Cost-effectiveness of open access publications

Jevin West[1] Theodore Bergstrom[2] Carl T. Bergstrom[1]

January 22, 2013

[1]Department of Biology, University of Washington, Seattle, WA

[2]Department of Economics, University of California, Santa Barbara, CA

*The authors are the founders of the Eigenfactor® Project. The open access cost effectiveness tools described here are freely available at http://www.eigenfactor.org/openaccess/ Correspondence can be sent to Jevin West at jevinw@u.washington.edu.

Keywords: Journal prices, Eigenfactor® Score, Article Influence® Score, publication charges

Abstract

Open access publishing has been proposed as one possible solution to the serials crisis — the rapidly growing subscription prices in scholarly journal publishing. However, open access publishing can present economic pitfalls as well, such as excessive publication charges. We discuss the decision that an author faces when choosing to submit to an open access journal. We develop an interactive tool to help authors compare among alternative open access venues and thereby get the most for their publication fees.

1 Introduction

Institutional subscription prices of academic journals continue to increase more rapidly than library budgets [1]. Journals produced by for-profit publishers typically cost libraries about three times as much as comparable journals produced by non-profit publishers [2, 3, 4]. Open access publishing has been widely heralded as a potential solution [5, 6, 7].

But open access publishing is no panacea. Firstly, while author-pay open access continues to grow [8, 9], it is unclear that open access publishing will quickly—or ever—come to dominate the market for scholarly publishing [10, 11]. Second, the author-pay model is not without its own pricing perils. Some commercial publishers charge author fees as high as $3,000 journals for publishing a single article. A number of "predatory" open access publishers operate like vanity presses, charging authors substantial fees in exchange for the thinnest veneer of editorial oversight [12, 13].

On the positive side, the structure of the market for open access publications offers the potential for a more competitive marketplace than that for subscription-based publication [14]. The reason is straightforward: authors, when deciding where to publish, can substitute one journal for another in order to get the best deal. This is not the case for libraries deciding what journals to subscribe to.

An example helps here. When a shopper goes to purchase a bundle of six bananas, he is approximately indifferent between buying bananas produced by Dole and bananas produced by Chiquita. If one company offers lower prices for equally good bananas, the customer is perfectly happy to go home with six bananas from a single producer. Thus we say that Dole bananas and Chiquita bananas are substitutes for one another. Not so when the same

consumer looks to purchase a couple of magazines at the checkout counter. Even if *People* magazine offers better value than does *Us Weekly*, there is little point in going home with two copies of the former and none of the latter.

Choosing an open access journal in which to publish — say, deciding between a submission to *PLoS One* or a submission to Nature Publishing Group's *Scientific Reports*—is like purchasing bananas. An author could send all of her papers to a single one of these journals. But deciding on subscriptions to *Science* and *Nature* is like buying magazines at the checkout counter; there is little value to be had in buying two subscriptions to one of them and none to the other.

Because open access publications are substitutes, authors can afford to comparison shop, seeking out only the very best deals and patronizing these exclusively. Should authors do so, publishers would be forced to compete aggressively on price, resulting in better deals for the academic community. Our aim with this paper is to describe and deploy an online tool that makes it easy for scholarly authors to engage in this kind of comparison shopping.

2 The author's perspective

Academic journals require one or more revenue streams to cover their costs. There are three basic sources of revenue to which a publisher can turn: (1) authors , (2) readers, and (3) sponsors. Publishers regularly employ each of these sources, sometimes in combination. For example, *Proceedings of the National Academy of Sciences USA* requires authors to pay page charges, and also charges subscription fees to university libraries. The PLoS family of journals charge publication fees, and has received grant funding from agen-

cies including the Sloan foundation and the MacArthur foundation. Authors may be charged upon publication of their work, upon article submission, or some combination of these. Here we examine authors' motivations for paying such fees.

