

# Article processing charge expenditure in Chile: The current situation

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## Abstract

The National Agency of Research and Development from Chile is proposing, for the first time, a national OA policy aiming to ensure access to the scientific knowledge contained in publications resulting from research projects and graduate thesis. Since no information regarding APC expenditure in Chile is available, this study examined the cost of APC for the 2019 publications that included at least one Chilean affiliation. The total expenditure for the year 2019 was estimated at USD 9,129,939. The results confirm that almost one third of the total APC was spent on publications from Health & Medical Sciences, research area with the highest APC (USD 6000). Furthermore, five commercial publishers collected 52% of the total APC expenditure. Unfortunately, the cost of publishing in some journals is so high that it causes detrimental effects on the research capacity of under resourced individuals. In the Chilean scenario, APC is not well suited to scale as most universities do not have an OA budget to support researchers that are eager to publish their work in OA journals. Perhaps the implementation of an OA policy ought to be accompanied by sustainable APC funding grants aimed at supporting under resourced researchers that want to make their research freely available.

**Keywords:** article processing charge, publisher, Chile, research area

## INTRODUCTION

Until the 1990s, most scholarly journals were published in printed form, so researchers could only access them through a personal or library subscription. In fact, during this time period, libraries played an important role supporting research by providing access to scholarly journals as subscription costs were high. Nevertheless, the constant rises in subscription costs of many scholarly journals, at a time when university budgets subsided due to a global economic recession, triggered the 'serials crisis'. A study by the Association of Research Libraries (Kyrillidou & Young, 2006) demonstrated that

serial unit costs had increased much faster than the inflation rate for almost two decades. Around the same time period, internet access grew rapidly around the globe (Chabowski & Samiee, 2020). Thus, this phenomenon spawned the appearance of scholarly journals in electronic form that presented advantages over printed journals such as ease of accessibility and lower production cost. However, despite the reduced production cost, subscription-based publishers kept rising their subscription price even though their documents were made available online. To illustrate the growth of electronic journals, while in 1991 a total of 110 were accounted for, in 1996 the number of electronic journals rose to 1688 (Pikowsky, 1997).

Unwillingly, all these events paved the road to the open access movement, which began at the Budapest Open Access Initiative (BOAI, 2002). As defined by the initiative, open access (OA) refers to literature that should be freely accessible online so anyone can read, download, copy, distribute, print and search, among other things. It also acknowledges the author's right over the published work. To achieve OA, the Budapest Open Access initiative recommended two complementary strategies: Self-archiving the documents in an OA institutional or subject repository (known as Green OA) and the creation of OA journals which provide unrestricted access to all the publications (known as Gold OA). In the latter, authors are generally charged an 'article processing charge' (APC) to publish their manuscript (Morillo, 2020). Since then, the OA publishing model has evolved giving rise to other types of OA:

**Hybrid OA:** Publishers may offer a combination of subscription access and OA access for some journals. In the case of OA publications, an APC fee is applied (Laakso & Bjork, 2016).

**Diamond/platinum OA:** Journals do not charge APC to publish a manuscript. In general, these journals are funded by scientific societies and universities (Fuchs & Sandoval, 2013).

APC policies have been adopted by scholarly journals for many years. In early 2000 the Public Library of Science, which began as an initiative, proposed the establishment of online public libraries that would make all content freely available by charging a reasonable fee to cover the cost of publication (Doyle, 2004). BioMed Central decided that all starting journals would be built and optimized for OA, acknowledging that the only way to economically sustain this publishing model was through the use of APC (Velterop, 2003). In the case of commercial publishers, Springer began offering the Open Choice Model in which the authors assume the cost of the publishing process, so their work is available to everyone for free (Springer, 2004). Likewise, Blackwell Publishing launched Online Open in 2005 as an OA alternative for authors willing to pay a fee of \$2,500 (Robinson, 2006). In the case of Elsevier, the publishing company delivered a conference presentation showing the company's view on open access and related activities (Hunter, 2004). Since then, Elsevier has increased the number that offer the option of OA publishing. While in 2013 only 46 journals were accounted (Morrison, 2017), in 2020 more than 2300 offer the possibility of OA publishing (Elsevier, 2021). Lastly, a recent study showed that some commercial publishers have begun raising their APCs for frequently cited journals (Asai, 2020).

