A Study of Open Access Journals Using Article Processing Charges

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Article processing charges (APCs) are a central mechanism for funding open access (OA) scholarly publishing. We studied the APCs charged and article volumes of journals that were listed in the Directory of Open Access Journals as charging APCs. These included 1,370 journals that published 100,697 articles in 2010. The average APC was $906 U.S. dollars (USD) calculated over journals and $904 USD calculated over articles. The price range varied between $8 and $3,900 USD, with the lowest prices charged by journals published in developing countries and the highest by journals with high-impact factors from major international publishers. Journals in biomedicine represent 59% of the sample and 58% of the total article volume. They also had the highest APCs of any discipline. Professionally published journals, both for profit and nonprofit, had substantially higher APCs than journals published by societies, universities, or scholars/researchers. These price estimates are lower than some previous studies of OA publishing and much lower than is generally charged by subscription publishers making individual articles OA in what are termed hybrid journals.

Introduction

Scholarly open access (OA) journals make their content available online to anyone and in doing so help solve the access challenges posed by subscription journals. Because OA journals do not charge for access, they rely on other means of funding publication. Most of the early OA journals were published by academics largely using voluntary labor and small subsidies. A second wave comprised established society journals with stable subscription income that made the electronic version of the journal openly accessible, either directly or after a delay of typically 6 months to a year (Laakso et al., 2011).

In 2000, two new professional publishers, the Public Library of Science (PLoS) and BioMed Central (BMC), began establishing journals that rely on article processing charges (APC) paid by the authors, their institutions, or funders as their main means of financing their journals' operations. The number of such publishers, journals they publish, as well as of the number of articles published in these journals has been growing rapidly. In the last few years a number of leading traditional publishing companies have also started launching OA journals funded by APCs. As of August 2011, 1,825 journals were listed in the Directory of Open Access Journals (DOAJ) that, at least by self-report, charge APCs. These represent just over 26% of all DOAJ journals.

The APC-funded OA model fundamentally changes the relationship among authors, publishers, and readers, transferring the role of funding the publication from subscribers, most often university libraries, to the authors, their funders, or employers. The cost of APCs adds a new dimension to the authors' decisions as to where to attempt to publish their manuscripts. It also changes the focus of the publishers' marketing efforts in that their customers in at least a financial sense are now the authors rather than the subscribers. In addition, the academic libraries' traditional role as an intermediary between the readers and the publishers disappears, though, in some cases, they have taken on a new role of managing the payment of APCs for the authors at their universities.

Charging authors has been a common practice for many years in subscription publishing, in particular among society publishers who have used page charges as an additional source of income to lower their subscription prices. Commercial scholarly publishers, on the other hand, have rarely used page charges as a source of funding (Tenopir & King, 2000).

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In the debate about whether OA publishing should become the predominant model for funding scholarly publishing, there seem to be widely held misconceptions about how commonly APCs are used to fund publication and the typical APC level. Two quite commonly held beliefs are:

- That most OA journals charge APCs (see, e.g., Kayser, 2010)
- That the level of the APCs in full OA journals are in the order of $1,000–3,000 U.S. dollars (USD; Bird, 2010; Ware & Mabe, 2009).

One reason for this might be that there has been extensive media coverage of the two leading OA publishers, BMC and PLoS, and that the level of their charges has been generalized to OA publishing. Also, there has been a lack of empirical studies providing comprehensive data on the cost and growth of APC-funded OA publishing.

The aim of this study was to expand the research on APC-funded OA publishing, producing empirical data about the use of such charges, specifically:

- The number of publishers and journals charging APCs as well as the number of articles these journals publish
- The size and distribution of APCs based on the number of journals and articles, and
- The relationship of the APC level to characteristics of the journals and their publishers, such as the scientific discipline, type of publisher, impact, and country of the publisher

Background

Based on the early success of BMC and PLoS, dozens of start-up companies have moved into this market. Subscription publishers have also launched what are termed *hybrid journals,* in which they offer authors the option of providing OA to their individual article in what is otherwise a subscription journal. David Prosser (2003) described this mechanism as a means for established subscription publishers to experiment with OA without taking significant risks.

Springer started their "Open Choice" program in 2004 and others have followed. The uniform price level of $3,000 USD that Springer charged for all the journals in their program seems to have set the level for other publishers as well. According to a Springer press release, "the 3,000 U.S. dollar fee covers the costs of Springer's publishing service—including a parallel printed version of the article in an established journal" (Springer, 2005). The uptake of the hybrid model has so far been very low. According to a recent study, the overall uptake has been around 2% for the roughly 2,000 journals from 12 major publishers offering this option (Dallmeier-Tiessen et al., 2010).

Several recent stuides have attempted to estimate the costs per article of publishing scholarly peer-reviewed journals in order to calculate the cost effects of different scenarios of moving towards OA. A study published by the UK Research Information Network (2008) estimated that the average publishing and distribution cost per article (excluding the "cost" of unpaid reviewers but including publisher surplus) was 2,863 British Pounds (GBP). The figure is based on an estimate of global revenues for peer review journal publishing and of the number of articles published globally per year (1.59 million).

The researchers estimated that the cost effects of a transition to electronic-only publication would reduce the overall cost for publishing, dissemination, and local library access provision by 13% and that a transition to OA publishing financed with author-side payments by a further 7%. A study by Houghton et al. (2010) estimated an average publisher cost of around 3,247 GBP per article for dual-mode print and electronic publishing, 2,337 GBP per article for electronic-only publishing, and 1,524 GBP for OA publishing. At the time these two reports were written (2007–2008), one British Pound was worth roughly $2 USD.