The competitive peer review system used by the majority of scholarly periodicals serves to certify the novelty, interest, and quality of academic publications. Publication in a leading journal confers substantial prestige upon a scholarly author, and authors are strongly motivated by this incentive [15]. A record of publication in the top tiers of the journal hierarchy has a critical impact on hiring, promotion, tenure, merit, salary, and funding decisions. Moreover, to have a significant influence on scholarly thought, one needs to be read widely by one's peers. Journals vary considerably in readership; researchers often conscientiously follow the publications in top journals, while turning to lower-tier journals only in pursuit of specific references. Of course prestige and readership are not independent of one another. Journals become prestigious in part because they are highly read, and prestigious journals are highly read in part because their prestige allows them to attract the top papers in a field.

When an author (or more commonly, her funders or home institution [16]) pays open access publication charges, she is not only paying for the broad accessibility to readers that results from open access publishing. She is also paying for the prestige and the readership that she will gain by publishing in that particular journal. When choosing among alternative venues, a sensible author would like to get as much possible for her money. In order to quantify what an author receives in exchange for her publication charges, we note that both prestige and readership translate into the number of scholarly citations that a paper receives. With all of the usual caveats

[17], we estimate this quantity using journal level citation data. We use the Article Influence® score —a measure of per-article citations weighted by influence [18] — to estimate the prestige and readership obtained from publishing in a given venue.[1]

Figure 1 compares the deals offered by five different hypothetical journals. All else equal, authors will prefer to publish in journals with higher Article Influence scores, and with lower publication charges.

To facilitate comparisons of this sort, we have deployed an interactive visualization that shows how each open access journal compares with its competitors with regard to (1) publication charges and (2) Article Influence score. The visualization, available at http://www.eigenfactor.org/openaccess/ , is shown in Figure 2.

The visualization allows users to examine articles from one discipline at a time. Disciplines are determined using the Eigenfactor Categories provided at Eigenfactor.org. These categories are derived from the community structure of the journal-level citation network, using the map equation approach [19]. This divides the set of open access journals into 50 distinct disciplines of science and social science such that each journal belongs to a single discipline. Since these disciplinary categories are relatively wide, not all journals in a given discipline would be an appropriate venue for the same paper. Journals on cardiovascular disease, epidemology, pediatrics, and nutrition

[1] Journals provide a different type of value to authors than they do to institutional subscribers. In exchange for publication charges, an author buys the right to publish a single article in a journal, whereas in exchange for subscription fees, a librarian buys the right to carry all articles published in the journal. Thus we use a per-article measure (Article Influence score) to quantify value to an author, whereas elsewhere (http://www.eigenfactor.org/costeffectiveness.php) we have used a per volume measure (Eigenfactor® score) to quantify value to a subscriber.

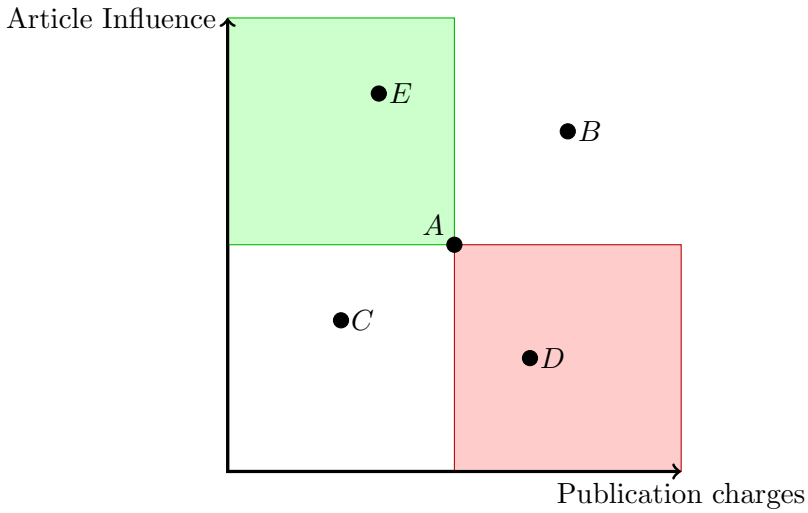

Figure 1: Comparing journals. With all else equal, authors will prefer journals with higher Article Influence scores to lower, and they will prefer journals with lower publication charges to higher. Thus an author will prefer journal A to the more expensive and less prestigious journal D and likewise to any journal in the red quadrant. Similarly, the author would prefer the less expensive and more prestigious journal E and likewise any journal in the green quadrant to journal A. How journal A compares with journals B and C depend on the author's willingness to pay extra publication charges in exchange for extra prestige.