But the OA movement not only permeated the publishing industry. The general and academic culture recognized the benefits of increasing the visibility of their work. Already in 2004, a group of thirteen universities in the Netherlands began working on a scheme that made available all the articles that were authored by researchers from these institutions (De Vries, 2004). However, in 2018 a new OA initiative proposed that all scholarly publications that were the result of projects funded by public or private grants provided by national, regional and international research councils ought to be published in OA journals or deposited in OA repositories without embargo (Else, 2018). This initiative, named Plan S, was originally signed by national agencies

### Key points

- Chilean researchers published 6776 OA articles in WOS-indexed journals during 2019, of which 65.4% charged an APC.
- The estimated cost to Chile for APCs during 2019 was US \$9,129,939.
- Articles in Health and Medical Sciences accounted for a third of Chilean APC costs in 2019, closely followed by Life and Earth Sciences.
- There is a large disparity in the potential APC cost to Chile according to discipline and type of publisher which may influence both research funding and OA requirements.

from Austria, Ireland, Luxembourg, Norway, Poland, and Slovenia, as well as by funders from Italy and Sweden. It is currently supported by cOAlition S, an international consortium of research funding and performing organizations. However, the implementation of Plan S has not been without its share of difficulties (Lopez-Borrull et al., 2020). In fact, the implementation was postponed for a year in the hope of providing more time for the research community to adapt to the changes required by Plan S (Else, 2019). One of the main issues is how to finance OA publishing as immediate, or gold OA, generally involves the payments of APC, to the disadvantage of authors lacking funding resources (Johnson, 2019). To accelerate the transition to OA publishing, cOAlition S funders favoured the gold route with a cap on the APC charged (Purton et al., 2019). However, it is unknown how publishers will arbitrarily standardize and cap the fees worldwide (Kowaltowski & Oliveira, 2019; Purton et al., 2019). As an example, the publishing company Taylor & Francis Ltd. has signed OA agreements with 12 countries (Taylor and Francis, 2021). However, the terms of agreement not only differ by country, but within the same country. For instance, while researchers affiliated to the Spanish National Research Council may publish in most of their journals at no cost for themselves, researchers based at institutions that are part of the Canadian Research Knowledge Network (composed of 76 institutions) are eligible to apply for at least a 25% discount on APC. In the case of Germany, the terms of the OA agreement vary depending on the counterpart that signed the agreement. Researchers based at the Max Planck Institutes or at institutions belonging to the Leibniz Association may publish without paying APC. Contrarily, researchers affiliated to institutions that belong to the Friedrich-Althoff-Konsortium are offered discounts on the APCs. Another publishing company, Springer Nature, recently signed an OA agreement with the Max Planck Society in Germany, setting a fee of U\$11,200 to publish OA articles in one of their 34 journals (Van Noorden, 2020). The publishing company argues that these journals review more manuscripts that are published, and that the contribution made by their in-house editors and press officers is valuable. However, these arguments are also valid for thousands of other journals.

Hence, the underlying mechanism by which APCs are set by each publishing company remains a mystery. That being the case, it is essential for countries to determine their yearly APC expenditure in order to negotiate with the publishers when the time comes.

In Latin America, the OA movement emerged for a variety of reasons. Besides the fact that many countries could not afford subscription costs to print journals, their geographical distance was a major determinant of whether researchers could get hold of printed journals (Babini & Machin-Mastromatteo, 2015). Additionally, OA journals presented the opportunity to increase the visibility of the research being produced by Latin American institutions (Costa & Leite, 2016). Many of these issues were solved by the implementation of SciELO (Scientific Electronic Library Online) in 1997. SciELO emerged in Brazil with the purpose of contributing to the promotion of Latin American and Caribbean scientific journals by providing free access to its content. After 20 years of operation, SciELO has turned into a network currently indexing over 1200 journals from 17 countries (SciELO, 2019). Most of these journals are published either by universities, scholarly societies, or professional associations. While the SciELO network has shown that it is possible to eliminate accessibility and price barriers, many countries in South America have not implemented open access policies (Minniti et al., 2018).

Among these countries is Chile, which started the development of the SciELO network by being the first country that adopted the model in 1997 (SciELO, 2019). Furthermore, in 2008 Chile formed a library consortium which has allowed universities, since then, to gain access to journals and citation databases that are behind a paywall at a cost of approximately USD 16.7 million just for the year 2020 (BEIC, 2020). All these achievements were the result of the Chilean National Agency of Research and Development (presently known as ANID), which is a government agency responsible for the coordination, promotion and of funding of scientific research in Chile. While this agency currently provides research funding through different programs, Fondecyt has remained as the most important research grant program designed to provide funding for basic research activities in all disciplines of science.