In our view, the main flaw of almost all previous estimates is that they have been calculated based on the average reported costs or income of traditional subscription publishing. The cost estimates of both electronic-only and OA publishing have been derived from these base figures by subtracting the printing and delivery costs for paper versions. The problem with this method is that it does not take into account the dynamics of the marketplace and competition in lowering prices. Cost data have in the past stemmed from a number of leading publishers who, in an oligopolistic market, have been able to set the prices without much pressure to cut costs and streamline processes.

An article in *The Economist* (2011) recently reported that Elsevier, the largest publisher of scholarly journals with almost 2,000 titles, made an operating profit margin of 36%. Publishers have frequently tried to justify high subscription prices by the need to invest in information technology infrastructure. Many smaller OA publishers have instead used open source publishing solutions as one way to cut costs, along with outsourcing operations like copyediting and typesetting to countries where labor costs are low.

Because APC-funded OA publishing has matured, we feel it is possible to estimate the costs of this type of publishing directly by obtaining data from a large representative sample of OA journals that charge APCs. In this model, the costs are estimated based on the revenues from APCs. Getting the basic data (level of charge, number of chargeable articles) is relatively straightforward compared with obtaining data from subscription journal publishers, where much of the revenue is obtained from bundled licenses.

So far, the most comprehensive empirical study in which the use of APCs in OA publishing has been investigated was carried out in the European-Commission-funded Study of Open Access Publishing (SOAP) project (Dallmeier-Tiessen et al., 2010). This study focused on gathering data concerning the 2,823 active English-language journals included in the DOAJ in July 2009. The report contains much useful data about the distribution of journals according to size, the size and type of publishers, etc.

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Of interest for this study are the data concerning income sources for 1,958 journals, including all major OA publishers. Unfortunately, the data are very inconclusive because no actual income sizes or APC sizes were reported. What is reported is which percentage of journals used each of seven funding methods: APCs, membership fees, advertisement, sponsorship, subscription, hard copy, other. Not unsurprisingly, 80% of the journals from large publishers used APCs versus 20% of the other journals.

Walters and Linvill (2011) examined 663 journals in six fields selected from the DOAJ. They noted that while 29% of the journals charged APCs, they accounted for approximately 50% of the articles. For journals charging fees, they found the average fee was $1,109 with a median of $1,300. In many ways, our study parallels theirs; however, we focus exclusively on journals charging APCs while selecting a broader group of disciplines. They, in turn, included all OA journals in the DOAJ within the six fields meeting some basic requirements and were able to compare APC-funded journals with those funded by other sources.

In the SOAP project, the behavior and attitudes of scientists concerning OA publishing were also studied (Dallmeier-Tiessen et al., 2011). Questionnaires were sent to authors who had published with any of the publishers involved in the project. Almost 23,000 authors who had published an article in an OA journal were asked how much they had paid. Half had not paid any fee at all, and only 10% had paid fees exceeding 1,000 euros. Only 12% of authors had had to pay themselves, whereas 59% could use funding from research grants and 24% funding from the employing institution. There were clear differences in the levels paid depending on scientific discipline and country affiliation.

In a recent study, we surveyed authors who had published articles in OA journals using APCs (Solomon & Björk, 2012). The results indicated that research grants and institutional funding are the dominant modes of financing higher level APCs (above $1,000 USD), whereas personal funds were quite common for journals with lower charges. There were quite distinct differences in behavior and attitudes between scientific disciplines and high-income and low-income countries. We also found indications that the level of the APC charged was strongly related to the scientific disciplines as well as the Thomson Reuters Web of Knowledge impact factors of the journals in question.

Methodology

Sample. We used metadata retrieved from the DOAJ on August 23, 2011, to identify OA journals that charge APCs. Along with other self-report data from publishers, the DOAJ has recently included a field specifying whether a journal charges APCs. We identified 1,825 journals in the DOAJ in which the publisher indicated that the journal charged such fees. These journals served as a basis for our data collection.

We organized the journals by the 512 publishers included in the sample according to the number of journals per publisher. The vast majority (422) were single-journal publishers. All journals from publishers with at least two journals were included in the sample. The work required to extract data from 422 single-journal publishers, each with a uniquely organized Web site, would have been prohibitive. To represent these publishers, we identified 50 randomly selected journals from the single-journal publishers. As an afterthought, we decided to include all 41 single-journal publishers that published at least 100 articles in 2010, based on Thomson Reuters Journal Citation Reports (JCR) 2010. This included eight of the journals we had originally selected in the sampled single-journal publishers.

To avoid fractional journals in the results from the statistical analysis, we weighted the 42 journals we sampled from the remaining 381 single-journal publishers by a factor of 9 to maintain their representation among journals listed in the DOAJ that charged APCs. Unless otherwise noted, all of the results presented below are based on the weighted data.

Data collection. One of the two authors reviewed the Web site of each sampled journal or their publisher, obtaining the necessary information to determine if the journal actually charged an APC as well as the amount or method by which it was calculated. We also determined how many articles the journals published in 2010. This was determined in a variety of ways. Some publishers listed the number of articles in the volume or used a sequential numbering system for articles within a volume, which simplified the process of counting.

For some of the journals, we obtained approximate 2010 article counts from Scopus through the SCImago Web site and/or from JCR 2010. When both were available we used the JCR 2010 data. Typically, most of the journals with volumes of more than 100 were obtained from one of these indexes to keep the workload manageable. For many of the journals, we simply counted the articles on their Web site that had been published.