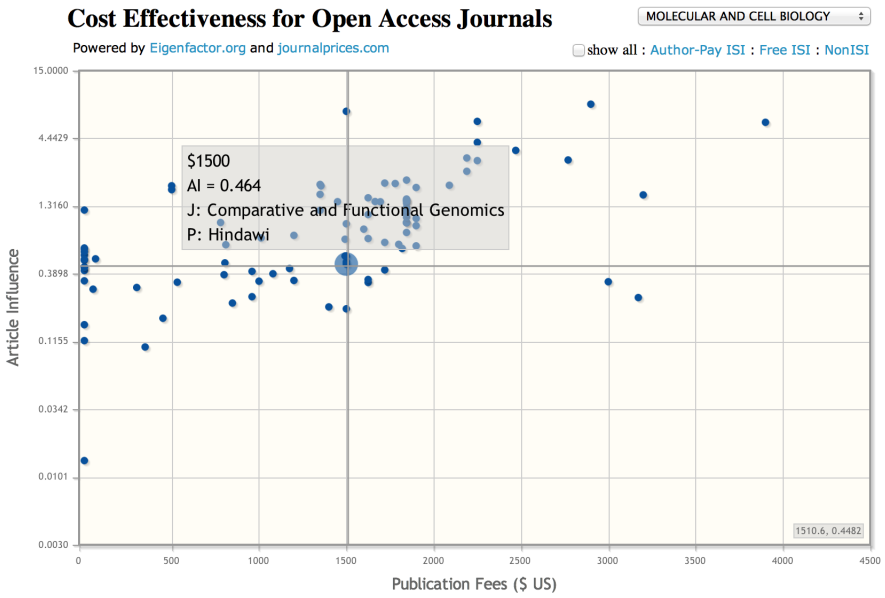

Figure 2: A screenshot of the interactive visualization, which can be found at http://www.eigenfactor.org/openaccess/ . The Article Influence scores are log (base 10) transformed. The selected journal is highlighted with a larger blue circle. The "crosshairs" indicate the four quadrants noted in Figure 1.

are all classified under Medicine, for example. Furthermore, many regional journals may be appropriate for only certain authors and articles. Nonetheless, the categories tend to group similarly situated journals together and as such provide a good indication of where a given journal stands relative to other open access journals on related subject matter.

Our focus here is on journals that are truly open access in that all of their content is open access. Many other journals offer hybrid open access programs in which individual articles can be made open access for a fee, often in the range of $3000 [20]. It is more difficult to quantify the value

of making one's article open access in a hybrid journal. On one hand, the prestige conferred by the journal is approximately the same whether one chooses to make one's article open, or not. On the other, open access articles in hybrid journals will probably attract more readers and possibly additional citations (see e.g. ref. [21] for an overview of the controversy around open access citation advantage).

We should note that publishing in an open access journal is not the only way to make an article freely available. Most academic journals allow immediate posting of a final refereed copy of an author's paper where search engines can find them on the author's own website or in a freely available institutional archive. Steven Harnad [22] [23] presents a cogent case for open access self-archiving as a means of transition to open access publishing. Harnad argues that as self-archiving becomes more widely practiced, competitive pressure will force open access publishers to realize potential cost-savings of open access publication and to pass these savings on in the form of lower publication fees. The website Sherpa/Romeo (http://www.sherpa.ac.uk/romeo/) has a nearly complete list of the policies of publishers with respect to copyright and self-archiving[2]. Since this option is available for a very large number of journals, authors and institutions may prefer to self-archive at zero cost rather than pay high publication fees to publishers for open access publication.