At the beginning of 2020, ANID proposed for the first time a national OA policy (ANID, 2020). Just as Plan S, the national OA policy aims to ensure access to the scientific knowledge contained in publications resulting from research projects and graduate theses funded by the Agency. However, many parameters need to be analysed prior to its implementation such as current APC expenditure by Chilean researchers. Depending on the research area, publication fees may range from USD 100 to USD 5200 (University of Cambridge, 2018). While some studies have analysed APC expenditure by institutions (Jahn & Tullney, 2016; Lawson, 2015; Solomon & Björk, 2016), data regarding APC expenditure by country is scarce. Pavan and Barbosa (2018) estimated that Brazil spent approximately USD 36 million in a 5-year period. Since no information regarding APC expenditure is available for Chile, the objective of this study is to establish the 2019 APC expenditure in Chile by analysing publishers, research areas and article processing fees. However, given the limitations of the

available data, for the purpose of this study it was assumed that no publishing waivers or discounts were granted to the authors. Additionally, APC costs were estimated assuming that all the documents were paid by the Chilean counterparts.

## MATERIALS AND METHODS

Bibliographic data for this study was extracted from the Web of Science database in May 2020. The search criteria (CU=Chile and PY = 2019) included publications indexed by Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index and Emerging Sources Citation Index. As a result of the initial query a total of 15,051 documents that registered at least one affiliation to a Chilean institution were downloaded. OA documents were subsequently selected and processed using Microsoft Excel and Sequel Pro. The query was repeated for the years 2010–2018 in order to establish the proportion of OA documents published annually.

The Web of Science database was used for this study due to the fact that the main Chilean research grant (Fondecyt) utilizes this database to assess all researchers as part of the evaluation process.

The list of the 2019 publications included for each document the details of the title, source, ISSN, publisher, subject category, type of OA and DOI. Since all the journals indexed by the Journal Citation Reports are classified in at least one of 254 subject categories, for the purpose of the study these categories were regrouped into nine major research areas based on the classification made by Martin-Martin et al. (2018). A slight modification was made, which consisted in creating an additional research area (multidiscipline) that grouped all those journals that covered a wide range of topics.

1. *Business, Economics & Management*: Business & Economics; Development Studies; Management; Operations Research & Management; Public Administration.
2. *Chemistry & Materials Sciences*: Chemistry; Construction & Building Technology; Crystallography; Electrochemistry; Energy & Fuels; Materials Science Mineralogy; Mining & Mineral Processing; Polymer Science.
3. *Engineering & Computer Sciences*: Automation & Control Systems; Computer Science; Engineering; Instruments & Instrumentation; Mechanics; Medical Informatics; Metallurgy & Metallurgical Engineering; Mining & Mineral Processing; Remote Sensing; Robotics; Telecommunications.
4. *Health & Medical Sciences*: Allergy; Anatomy & Morphology; Anesthesiology; Audiology & Speech-Language Pathology; Behavioural Sciences; Cardiovascular Systems & Cardiology; Dentistry, Oral Surgery & Medicine; Dermatology; Emergency Medicine; Endocrinology & Metabolism; Gastroenterology & Hepatology; General & Internal Medicine; Geriatrics & Gerontology; Health Care Sciences & Services; Haematology; Immunology; Infectious Diseases; Integrative & Complementary Medicine; Legal Medicine; Medical Laboratory Technology; General & Internal Medicine; Neurosciences & Neurology;

- Nursing; Nutrition & Dietetics; Obstetrics & Gynaecology; Oncology; Ophthalmology; Optics; Orthopaedics; Otorhinolaryngology; Pathology; Paediatrics; Pharmacology & Pharmacy; Physiology; Psychiatry; Psychology; Radiology, Nuclear Medicine & Medical Imaging; Rehabilitation; Research & Experimental Medicine; Respiratory System; Rheumatology; Sport Sciences; Substance Abuse; Surgery; Toxicology; Transplantation; Tropical Medicine; Urology & Nephrology.
5. *Humanities, Literature & Arts*: Art; Arts & Humanities—Other Topics; Classics; Literature; Philosophy; Religion.
  6. *Life & Earth Sciences*: Agriculture; Biochemistry & Molecular Biology; Biodiversity & Conservation; Biotechnology & Applied Microbiology; Cell Biology; Developmental Biology; Entomology; Environmental Sciences & Ecology; Evolutionary Biology; Fisheries; Food Science & Technology; Forestry; Genetics & Heredity; Geochemistry & Geophysics; Geography; Geology; Genetics & Heredity; Geography; Geology; Life Sciences & Biomedicine—Other Topics;; Marine & Freshwater Biology; Meteorology & Atmospheric Sciences; Microbiology; Mycology; Oceanography;; Palaeontology; Parasitology; Physical Geography; Plant Sciences; Public, Environmental & Occupational Health; Veterinary Sciences; Virology; Water Resources; Zoology.
  7. *Multidiscipline*: Science & Technology—Other Topics.
  8. *Physics & Mathematics*: Acoustics; Astronomy & Astrophysics; Biophysics; Mathematical Methods in Social Sciences; Mathematics; Mathematics & Computational Biology; Nuclear Science & Technology; Physics; Thermodynamics.
  9. *Social Sciences*: Area Studies; Architecture; Archaeology; Communication; Cultural Studies; Education & Educational Research; Government & Law; History & Philosophy of Science; History; Information Science & Library Science; Social Sciences—Other Topics; Urban Studies.