Journals that did not publish articles in 2010 or did not charge APCs were excluded from the sample. It should be noted that the article counts used in this study are for calendar year 2010; however, the APCs were those listed at the time of data collection, which ranged between the end of September 2011 and mid-November 2011. In most cases, it would have been impossible to determine from the Web sites what the level of the APC was specifically in 2010.

Publishers used a variety of strategies for determining how the APC authors were charged. A detailed description of these strategies and their prominence among publishers is presented elsewhere (Björk & Solomon, in press). Briefly, some publishers charged a fixed amount for all their journals or charged a fixed amount specific to each journal. Publishers often had different charges for different types of articles (i.e., research articles, review articles, shorter commentaries). Some publishers charged by the page or a flat fee plus a page charge over a certain amount of pages. Many

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publishers provide waivers for authors unable to afford to pay but publishers had a variety of criteria for determining eligibility. Some provide discounts for society membership, country of the author(s), and/or discounts for employer membership with the publisher. A few gave discounts for personal memberships or multiple manuscripts submitted in the same year.

In the case of journals using page charges or other differential pricing mechanisms, the authors reviewed a sample of about 10 articles from each journal and devised an estimate that represented the average APC for that journal. Given the variety of strategies for charging APCs, no specific algorithm was used and the calculation was done on a case-by-case basis. To check the reliability of the results, both authors coded the same set of 10 journals. There were no discrepancies in the article counts. There was a slight discrepancy in one of the APCs recorded, $150 USD versus $130 USD. Otherwise our coding of the APCs was consistent.

The publishers used a total of 13 different currencies. The majority of APC prices were in USD. Where a publisher posted prices in multiple currencies, the USD price was used. APCs in other currencies were converted into USD using the published exchange rate on November 23, 2011 obtained from FXware (http://www.fxware.com/en/).

The DOAJ metadata included information on a number of key journal characteristics. Along with the name of the publisher, the country of the publisher, up to three subject codes for the scientific discipline, the language(s) in which the journal was published, and the ISSN were included in the data set. Based on the ISSN numbers, we merged article counts and 2-year impact factors for 2010 from Scopus and the JCR 2010. In reviewing the Web sites, we also coded the type of publisher, such as commercial society or nonprofit, and the journal management software used. In addition, we recorded details about how the APC was calculated. Beyond the categorization on these attributes, notes were also collected on unusual or notable aspects of each publisher.

Calculations of averages and medians. Average and median APCs were calculated in two ways: first, based on journals, so that the average or median reflected the APC charged by the journals; second, based on articles published in 2010, so that they reflected the average or median APC paid by authors in that year. Each method reflects a somewhat different perspective, and because many of the journals published very few articles while others published thousands of articles, these two methods in some cases generated substantially different results. In our view, both perspectives are important, and depending on the question asked, one is generally more appropriate than the other.

Results

After excluding journals that did not charge APCs or did not publish in 2010, our sample included 1,090 journals, of which 64 were from single-journal publishers. The publishers, number of journals, and article counts are given in the Appendix. After weighting the results for the single-journal publishers, there were an estimated 1,370 journals that published a total of 100,697 articles in 2010 at a cost of $91,078,558 USD. All other statistical results presented below reflect weighting the sample of single-journal publishers. Summary statistics on APCs for both the journals and the articles published in 2010 are presented in Table 1.

TABLE 1. Article processing charges in U.S. dollars with summary statistics presented by journals and articles published in 2010.

	By journal	By article published in 2010
Mean	906	904
Median	800	740
Standard deviation	642	742
Minimum	8	8
Maximum	3,900	3,900
Number	1,370	100,697

Figures 1a and 1b present a breakdown of the APC charged into $200 USD categories. Figure 1a presents the breakdown of APCs charged for articles published in 2010. Figure 1b presents the breakdown of APCs charged by journal.

Figure 2 presents the average APC based on articles published in 2010 broken down by type and size of the publisher. This breakdown is presented in tabular form for means and medians for journals and articles published in 2010 in the Appendix.

Figure 3 presents the total expenditure for APCs by discipline category. The actual expenditures are shown above each bar. As can be seen, the vast bulk of the expenditures for APC-funded OA publishing has been in biomedicine.

Figure 4 presents the average level of the APC by discipline. The means represented by dark bars are based on journals. The lighter bars are based on the number of articles published in 2010. The numbers of journals and articles published in 2010 are listed at the top of each bar.

Figure 5 presents the average APC for the journals grouped into five categories based on the journals' impact factor. The first group includes journals that are not indexed in either Scopus or the Thomson Reuters Web of Science. The impact factor data for Scopus were obtained obtained from the SCImago Journal and Country Rank portal (www.scimagojr.com/) and for Web of Science from the JCR 2010.

In both cases, 2-year impact scores were used. Journals in Scopus but not in the JCR were split into low-impact and high-impact groups based on the median of the journals in the whole Scopus database. Those journals in the JCR 2010 were split into low-impact and high-impact groups based on the median impact of all journals in a combination of the Science and Social Science JRC 2010 Reports. Although roughly half the journals were not indexed at all, the proportion of articles in indexed journals was much higher (67% in ISI) because of the larger article volumes of these journals.