[2]Sherpa distinguishes two policies, each of which allows posting of a final copy of one's articles. These are Green–Can archive pre-print and post-print or publisher's version/PDF and Blue–Can archive post-print (ie final draft post-refereeing) or publisher's version/PDF.

3 Data and Results

In January 2012, we collected pricing information on 985 open access journals from 422 different publishers. To provide an overview of these data, Figure 3 shows the 2010 Article Influence scores and 2012 publication charges for the JCR-listed open access journals.

Figure 4 compares the distribution of Article Influence scores for the open access journals with the distribution for non open-access journals. The mean Article Influence score for all open access journals in 2010 is 0.737. The mean Article Influence score in 2010 for non open access journals is 0.776. These means are not significantly different (Mann-Whitney p-value = 0.2198).

Figure 5 shows a histogram of the publication charges levied by open access journals. The modal cost is zero, highlighting the large number of free open access journals in the data set. Another prominent peak just below $2000 indicates a common price point for many journals that require publication charges.

For some applications it may be desirable to quantify the cost-effectiveness of open access venues using one single number. We do this by looking at the ratio of Article Influence to publication charges. We define the *cost effectiveness* of a journal as (1000 * Article Influence / publication charges). We provide cost effectiveness values for the major open access journals, and within each discipline we list open access publications ranked from the most to the least cost effective.

We are able to compute Article Influence scores only for those journals listed in Thomson-Reuters' Journal Citation Reports (JCR). While the JCR includes over 10,000 total publications and 658 open access publications in