Additionally, publisher names were normalized prior to classifying into one of three categories (Torres-Salinas et al., 2014):

1. *Commercial publisher*: This publisher is defined as a profit-oriented firm not associated to universities such as MDPI or Wiley.
2. *Non-university academic publisher*: This publisher relates to scientific societies, or any other type of academic entity not associated to universities.
3. *University press*: Any publisher belonging to a university.

The APC for each journal was collected from the journal website. If the currency indicated in the journal website was not US dollar (USD), it was converted into USD to allow comparisons across research areas, journals, and publishers.

## RESULTS

According to the data extracted from Web of Science, a total of 6776 OA documents (45%) were published in 2019 by Chilean

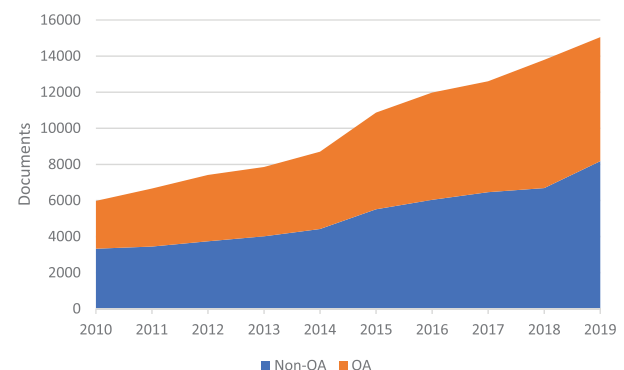
researchers. As Fig. 1 illustrates, the proportion of OA documents has remained stable since 2010.

The overall result of the analysis identified 681 journals that did not charge APCs for the publication of 2382 documents authored by Chilean researchers in 2019. When the data were disaggregated by research areas, important differences emerged. As Table 1 reveals, the majority of documents (94%) associated with Humanities, Literature & Arts were published in journals free-of-charge. A similar situation was observed for documents associated to the Social Sciences. For the rest of the research areas, this proportion was below 40%, and the area of Multidiscipline science stands out with only 2.1% of its documents published on journals not charging APCs.

The average cost of APC for each research area and the total amount of dollars spent on APC in 2019 are detailed on Table 1. To avoid a distortion on the average cost of APC, this value was estimated excluding journals that did not charge a publication fee. The cost of the publications related to Health & Medical Sciences were not only the most expensive on average (USD 2403) but it represented 32.1% of the total money spent on APC in 2019. The APC rates of these journals ranged from USD 150 to USD 6000. Contrarily, the publications related to Humanities, Literature & Arts were the cheapest, charging on average USD 575. The total cost of the 4496 documents that were charged APC during 2019 was estimated at USD 9,129,939.

## Research area

It is important to note that APC cost varied greatly, depending on the research area. Figure 2 illustrates the number of documents published according to their APC cost, for each research area. Regarding Business, Economics & Management, a major proportion of documents were published in 27 different journals charging between USD 2500–USD 3000. In the case of Chemical & Material Science, almost half of the documents (49%) paid an APC that ranged between USD 1501–USD 2000 to be published in one of 19 different journals. As for the documents related to Engineering & Computer Science, 38.2% were published in seven different journals charging between USD 1501–USD 1750. In



**FIGURE 1** Proportion of OA and non-OA documents that registered at least one Chilean affiliation.

**TABLE 1** APC by research area.

| Research area                    | Totaldocs | Docs charged APC | Min (USD) | Max (USD) | Median (USD) | Mean (USD) | Total (USD) |
|----------------------------------|-----------|------------------|-----------|-----------|--------------|------------|-------------|
| Business, Economics & Management | 131       | 83 (63.4%)       | 100       | 3500      | 2700         | 2067       | 172,165     |
| Chemistry & Materials Sciences   | 347       | 302 (87.0%)      | 280       | 4000      | 1664         | 1722       | 524,639     |
| Engineering & Computer Sciences  | 222       | 166 (74.8%)      | 372       | 4300      | 1750         | 2079       | 347,981     |
| Health & Medical Sciences        | 1812      | 1326 (73.2%)     | 150       | 6000      | 2500         | 2403       | 2,932,780   |
| Humanities, Literature & Arts    | 401       | 24 (6.0%)        | 80        | 4500      | 80           | 575        | 13,789      |
| Life & Earth Sciences            | 1470      | 1117 (76.0%)     | 18        | 5250      | 1871         | 2102       | 2,594,572   |
| Multidiscipline                  | 373       | 365 (97.9%)      | 600       | 5250      | 1695         | 1898       | 692,762     |
| Physics & Mathematics            | 1044      | 960 (92.0%)      | 299       | 5000      | 1698         | 1678       | 1,611,705   |
| Social Sciences                  | 1078      | 153 (14.2%)      | 100       | 4500      | 1500         | 1565       | 239,546     |
| Total                            | 6878      | 4496             |           |           |              |            | 9,129,939   |