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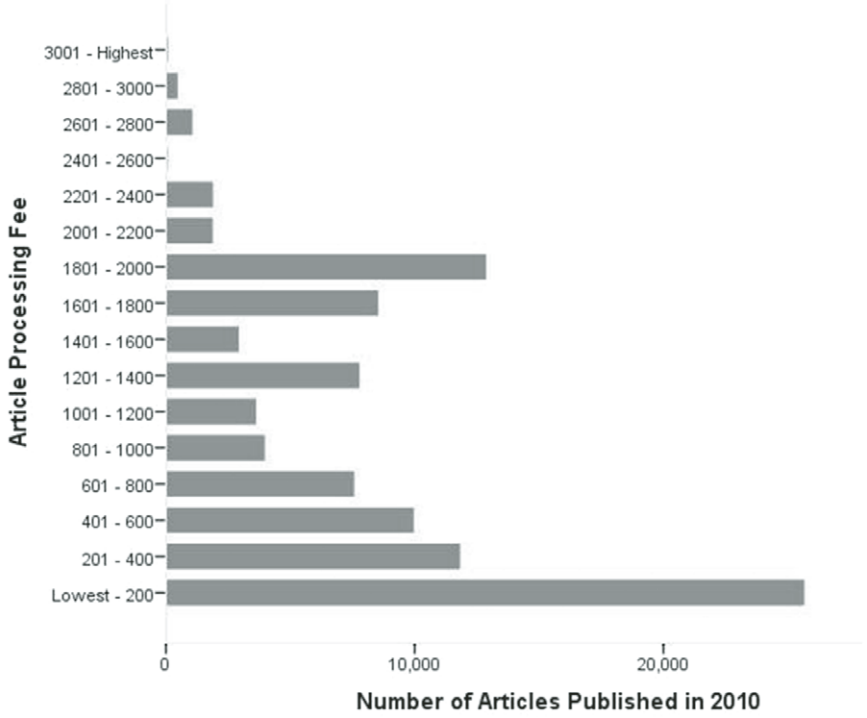

FIG. 1a. Number of articles published in 2010 by article processing charge size category.

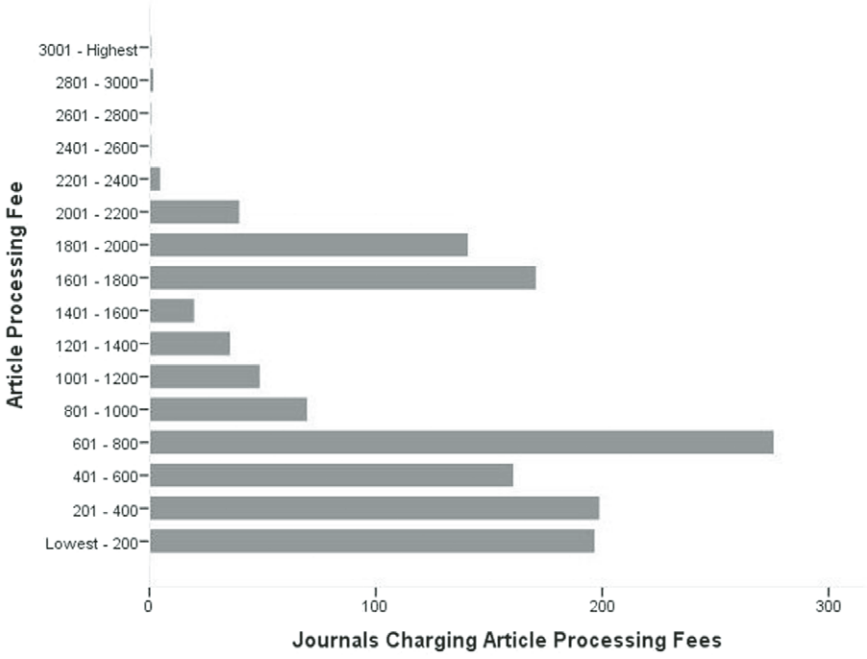

FIG. 1b. Number of journals by article processing charge size category.

Discussion

We feel our methodology is robust. The data set included a complete sample of all OA publishers in the DOA listed as charging APCs that published at least two journals. We included a random sample of approximately 11% of the single-journal publishers weighted to represent the full sample of single publishers. Given the ease and lack of any cost of including one's journals in the DOAJ and the visibility it provides, we expect the directory

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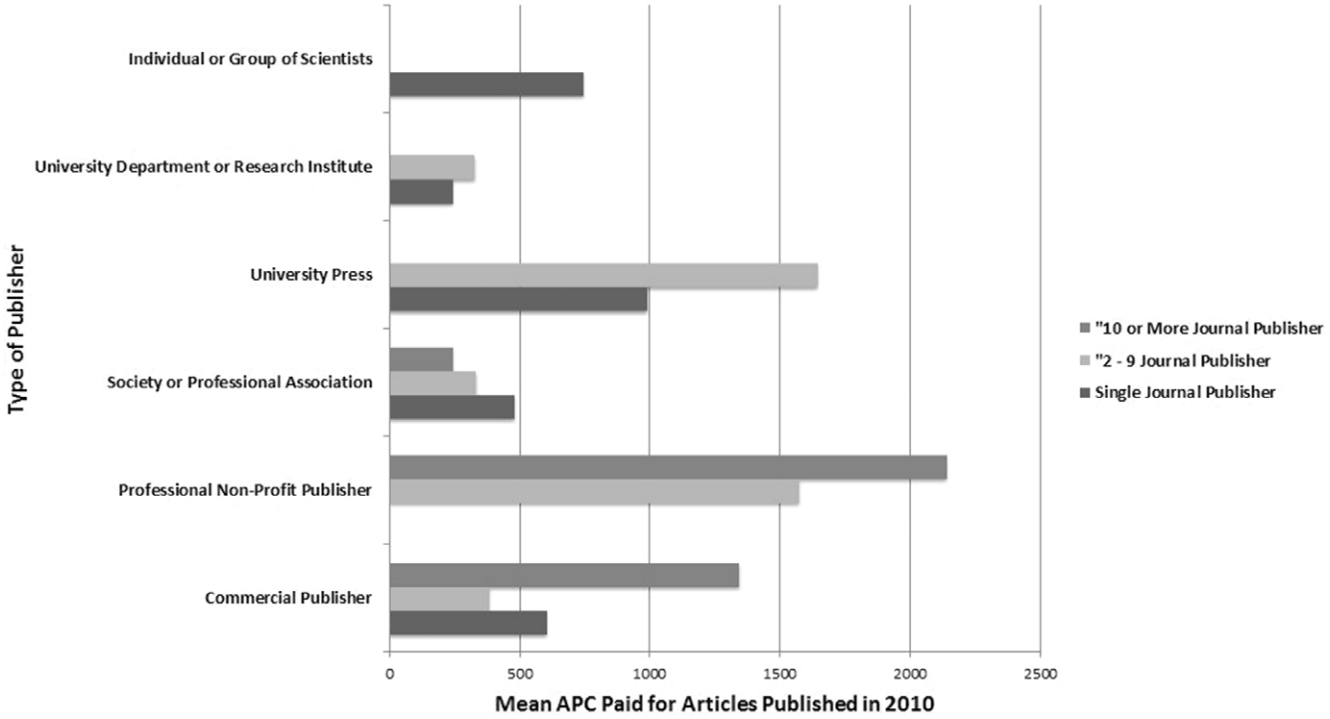

FIG. 2. Breakdown of articles published in 2010 by type and size of publisher.

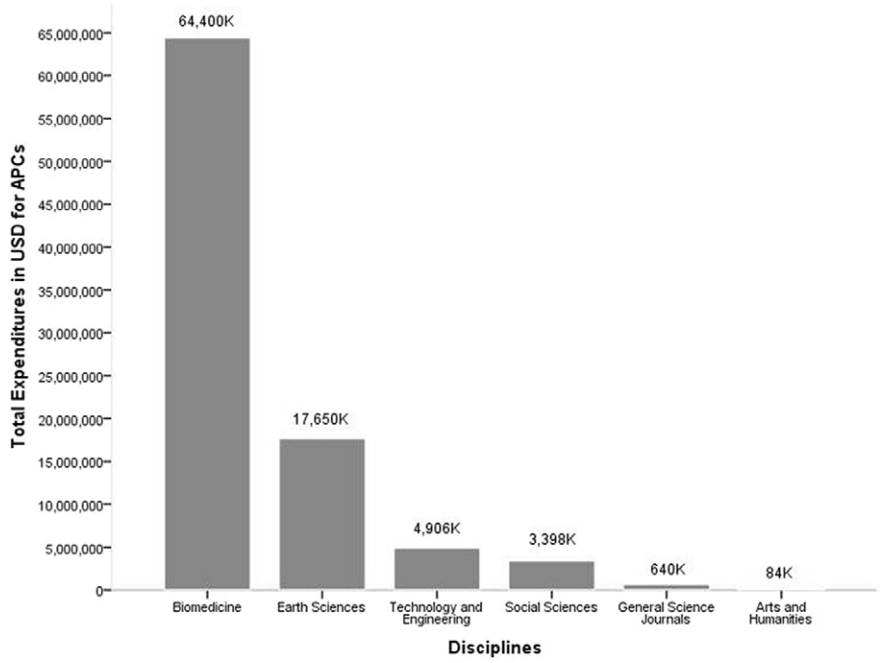

FIG. 3. Total expenditures for article processing charge in 2010 by discipline.
Note. Numbers above bars are expenditures in USD rounded to the nearest $1,000.

includes virtually all OA publishers that charge APCs, although we cannot verify this point.

We also cannot estimate the percentage of waivers or discounts granted to authors, but we expect that waivers have been granted for only a small percentage of the articles published in OA journals that charge fees. We found a small number of publishers who indicated that their journals charged fees, but we were unable to locate any indication of

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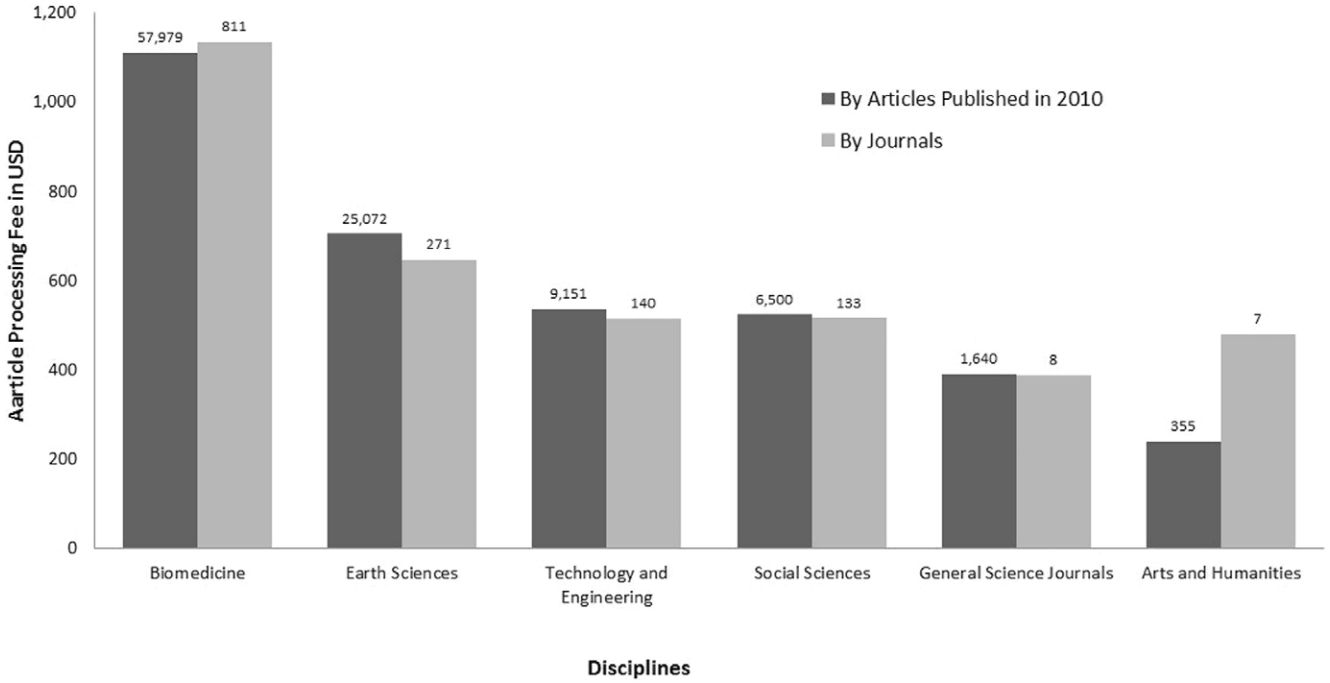

FIG. 4. Average article processing charge by subject matter area.
Note. Numbers above the bars are articles published in 2010/journals.

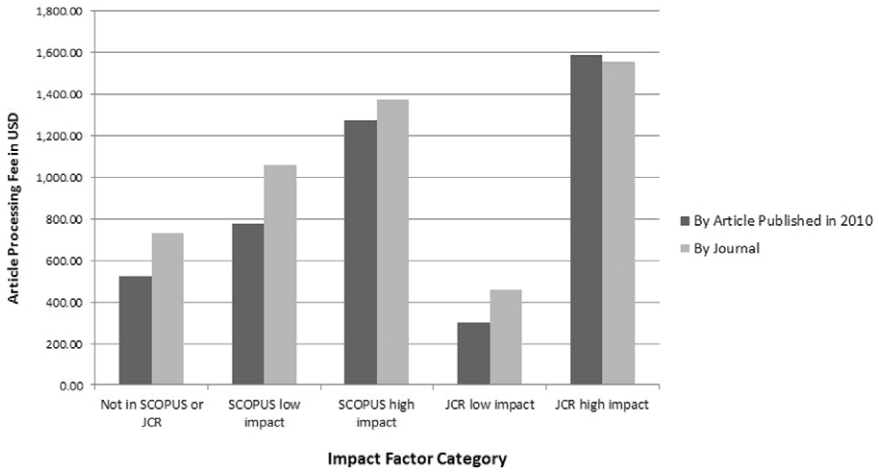

FIG. 5. Average article processing charge by impact factor category.

a fee in the instructions for authors or other documentation on the journal Web site. We likewise expect there may have been publishers who did not indicate their journals charged fees but in fact do. We expect that any such biases in our results would be small.

As can be seen in Figure 1a, journals charging $200 USD or less published by far the most articles. There is also a smaller spike in articles published in the $1,500–2,000 USD range, likely reflecting articles from large biomedical publishers such as BioMed Central. There is a smaller spike in the $1,200–1,400 USD range, possibly reflecting PLoS One which published over 6,700 articles at $1,350 USD in 2010.

The distribution of APCs charged by journals presented in Figure 1b demonstrates a large number of low- to moderate-cost journals from below $200 USD up through $800 USD. The large number of journals in the $601–800 USD range largely reflects the 200-plus journals published by Bentham Open, all at $800 USD. There is also a large group of journals charging between $1,601 and $2,000 USD. These likely reflect BioMed Central and other large

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biomedical publishers. As with articles, there is a long positively skewed tail of high-cost publishers between $2,000 and $4,000 USD.

The average APC of $904 USD for articles published in 2010 and $906 USD for journals as shown in Table 1 is substantially lower than some earlier reported ranges for APCs (Bird, 2010; Ware & Mabe, 2009). At the same time, our finding that approximately 25% of articles published were in journals charging less than $200 USD (reflected in Figure 1a) are in line with two recent studies surveying authors who had paid APCs (Dallmeier-Tiessen et al., 2011; Solomon & Björk, 2012). Walters and Linvill (2011), in a study carried out in the spring of 2009 of 663 OA journals in six disciplines, found an average APC of $923 USD per journal and $1,109 USD per article for the 192 journals that charged authors.

Our results are also similar to earlier studies of subscription journals in which there are marked differences in pricing level between commercial and society journals (European Commission, 2006). As can be seen in Figure 2, in general we found a clear relationship between the magnitude of the APC and the type of publisher. Commercial publishers, which dominate the multijournal publisher categories, have a higher average APC level. This is particularly evident for commercial publishers with 10 journals or more where the average APC was $1,345 USD for articles listed, as shown in Table A2 in the Appendix.

Scientific societies and universities in general have a much lower pricing level—$461 USD on average, based on articles published. These publishers tend to be spread throughout the world and, in many cases, appear to be catering to local authors. The lowest overall averages are found for journals published by universities or university departments ($246 USD, by articles). This is not surprising in that the university may subsidize them either financially or by "in kind" services. The categories of professional nonprofit publishers, university presses, and journals published by individual scholars are so dominated by a few journals with high-quality standards (i.e., PLoS and Oxford University Press) that it is difficult to predict whether these results will generalize.

The vast majority of the expenditures for APC-funded OA publications are in biomedicine, as shown in Figure 3. This probably reflects a variety of factors. The availability of grant funding coupled with funder mandates has certainly had an impact. APC-funded publication also began in biomedicine with the creation of BioMed Central and PLoS. Other publishers with relatively high-priced APCs, such as Frontiers Research Foundation, have also contributed to the high expenditures in the biomedical fields. Consistent with Figure 3, Figure 4 shows APCs are much higher in biomedicine than in other disciplines. This can largely be explained by the same factors: relatively high APCs and the availability of grant funding.

Figure 4 also highlights the fact that OA publishing funded through processing fees is today largely concentrated in the scientific, technical, and medical (STM) fields. There appears to be a growing number of APC-funded journals in the social sciences, but they are still quite rare in the arts and humanities. This probably reflects both the limited availability of funding and the tendency in these disciplines to emphasize monographs over journal articles for disseminating work.

According to the fundamentals of microeconomic theory, the market price of a commodity or service is a function of both the supply and the demand. In subscription publishing, the demand side has appeared to dominate and the costs of what are often called "core journals" have increased well beyond the inflation rate, which is perceived by many to be due to the need for librarians to maintain their subscriptions to these journals at any price (Panitch & Michalak, 2011).

OA publishing with a focus on the individual authors as customers radically changes the dynamics of the market. Authors usually have a choice between a few alternative journals to which to submit their manuscripts. Most of these alternatives are subscription based, in which publishing in most cases is free of charge to the author. Some might be OA and may require an APC. The authors are faced with the task of choosing which journal to submit their manuscript, taking into account the following factors (Björk & Öörni, 2009; Solomon & Björk, 2012):

- The fit of the article topic with the journal's scope
- The prestige of the journal (for instance, its impact factor)
- The likelihood of acceptance
- The expected time from submission to publication (if accepted)
- Possible mandate of the research funder that the results must be made openly available
- Whether or not the journal is OA
- The level of the APC if the journal charges one

In essence, if authors choose to submit to a journal that charges an APC, the expected value of the dissemination, branding, and other services provided by a journal must exceed the other potentially no-cost publishing options. In addition, authors must have the financing to fund the APC, via grants, their employer, or by using their own money. Hence, we believe the APCs that OA publishers have set for their journals reflect to a large extent what they expect the market can bear, given the "customer value" that they provide to their authors. In the long run, of course, the charges must also be set at a level that provides enough revenue to make the publishing sustainable.

To take a concrete example, the OA publisher Bentham Open has launched over 200 journals in a very short time, charging a uniform fee of $800 USD for research articles. After 3–4 years in operation, the average number of articles published in these journals is nine, with many journals appearing to be more or less empty placeholders in a uniform publishing information technology platform. This would suggest that authors are not satisfied with the value offered compared to the price.

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In contrast to Bentham Open's lack of success in attracting submissions, PLoS ONE, launched in December 2006, has published over 13,000 articles, charging a fixed price of $1,350 USD per article. In this example, a highly reputable OA publisher has been successful in offering a journal with a broad scope encompassing all of the life sciences, narrowly focused peer review criteria with rapid publication coupled with a good impact factor, and a quite advanced electronic platform.

Figure 5 provides an interesting and somewhat perplexing view of the relationship between impact factors, perceived by some to be a measure of quality and pricing. The fact that the higher impact factor journals in JCR had by far the highest APC level ($1,553 USD for journals) comes as no surprise. Such journals, in order to achieve the higher quality, often have a lower acceptance rate and salaried editorial staff and hence have more costs per published article. Second, these journals are predominantly in biomedicine which overall has a higher pricing level. Third, authors are probably more willing to pay the higher APCs given the higher visibility and recognition they get from publishing in journals with above-average impact scores.

In descending order, the average APC level goes from high impact in the JCR, to high impact in SCOPUS, to low impact in SCOPUS, and to nonindexed journals. This is what we expected. What is surprising is that the lower impact journals in the JCR had lower prices than the journals that are not in either index. Thomson Reuters indexes a limited number of journals in the JCR, and while their criteria are not made public, the general perception is that only fairly high-quality journals are indexed in the JCR. Although Scopus indexes a larger number of journals, again the perception is that journals are screened for quality before being included in the index. The reason for the lower impact journals in the JCR, in general, charging a very low APC, we believe, can be found in the distribution of the journals across types of publishers, country of publication, and discipline. The lower impact JCR group contains a large number of society-published journals from countries outside the United States, United Kingdom, and Western Europe, which typically have a very moderate pricing level. At the same time, there are many new mid-priced or high-priced commercial journals in the nonindexed group of journals.

Our data suggest that it might be meaningful to cluster the APC journals in a number of groups:

- A few very high-impact journals from well-respected publishers charging $2,000–4,000 USD
- A large number of journals in biomedicine from commercial publishers in the range $1,500–2,000 USD, some indexed and some not
- A quickly growing segment of "megajournals" with prices in the range $1,000–1,500 USD, usually with very broad scopes. These journals have quick submission-to-publication times and only screen for scientific reliability, leaving it to the readers rather than the reviewers to judge the relevance.
- Journals from commercial publishers covering a wide range of disciplines in a mid-price range of $500–1,000 USD
- Lower priced society journals, typically priced below below $500 USD
- Very low-priced journals, below $200 USD, published by both commercial and society publishers in developing countries and mainly catering to authors from the countries in question

All in all, the scientific publishing landscape is rapidly changing. Our data show that over 100,000 articles were published in APC-funded OA journals in 2010 and the number is rapidly increasing. The leading journals have already had time to establish themselves and a sustainable price level. It is interesting to note that a little over 100,000 articles could be published and made available to the global scientific community at an estimated cost of $91 million USD. This can be contrasted to the revenue estimate of $8 billion USD for STM journal publishing, which constitutes the bulk of an estimated 1.5 million overall article volume (Ware & Mabe, 2009).

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Appendix

TABLE A1. Listing of publishers included in the sample.

Publisher	Country	Journals	Article count
Bentham Open	Arab Emirates	211	1,941
BioMed Central	United Kingdom	193	16,066
Hindawi Publishing Corporation	Egypt	132	3,943
Dove Medical Press	New Zealand	81	2,034
Libertas Academica	New Zealand	58	459
Scientific Research Publishing	United States	48	2,279
Frontiers Research Foundation	Switzerland	26	1,152
MDPI AG	Switzerland	25	3,957
AIRCC	India	21	624
Canadian Center of Science and Education	Canada	20	1,877
OMICS Publishing Group	United States	20	329
PAGEPress Publications	Italy	18	433
Copernicus Publications	Germany	13	2,089
Springer	Germany	12	1,437
Co-Action Publishing	Sweden	10	192
Maxwell Science Publication	Pakistan	10	429
Academic and Business Research Institute	United States	9	243
Kamla-Raj Enterprises	India	9	378
Public Library of Science (PLoS)	United States	8	9,065
Academic Journals	Nigeria	7	3,095
Internet Scientific Publications, LLC	United States	7	117
OpenJournals Publishing	South Africa	7	227
Academy Publisher	Finland	6	898
e-Century Publishing Corporation	United States	6	238
AstonJournals	United States	5	50
Karger Publishers	Switzerland	5	265
Macrothink Institute	United States	5	91
21 publishers with 2–4 journals		54	6,586
64 publishers with 1 journal		64	15,483
Totals		1,090	75,977

Note. AIRCC = Academy & Industry Research Collaboration Center.

TABLE A2. Average APC in USD by type of publisher and size of journal portfolio for articles published in 2010.

Type of publisher	Single journal	2–9 journals	≥10 journals	Totals
Commercial publisher	606 / 1,623	384 / 11,452	1,345 / 36,164	1,097 / 49,239
Professional nonprofit publisher		1,574 / 9,243	2,141 / 1,152	1,635 / 10,395
Scientific society or professional association	482 / 24,888	335 / 89	255 / 2,501	461 / 27,478
University press	991 / 476	1,645 / 1,998		1,519 / 2,474
University, university department, research institute	245 / 9,231	329 / 125		246 / 9,356
Individual scientist or group of scientists	747 / 1,755			747 / 1,755
Totals	488 / 37,973	974 / 22,907	1,300 / 39,817	904 / 100,697

Note. APC = article processing charges; USD = United States dollar.
Table cells contain the "mean APC / number of articles."

TABLE A3. Average APC in USD by type of publisher and size of journal portfolio for journals.

Type of publisher	Single journal	2–9 journals	≥ 10 journals	Totals
Commercial publisher	547 / 41	362 / 131	1,132 / 849	1,010 / 1,021
Professional noncommercial publisher		1,289 / 14	2,141 / 26	1,843 / 40
Scientific society or professional association	438 / 165	331 / 3	208 / 41	391 / 209
University press	1,065 / 10	704 / 10		885 / 20
University, university department, research institute	287 / 60	222 / 2		284 / 62
Individual scientist or group of scientists	1,058 / 18			1,058 / 18
Totals	482 / 294	462 / 160	1,120 / 916	906 / 1,370

Note. APC = article processing charges; USD = United States dollar.
Table cells contain "mean APC / number of journals."

TABLE A4. Median APC in USD by type of publisher and size of journal portfolio for articles published in 2010.

Type of publisher	Single journal	2–9 journals	≥10 journals	Totals
Commercial publisher	358 / 1,623	400 / 11,452	1,610 / 36,164	1,000 / 49,239
Professional noncommercial publisher		1,350 / 9,243	2,141 / 1,152	1,350 / 10,395
Scientific society or professional association	220 / 24,888	302 / 89	300 / 2,501	258 / 27,478
University press	1,110 / 476	2770 / 1,998		1,110 / 2,474
University, university department, research institute	152 / 9,231	401 / 125		153 / 9,356
Individual scientist or group of scientists	125 / 1,755			125 / 1,755
Totals	152 / 37,973	650 / 22,907	1,610 / 39,817	740 / 100,697

Note. APC = article processing charges; USD = United States dollar.
Table cells contain the "median / number of articles."

TABLE A5. Median APC in USD by type of publisher and size of journal portfolio for journals.

Type of Publisher	Single journal	2–9 journals	≥10 journals	Totals
Commercial publisher	358 / 41	250 / 131	1,000 / 849	800 / 1,021
Professional noncommercial publisher		928 / 14	2,141 / 26	2,141 / 40
Scientific society or professional association	322 / 165	302 / 3	120 / 41	300 / 209
University press	1,110 / 10	174 / 10		1,110 / 20
University, university department, research institute	152 / 60	222 / 2		152 / 62
Individual scientist or group of scientists	1,057 / 18			1,058 / 18
Totals	322 / 294	551 / 160	870 / 916	800 / 1,370

Note. APC = article processing charges; USD = United States dollar.
Table cells contain "median / number of journals."

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