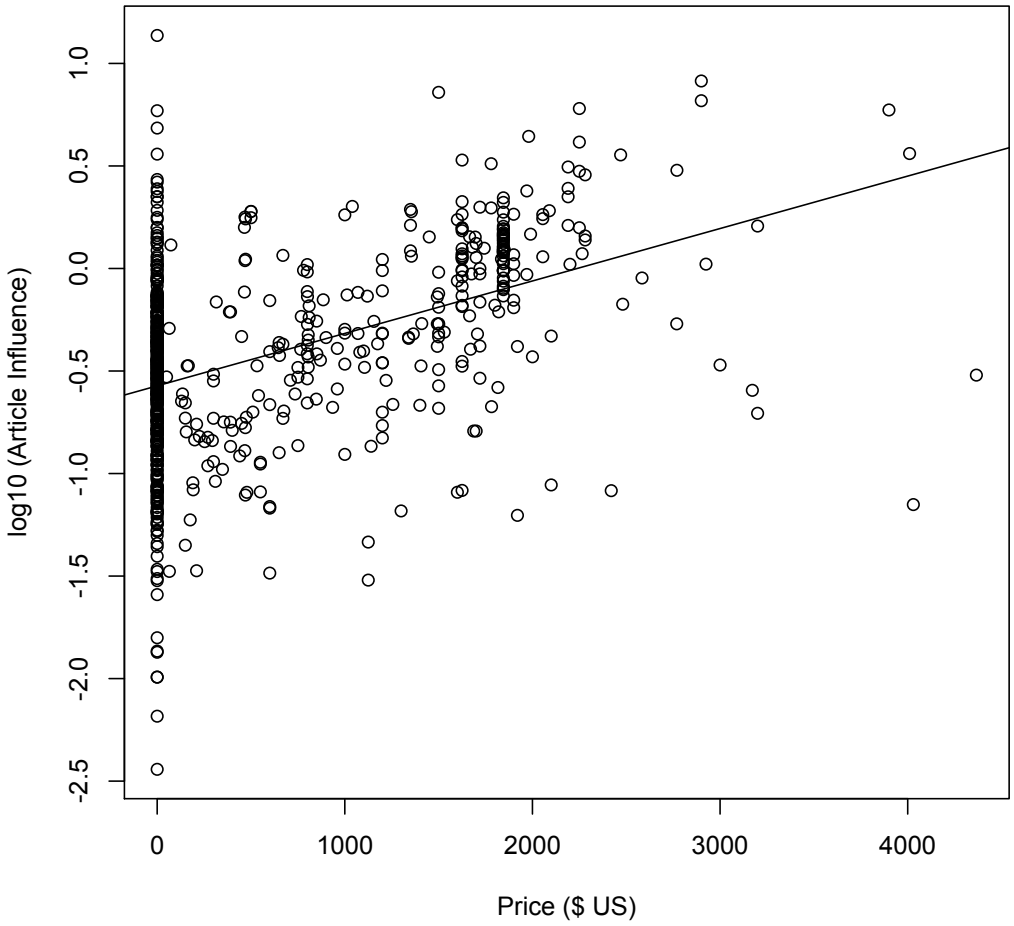

Figure 3: Article Influence score versus publication charges. Only JCR-listed journals are included in this graph. The Article Influence scores are log transformed. The linear regression line indicates that more prestigious journals tend to charge higher publication charges.

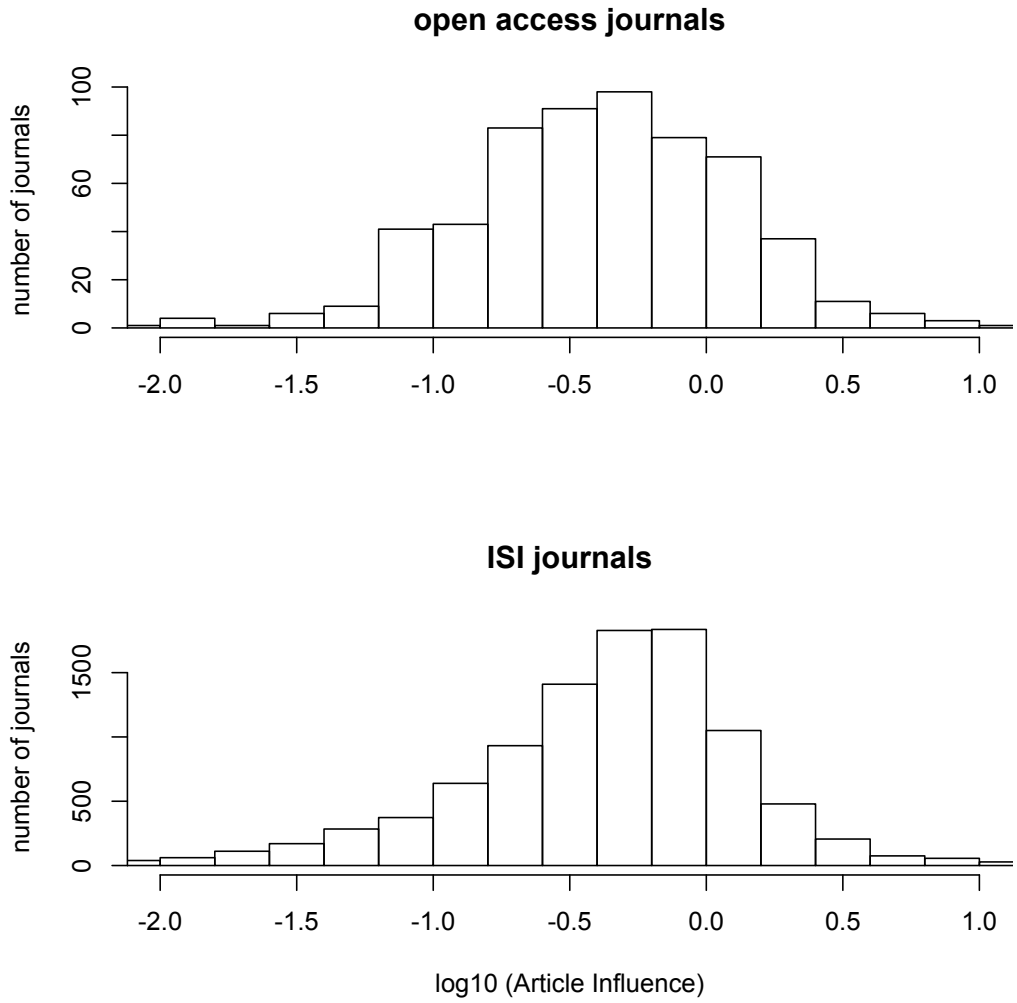

Figure 4: Article Influence distributions for open access journals (top) and non open-access journals (bottom). Article Influence scores are log (base 10) transformed.

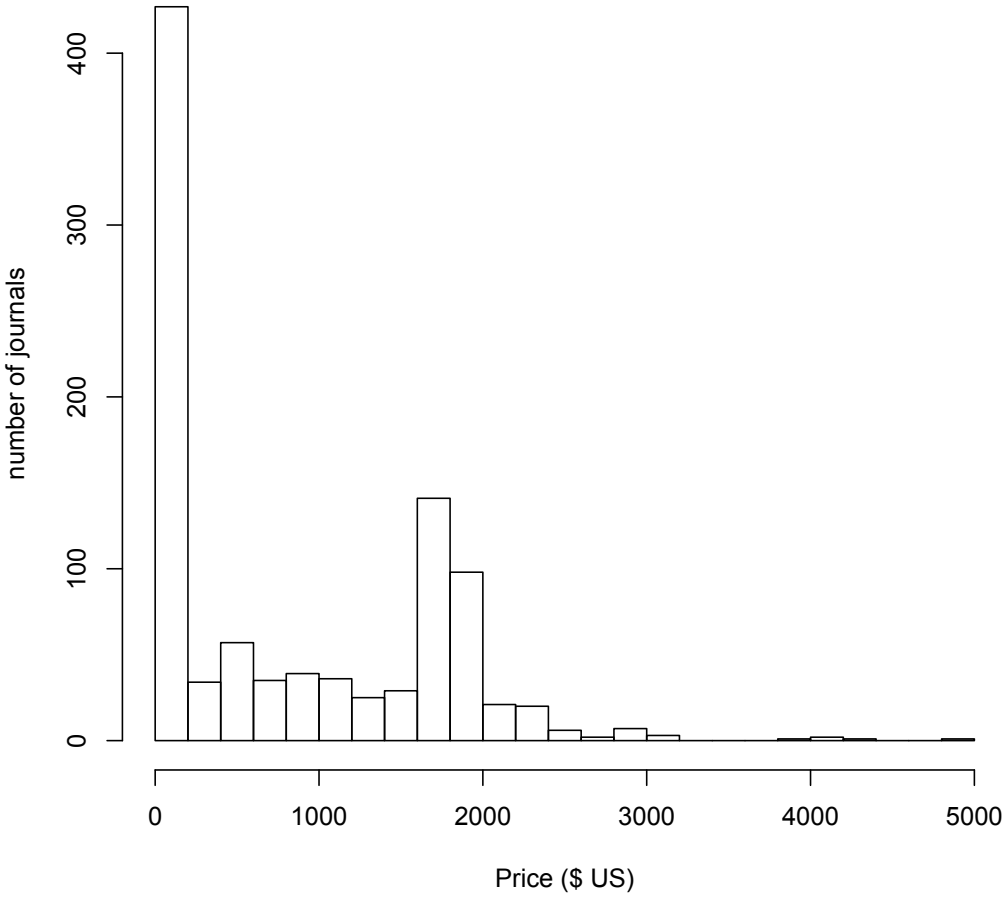

Figure 5: Publication charges for open access journals in 2012.

2010[3], some newer open access journals and many lesser-known ones are not included in this list. We provide partial information for these journals, including ISSN number and publication charges where possible, at http://www.eigenfactor.org/openaccess/nonISI.php . Some of these journals may represent good value as well, though potential authors should think carefully about the prestige and readership to be gained from publishing in journals not included in the JCR.

Open access journals offer several different pricing models. In our data set, there were 480 journals that charge a fixed fee per article. Table 1 lists the top 10 of these ranked by cost-effectiveness. An additional 357 journals charge no publication charges whatsoever; we refer to these as free journals. Table 2 lists the top 10 free journals ranked by Article Influence score. Finally, 148 journals charge by the page rather than by the article. For these journals, we multiplied the price per page by an article length of 15 pages to determine the publication charges used in our analysis.

4 Coda

In this paper, we develop a tool to help authors comparison shop among alternative open access venues. In general, authors should prefer journals with higher article influence scores and lower publication charges. A separate question which we have not treated in detail here is that of how universities or funding agencies should subsidize open access publishing. In discussion of subscription-based publishing, Shieber (2009) draws the analogy between academic publishing and medical care. In both cases, consumers do not pay

[3]Wouter Gerritsma has compiled a useful list of the open access journals indexed in the Thomson-Reuters Journal Citation Reports [24].

Table 1: Top 10 author-pay open access journals ordered by Cost Effectiveness (CE), i.e., 1000*Article Influence score divided by price. AI is the Article Influence score. This list includes only JCR-listed open access journals that charge by the article, rather than by the page.

	Journal	**AI**	**Price**	**CE**
1	Publication of the Astronomical Society of Japan	1.302	$73	17.841
2	Journal of Physiology and Pharmacology	0.510	$64	7.976
3	Asian Pacific Journal of Cancer Prevention	0.296	$50	5.918
4	Oceanography	1.898	$500	3.795
5	DNA Research	1.897	$500	3.793
6	Molecular Medicine	1.769	$500	3.538
7	PLoS Biology	8.211	$2900	2.831
8	PLoS Genetics	6.027	$2250	2.679
9	PLoS Medicine	6.580	$2900	2.269
10	Evolutionary Bioinformatics	4.408	$1980	2.226

Table 2: Top 10 free open access journals ordered by Article Influence score (AI)

	Journal	**Category**	**AI**
1	Living Reviews in Relativity	HIGH ENERGY PHYSICS	13.691
2	Journal of Economic Perspectives	ECONOMICS	5.880
3	Aldrichimica Acta	PHYSICS	4.840
4	Bul. of Am. Mathematical Society	MATHEMATICS	3.611
5	Bul. of Am. Museum of Natural History	ECOLOGY & EVOLUTION	2.716
6	European Cells & Materials	PHARMACOLOGY	2.638
7	Journal of Machine Learning Research	INFORMATION THEORY	2.448
8	Bul. of the World Health Organization	MEDICINE	2.375
9	Emerging Infectious Diseases	INFECTIOUS DISEASES	2.240
10	Bayesian Analysis	PROB & STATS	2.237

directly for what they consume and thus do not respond to price incentives [11]. Shieber acknowledges, but largely dismisses, the potential for a similar problem with subsidized publication charges. Our view is that full subsidies of publication charges will create the same problems that arise under subscription-based publishing. We believe that it would be wiser for funders to support open access in ways that encourage price competition among open access publishers. A way to ensure that authors remain sensitive to price differences would be for funders to bear only a fraction of the cost beyond some low threshold (e.g. $500). In economic terms, we want the price elasticity of demand to remain high. Of course, university administrators should be attentive to quality as well as price. Subsidizing publication in low-quality, low-prestige venues is not likely to be in a university's best interest.

Acknowledgments

This work was supported in part by National Science Foundation Grant SBE-0915005 to C.T.B.

References

[1] Martha Kyrillidou. ARL statistics 2010-11. Technical report, Association of Research Libraries, 2012.

[2] T. C. Bergstrom and P. McAfee. http://journalprices.com/.

[3] C. T. Bergstrom and T. C. Bergstrom. The costs and benefits of library site licenses to academic journals. *Proceedings of the National Academy of Sciences USA*, 101:897–902, 2004.

[4] C. T. Bergstrom and T. C. Bergstrom. The economics of ecology journals. *Fronteirs in Ecology and the Environment*, 4:488–495, 2006.

[5] P. Young. The serials crisis and open access. Technical report, Virginia Tech, 2009.

[6] J. Willinsky. The stratified economics of open access. *Economics Analysis and Policy*, 39:53–70, 2009.

[7] P. Suber. http://www.earlham.edu/˜peters/fos/newsletter/archive.htm.

[8] B.C. Björk, P. