
## FINDINGS

The majority of journals in the DOAJ have consistently been diamond open access (Fig. 1). While there has been slow growth in the percentage of gold open access journals, as of 2020, 66.64% of DOAJ journals were diamond open access. However, gold open access journals listed in the DOAJ have had a much more rapid increase in publication rates than their diamond open access counterparts (Fig. 2). In 1987, the vast majority of articles published in DOAJ journals were in diamond open access journals. Since then, the overall publication rate has trended in favour of gold open access journals. 2008 was the first year in which the majority of articles published in DOAJ journals were published in gold open access journals. Since then, this trend has continued unabated, culminating in 2020 when 68.6% of DOAJ articles were published in gold open access journals.

The percentage of articles published in gold open access DOAJ journals that offer APC waiver policies has tended to increase over time (Fig. 3). 34.46% of gold open access articles were published in journals that offered waivers in 1987, compared with 63.48% in 2020. There has, however, been a slight decrease in the percentage of articles published in gold open access DOAJ journals offering waivers since the maximum of 74.71% was reached in 2013.

## Publication trends by country income level

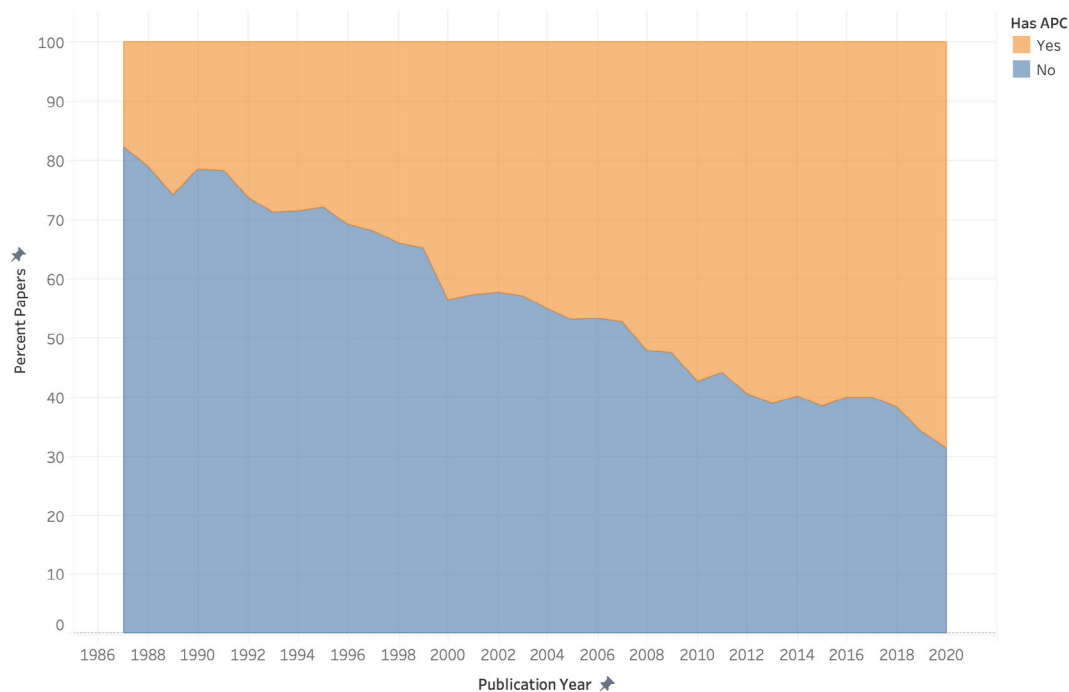
Figure 4 shows the overall number of articles published in DOAJ journals on a logarithmic vertical axis. Each line represents the number of articles with at least one author based in a country with the indicated income level. All income levels show logarithmic growth in the number of articles over time. Overall, the number of HIC articles increased from 428 to 447,213, UMIC articles from 471 to 283,359, LMIC articles from 246 to 112,249 and LIC articles from 19 to 9,380. The number of HIC articles increased 104,389% during the course of the chart, a much larger increase than the other income levels. UMIC articles increased 60,061%, LMIC articles increased 45,529% and LIC articles increased 49,268%.



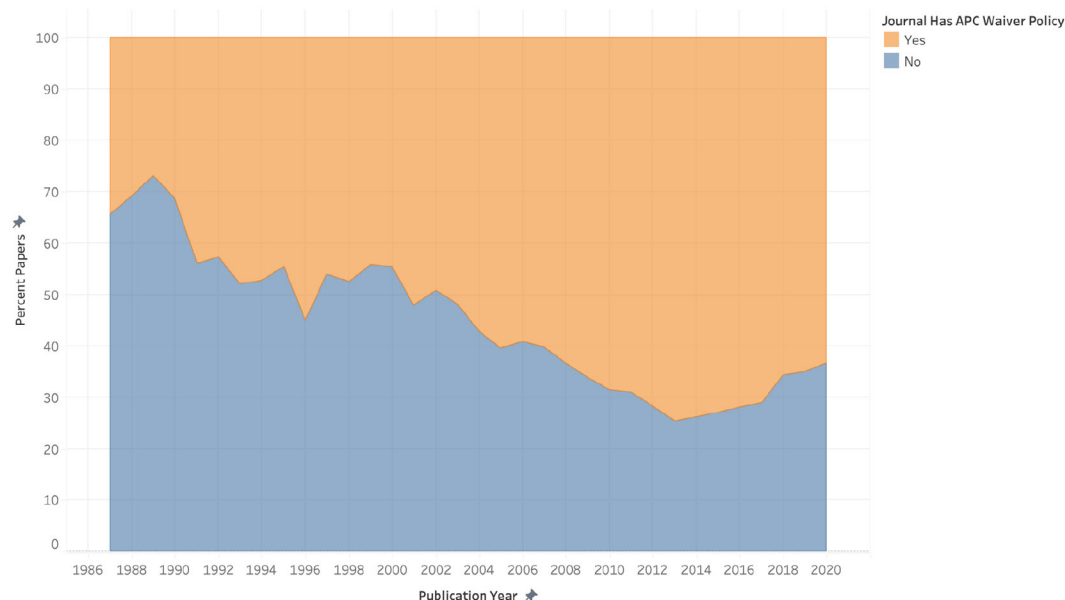
**FIGURE 1** Percentage of DOAJ journals by APC. APC, article processing charge; DOAJ, Directory of Open Access Journals.

During any given year on the chart, there were far fewer articles associated with authors based in LIC countries than the other three income levels. Starting in 2007, the gap between the LIC line and the other income levels widened. Additionally, in

1988 and from 2002 to 2005, the number of LMIC articles suddenly increased while the number of UMIC articles decreased, putting the LMIC line above the UMIC line. After each of these brief episodes, the reverse occurred, putting the UMIC line back



**FIGURE 2** Percentage of DOAJ articles by APC. APC, article processing charge; DOAJ, Directory of Open Access Journals.

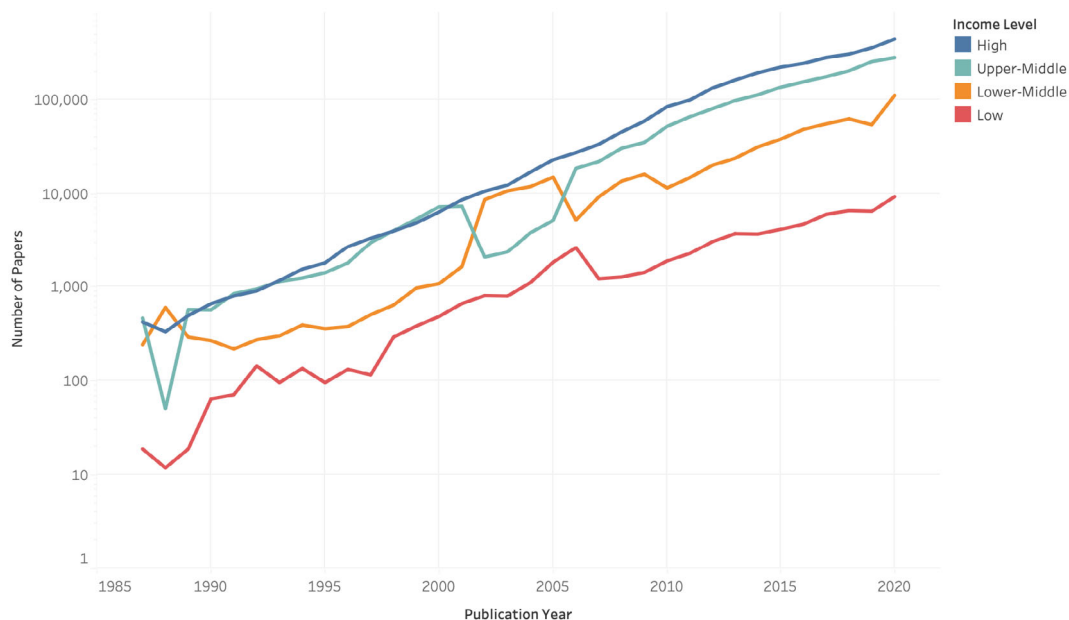


**FIGURE 3** Percentage of articles published in gold open access DOAJ journals by APC Waiver. APC, article processing charge; DOAJ, Directory of Open Access Journals.

above the LMIC line. These episodes were driven by the reclassification of Brazil from a UMIC to an LMIC and back, causing sharp, sudden changes in both the UMIC and LMIC lines.

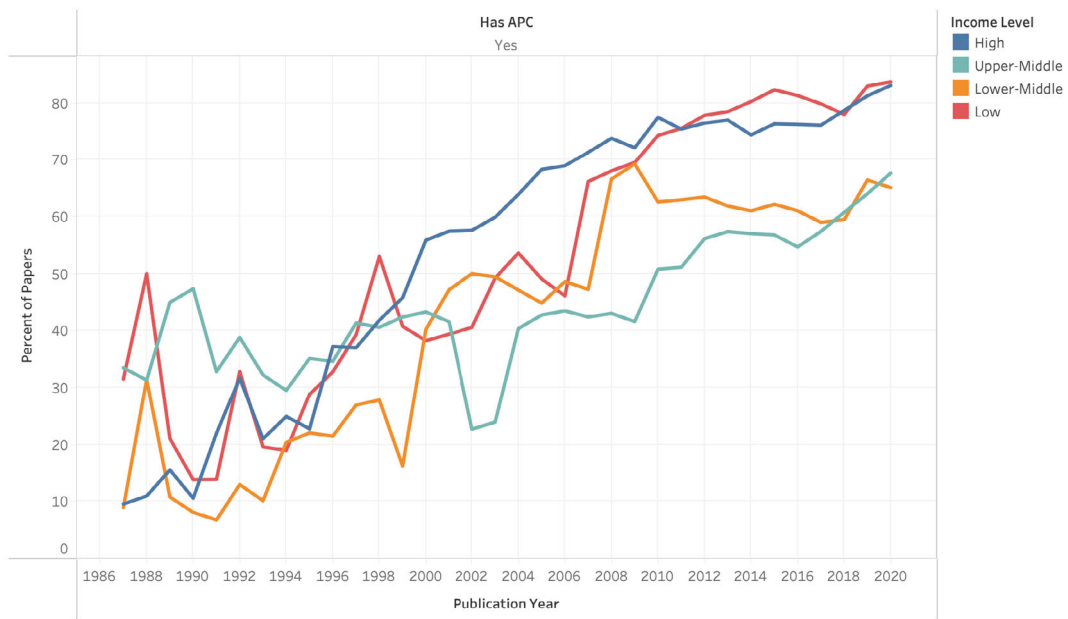
Figure 5 shows the percentage of articles published in gold open access journals in the DOAJ. Each line represents the percentage of articles that have at least one author from the indicated income level. On this chart, HICs and LICs generally trend upwards, showing that their publication rates in gold open

access journals have increased over time. However, the UMIC line shows a different behaviour from the other three income categories. From 1989 to 1995, UMICs have the highest publication rate in gold open access journals, sometimes exceeding the other income categories by wide margins. However, during this time period, rather than trending upwards like the other income levels, the UMIC publication rate trends sideways until 2001, after which the rate drops sharply, reaching an



**FIGURE 4** Number of articles published in Directory of Open Access Journals journals by income level (logarithmic).





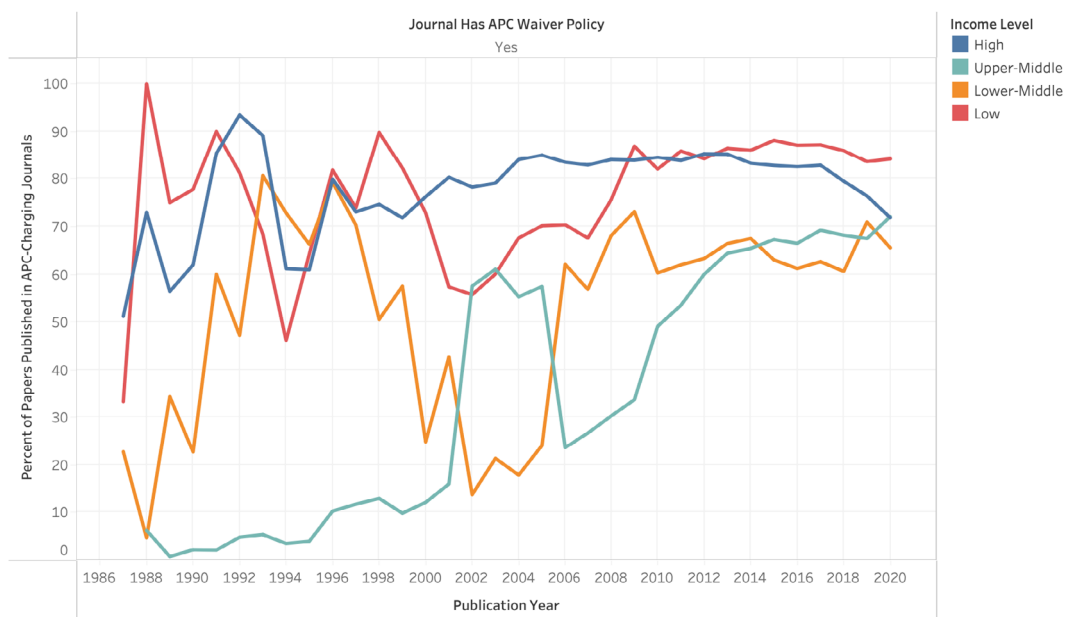
**FIGURE 5** Percentage of articles published in gold open access Directory of Open Access Journals journals by income level.

all-time-low of 22.7% in 2002. After 2002, the trend changes and UMICs experience an uptrend that is similar to the ones shown by HICs and LICs. After 2001, the UMIC publication rate has been the lowest of the four income categories for every year except 2018 and 2020.

Figure 6 shows the percentage of articles published in gold open access journals in the DOAJ that have APC waiver policies. These waivers could potentially help authors reduce or avoid

having to pay an APC. The HIC and LIC rates trend sideways, rather than upwards. The HIC and LIC rates are also less erratic than the UMIC and LMIC lines. HICs and LICs also show the highest publication rates during most years, with the exceptions of 1994 and 1995 when the LMIC publication rate was briefly the highest.

Figures 5 and 6 show that UMICs and LMICs have the lowest publication rates in gold open access journals, including those



**FIGURE 6** Percentage of articles published in gold open access DOAJ journals with APC waivers. APC, article processing charge; DOAJ, Directory of Open Access Journals.

that offer waiver programmes. The only exceptions to this are shown on Fig. 5: HICs had the lowest publication rate in 1988 and LICs had the lowest rate by a small margin in 1994, 2000 and 2001. In Fig. 5, the LMIC publication rate began to trend sideways in 2010 and failed to show any more signs of major growth until 2019. UMICs show an especially low gold open access journal publication rate starting in 2002, following an initial period of trending sideways. However, after 2002, the UMIC rate grows steadily until meeting up with the LMIC rate around 2018.

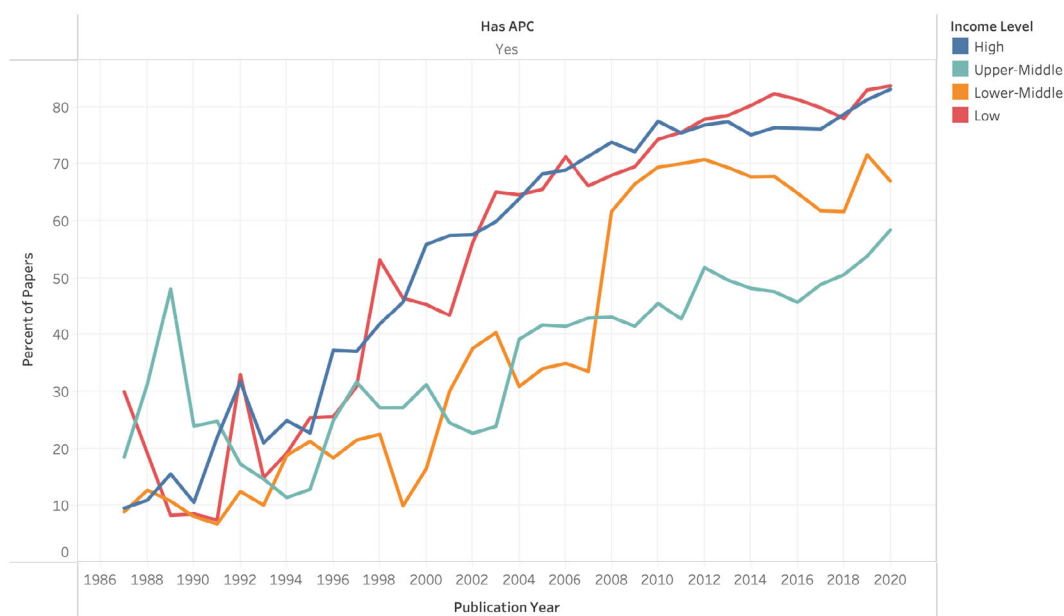
The low publication rates of MIC authors cannot be explained by attributing these overall trends to the most prolific countries within the MIC income category. For example, since 2011, China has been the biggest contributor of articles within the UMIC category. Given this, it would be possible for the general trend of the line to be a better representation of China's publication trends alone, rather than of UMICs as a whole. However, by filtering out the prolific MICs of China, Brazil, India and Russia (Fig. 7), it is clear that the tendency for MICs to represent the lowest publication rate remains unchanged. In fact, the removal of these countries widens the publication rate gap, dropping the UMIC publication rate a great deal over much of the chart. Figure 7 is also remarkable in that the removal of these prolific countries actually causes the HIC and LIC rates to follow each other even more closely. Thus, the trends visible in Fig. 5 are not due to a small number of highly prolific MICs.

In sum, the percentage of authors publishing in gold open access journals is increasing over time (Fig. 5). This increase is apparent in all country income levels since 1990, with the exception of UMICs before 2004. Starting in 2008, the majority of articles published in DOAJ journals have been published in gold

open access journals (Fig. 2). Since then, gold open access journals have continued to outpace diamond open access journals in terms of growth in publication rate. As of 2020, 68.6% of articles were published in gold open access journals listed in the DOAJ. Given that HICs and LICs are on opposite ends of the economic spectrum, one may expect that HICs and LICs would differ greatly in their publication trends within DOAJ journals. Figures 5 and 6 show that this is not the case: HICs and LICs show remarkably similar trends of participation in gold open access journals both with and without APC waivers, while UMICs and LMICs often have the lowest publication rates in gold open access journals.

## DISCUSSION AND CONCLUSION

The findings of this study show that there is a lack of global diversity in open access journals indexed by the DOAJ. The majority of gold open access articles have authors who are based in HICs, a result that is in line with the findings of Smith et al. (2021). Moreover, only a small proportion of authors are granted waivers (Smith et al., 2016). For publishers who operate gold open access journals, publishing more articles will likely mean publishing more articles from HIC authors who, in turn, are more likely to have a reliable source of funding to pay the full APC price. However, it should be noted that a high proportion of authors in high GNP countries have been found to receive waivers (Solomon & Björk, 2012, 2013). This coincides with emerging revelations regarding the extent to which open access publishing practices unfairly benefit HIC authors (Barrington et al., 2020; Ross-Hellauer et al., 2022).



**FIGURE 7** Percentage of articles published in gold open access Directory of Open Access Journals journals: China, Brazil, India and Russia removed.



Asai (2021) shows that open access articles in hybrid journals are mainly from HICs. This reinforces the status quo of not only the already established journals, but also the predominance of the so-called scientific core in Western HICs. This trend will likely continue with the implementation of Plan S in Europe (e.g., [https://cordis.europa.eu/programme/id/H2020\\_IBA-SWAFS-PlanS-2020](https://cordis.europa.eu/programme/id/H2020_IBA-SWAFS-PlanS-2020)) and the Biden–Harris Administration's announced intentions to advance open research in the United States ([www.whitehouse.gov/ostp/news-updates/2023/01/11/fact-sheet-biden-harris-administration-announces-new-actions-to-advance-open-and-equitable-research](https://www.whitehouse.gov/ostp/news-updates/2023/01/11/fact-sheet-biden-harris-administration-announces-new-actions-to-advance-open-and-equitable-research)).

Together with the trends shown in this study, the gold open access model can exacerbate the lack of epistemic diversity and perpetuate inequities in knowledge production. In addition, the findings of this study also show that there seems to be a lack of support for diamond open access journals. There could be many reasons for the relatively weak publication rates of diamond open access journals, but one important factor is likely related to the prestige of these journals and their publishers when compared to gold open access journals and their publishers. Future studies can explore the distribution of journals in terms of country and publisher and whether they are indexed in Scopus or Web of Science, which are widely presumed to be the gold standards of research quality.

The finding that APC waivers do not appear to increase the percentage of contributions from MICs demands further study, especially in relation to the development of infrastructures, portals and research policies in different regions. APC waivers for MICs may often amount to a discount, implying that APCs would still incur hefty costs for these researchers. For these authors, publishing in gold open access journals could mean cutting into the funding available for other research activities. In order to remain internationally competitive, research policy shifts in countries such as China and Russia are pushing researchers to publish in prestigious, and often subscription-based, journals. Nevertheless, the kinds of developments in open infrastructure seen in Latin America can also be strong—and good—motivations for researchers in those regions to publish in diamond open access journals, as well as with publishers who are partners of initiatives such as Research4Life ([www.research4life.org](http://www.research4life.org)).

Finally, these findings raise further questions about APC waivers. While it appears that LICs benefit from APC waivers, what would happen if these waivers are no longer available, for example, for geopolitical reasons? Is the offer of an APC waiver really the best way for researchers in LICs or MICs to publish their work in open access journals? In a report in *The Scientist*, a researcher states that ‘the entire concept of waiver is damaging to publishing’ because ‘it puts underprivileged researchers in a position where they have to beg to somebody in a large editorial industry’ (Manjarrez, 2021). Furthermore, concerns about exploitation and inequities in open science raise important issues about how research data and findings will be shared among international collaborators and secondary users based in HICs (Ewuoso et al., 2022).

In conclusion, this exploratory study shows that the gold open access model is disadvantageous to authors in lower income regions. APC waiver policies do not seem to be sufficient for authors in MICs to increase the percentage of publications in gold open access journals. Similarly, the gold open access model has been unsuccessful in helping LIC authors to publish a globally competitive number of articles. Further studies are required to understand the factors impacting authors in LICs and MICs including, but not limited to, the effects of research policy, the development of open research infrastructure, and the lack of readily available APC discounts and waivers. This study also points to the importance of supporting the diamond open access model as a potential means of improving global equity and epistemic diversity in knowledge production.

## LIMITATIONS

This analysis relies heavily on journal metadata sourced from the DOAJ. The metadata reported by the DOAJ is self-reported by the journals themselves and is reviewed by an editor who may be a volunteer (Directory of Open Access Journals, n.d.). The accuracy of the DOAJ metadata relies heavily on the honesty and accuracy of the applying journals and the scrupulousness of the editor reviewing the application. Since the metadata upon which this analysis is based uses a yearly timescale, some loss of accuracy is expected. There is a similar lack of granularity in the World Bank income data. Finally, as these results are based upon the journals listed in the DOAJ, they may not be generalizable to other sets of open access journals or to open access journals broadly. However, the large number of journals listed in the DOAJ, as well as the broad diversity of publishers represented in the directory both suggest that the DOAJ may be one of the best available sources of open access journal metadata on a global scale.

## AUTHOR CONTRIBUTIONS

**David Druelinger:** Developed the methodology, performed the data collection, created the figures and co-wrote the article.  
**Lai Ma:** Developed the original research question, provided research support and co-wrote the article.

## ACKNOWLEDGEMENT

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are publicly available via Directory of Open Access Journals (DOAJ), OpenAlex and World Bank country income data.

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