Note: 'Total docs' indicates the total number of OA documents published in 2019; 'Docs charged APC' indicates the number of OA documents published in 2019 that were charged APC. 'Min' indicates the minimum APC value; 'Max' represents the maximum APC value; 'Total' indicates the total amount paid in publication fees for a specific research area.

particular, one specific journal (IEEE Access) published 92% of these documents. In Health & Medical Sciences, while a large proportion of documents (27.1%) were charged between USD 1751–USD 2500, a substantial share (21.5% of the total) paid between USD 2751–USD 3000 to be published in one of 89 different journals. In fact, 61.8% of the documents that were charged between USD 2751–USD 3000 were published in journals from just one publisher (Frontiers Media SA). As for Humanities, Literature & Arts, only 15 documents paid APC, being the majority published in one journal (*Revista Inclusiones*) that charged a fee below USD 250. In Life & Earth Sciences two APC ranges concentrated a large share of the published documents, 19.3% of the published documents paid between USD 1751–USD 2000, while 15.3% was charged between USD 2751–USD 3000. In the case of the Multidiscipline research area, six journals concentrated two thirds (66.9%) of the documents that paid between USD 1500–USD 2000 in APC. While in the research area of Physics & Mathematics one APC range (USD 1501–USD 1750) represented 27.8% of the total documents that were charged a fee. In the case of Social Sciences, 33.3% of the published documents were charged below USD 250.

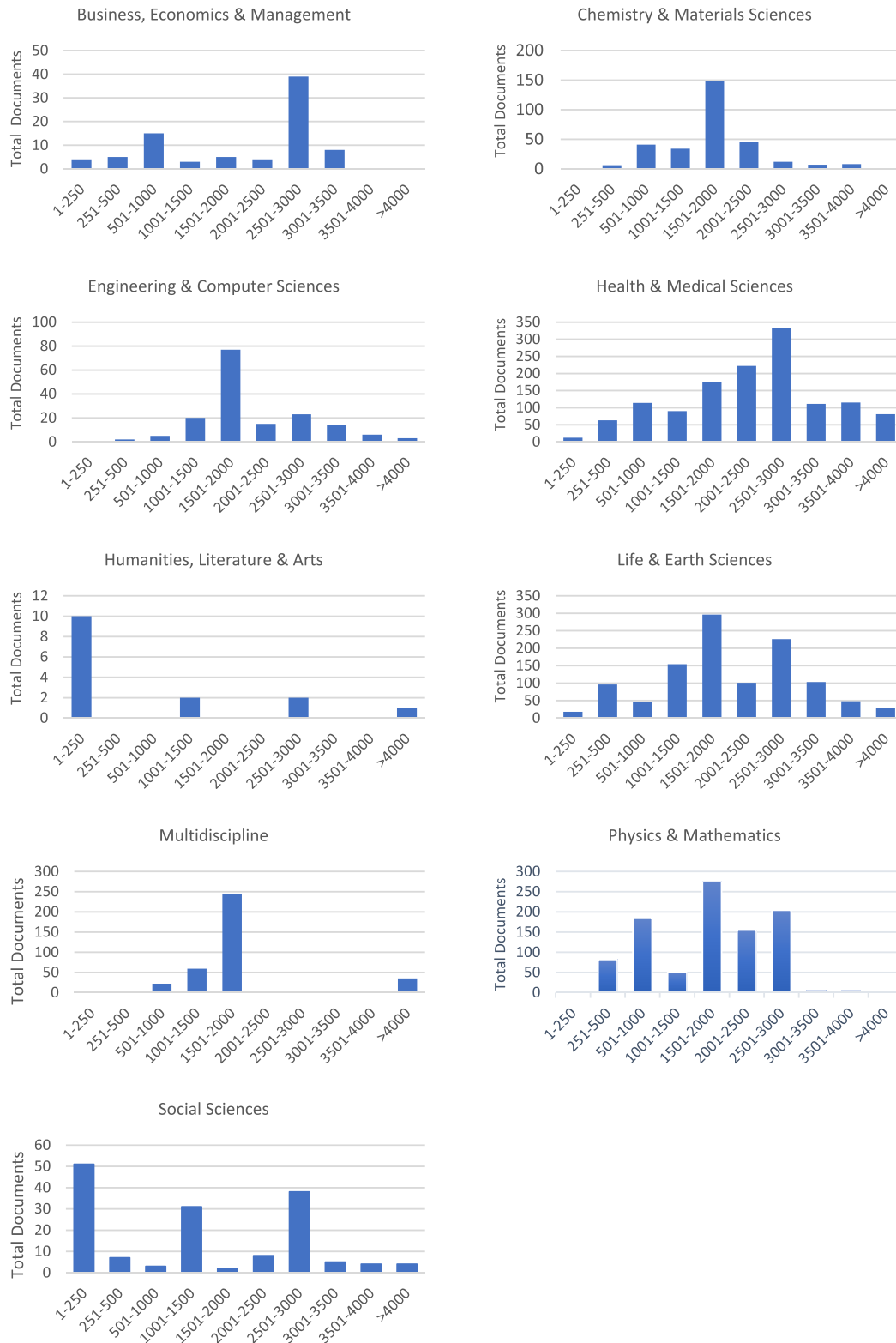
### Types of publishers

This study identified 99 commercial publishers, 268 non-university academic publishers and 255 university presses that were used in 2019. Table 2 details a ranking of the top-20 publishers according to the total APC charged in 2019. This ranking is led by five commercial publishers, beginning with MDPI (USD 1,169,529), followed by Wiley (USD 1,032,204), Frontiers Media SA (USD 985,790), Elsevier (USD 883,955) and Springer (676,775). The total APC cost for these five publishers corresponded to 52% of the total APC expenditure in 2019.

A comparison of APC expenditure by research area among the different types of publishers revealed some interesting results (Fig. 3). In the case of commercial publishers, the total cost of APC by research area tends to be proportional to the number of documents published in each research area. However, for the other two publisher types it differs. In the case of non-university academic publishers, while 42.2% of the documents published belonged to Health and Medical Science, APC expenditure accounted for only 18% of the total APC spent on non-university academic publishers. As for university presses, 46.4% of the published Social Sciences documents accounted for 6.1% of the total APC paid. Contrarily, Physics & Mathematics represented 57% of the total APC expenditure with only 9.9% of the documents.

### DISCUSSION

Never before had the OA model proved to be so valuable. The speed at which COVID-19 literature was made freely available online has facilitated research towards finding a solution. However, someone must bear the cost of making this information available to everyone. As previously described, in the case of Diamond/Platinum OA journals the publisher covers all the costs such as submission system, copyediting, triaging, dissemination and web hosting. The results of this study showed that most journals from Social Sciences, Humanities and Arts fall within this category as these journals did not charge a publication fee. This outcome resembles the findings of Solomon and Björk (2012) which showed that Arts & Humanities rarely charged APC. Moreover, a study on Brazilian publications reported that the area of Literature, Linguistics and Arts characterized by being the only one that did not include journals with APC (Pavan & Barbosa, 2018). As one might expect, only a small proportion of these journals are managed by commercial



**FIGURE 2** Number of documents published according to their APC cost, disaggregated by research area.

publishers. In this study, commercial publishers managed 16.2% of the journals used in Social Sciences and 7.3% of the journals used in Humanities, Literature & Arts. These results seem to confirm that

commercial publishers have had, historically, a low economic interest on these type of journals as their number have been traditionally low since the print era (Rodrigues et al., 2020).

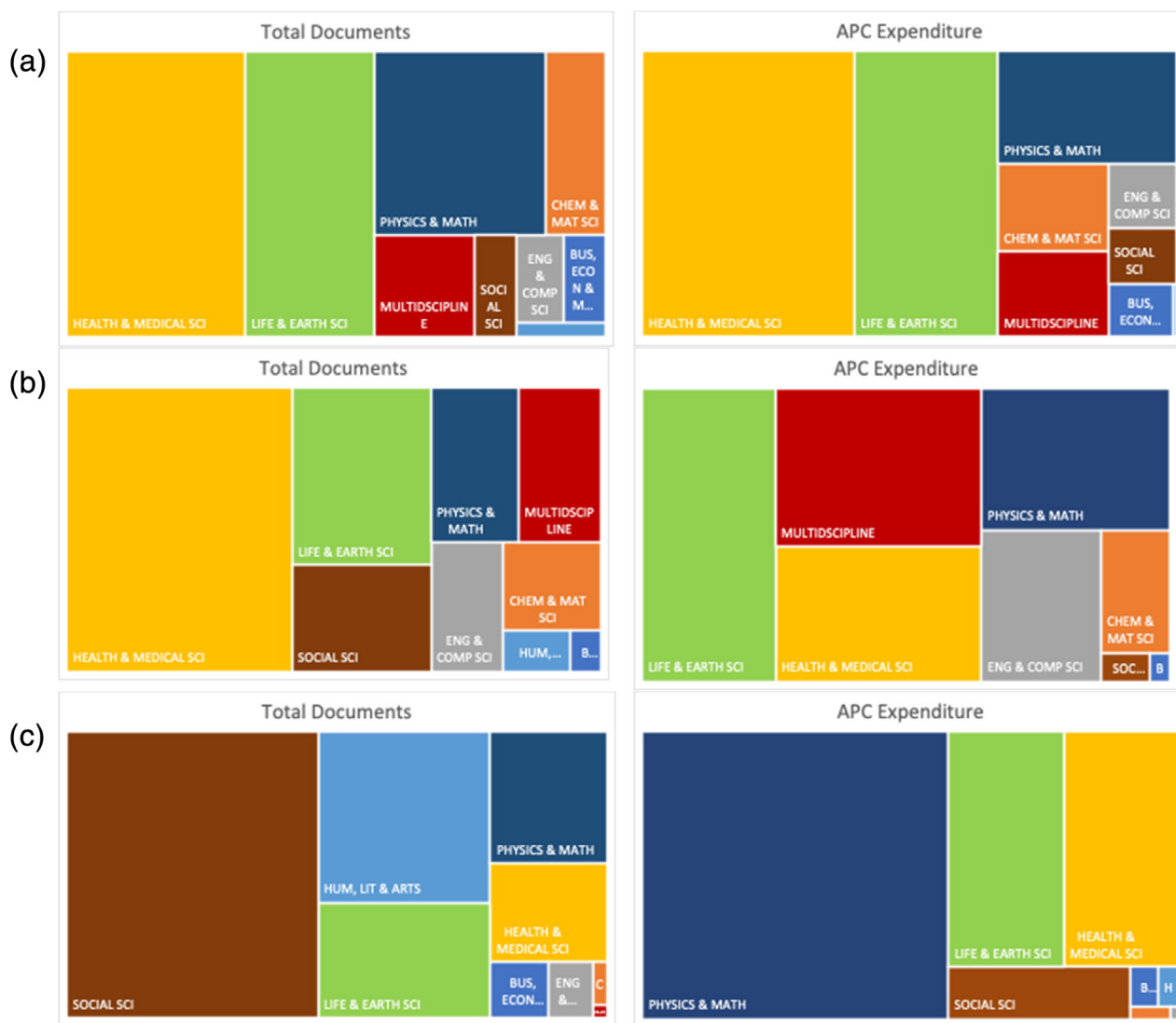
**TABLE 2** Top-20 publishers ranked by total APC charged in 2019.

| Publisher                                      | # Journals | # Documents | Total APC (USD) |
|--|------------|-------------|-----------------|
| MDPI   | 72         | 703         | \$1,169,529     |
| Wiley  | 183        | 330         | \$1,032,204     |
| Frontiers Media SA                             | 35         | 339         | \$985,790       |
| Elsevier                                       | 215        | 407         | \$883,955       |
| Springer                                       | 121        | 283         | \$676,775       |
| Oxford Univ Press                              | 47         | 231         | \$645,636       |
| EDP Sciences S A                               | 5          | 260         | \$430,604       |
| Nature Publishing Group                        | 31         | 186         | \$409,545       |
| BMC  | 68         | 119         | \$277,370       |
| Taylor & Francis Ltd                           | 72         | 99          | \$214,785       |
| Public Library Science                         | 6          | 111         | \$200,320       |
| IOP Publishing Ltd                             | 18         | 227         | \$188,110       |
| Amer Physical Soc                              | 8          | 95          | \$178,540       |
| Hindawi Ltd                                    | 34         | 78          | \$153,650       |
| IEEE-Inst Electrical Electronics Engineers Inc | 8          | 63          | \$114,350       |
| BMJ Publishing Group                           | 12         | 46          | \$113,786       |
| Amer Geophysical Union                         | 10         | 28          | \$85,500        |
| Amer Assoc Advancement Science                 | 3          | 17          | \$76,500        |
| Cambridge Univ Press                           | 18         | 27          | \$68,481        |
| Cell Press                                     | 9          | 26          | \$68,000        |

As Table 1 outlines, 60.5% of the money spent on APC during 2019 was directed towards the publication of 2443 documents (54.3%) in the areas of Health & Medical Sciences along with Life & Earth Sciences. Similarly, Pavan and Barbosa (2018) reported that 68.7% of all the documents that were charged APC belonged to the Agricultural, Biological and Health Sciences. Contrarily, this study established that APC expenditure on Humanities, Literature & Arts was the lowest (USD 13,789) by far. This result is in line with the findings of other reports (Kozak & Hartley, 2013; Solomon & Björk, 2012). The latter established that a large share (96%) of the journals listed by DOAJ in the Humanities did not charge a publication fee. Furthermore, the same study reported that none of the journals that were associated to Arts required APC payment. The reason behind this might be the fact that these research areas are scantily funded. A study among Estonian Humanities researchers established that while the competition for resources was high, the amount of money awarded was low (Eigi et al., 2014). Funding limitations have also been expressed by Vietnamese researchers within the Humanities and Social Sciences (Pham & Hayden, 2019). While disciplines associated to the Social Sciences, Humanities, Literature and Arts may not require the same amount of resources as natural or exact sciences, the observed disparities are important. According to data extracted from Scival ([www.scival.com](http://www.scival.com)), the field of

General Medicine was awarded a total of USD 5.9 billion in 2019, whereas General Arts & Humanities was only awarded USD 5.2 million.

The picture across all the publishers covered in this study is not even. Commercial publishers collected 79% of the total APC expenditure for the publication of 3552 documents in 2019. Thus, it is not surprising that the list of the top-20 publishers ranked by APC included 14 commercial publishers. Similar results were observed by other studies which described a high concentration of a few publishers (Jahn & Tullney, 2016; Lariviere et al., 2015). Furthermore, a concentration of traditional publishers among the top-20 list is consistent with the results of another study (Pinfield et al., 2015). As Fig. 3 illustrates, a large proportion (39.7%) of APC paid to the commercial publishers occurred through journals concentrated in the Health & Medical Sciences, which have the highest fees on average. Interestingly, while no research area led APC expenditure in the case of non-university academic publishers, 42.2% of the total documents were published in journals from the Health & Medical Sciences. The reason why the high number of documents published in this research area did not affect APC expenditure was the fact that these journals had an average publication fee of USD 331, which is low compared to similar journals published by other types of publishers.



**FIGURE 3** APC distribution by number of documents and APC expenditure. (a) Commercial publishers. (b) Non-university academic publishers. (c) University presses.

The scenario for journals managed by university presses is quite different. While 46.4% of the total documents were published in journals related to Social Sciences, only 6.1% of total APC expenditure was spent on this research area, corroborating the fact that the vast majority of these journals do not charge publication fees. Instead, 57% of the total APC paid to university presses was published in journals from Physics & Mathematics, although it only corresponded to 9.9% of the total documents. On average, the APC charged by Physics & Mathematics journals from university presses is the highest (USD 2641) in comparison to non-university academic publishers (USD 1487) and commercial publishers (USD 1298). It is important to note that 94% of all these documents were published in just one journal, *Monthly Notices of the Royal Astronomical Society*, which charges an APC of USD 2760. However, aside from Physics & Mathematics, commercial publishers charged

the highest average APC in all other research areas analysed in this study.

## CONCLUSIONS

In many countries, not only researchers and students are advocating for OA but people outside the academic society have joined this movement. While the majority see OA as the democratization of knowledge, the truth of the matter is that researchers from the Global South are encountering significant barriers to publish their work in thousands of journals due to the high fees charged by some journals. The challenge is how to level the field to ensure researchers have the necessary funds to pay for these fees, especially in Chile now that ANID will be implementing an OA policy by the end of 2021.



One of the key steps while designing a policy is to collect precise information to design a first draft. This study provides an analysis that was made using recent data to establish which research areas are currently spending more funds on APC in Chile, in the hope that the implementation of an OA policy will be accompanied by sustainable APC funding grants aimed at supporting under resourced researchers that want to make their research freely available.

Nonetheless, the future implementation of an OA policy in Chile has begun raising questions among the scientific community. For instance, will the Chilean library consortium continue funding institutional access to paywalled journals? Some researchers are wondering whether the implementation of the OA policy will pose budgetary restrictions on the library consortium that has been essential to address the needs of academics and students.

In sum, albeit the objective of the OA policy is to ensure citizens access to scientific knowledge, the process by which it will be formulated and implemented is relevant. We must be aware that the OA publishing-model is not a solution *per se*. Publishers have already noticed that OA can be profitable from a commercial perspective, thus, any OA policy should avoid encouraging APC-free journals to begin charging publications fees.

## Limitations

It is important to note that this study has some limitations. First, some journals grant waivers or discounts to authors. Since this information is not detailed in the published documents, for the purpose of this study it was assumed that no waivers or discounts were granted. Second, no differentiation was made regarding the type of OA in this study as 8.9% of the data downloaded from Web of Science did not contain this information. Third, APC costs were estimated assuming that all the documents were paid by the Chilean counterparts, even though this may not have occurred.

## ACKNOWLEDGEMENTS

This research received no external funding.

## AUTHOR CONTRIBUTION

Erwin Krauskopf: Conceived the study idea; design and implementation of the research; analysis of the results; writing the manuscript.

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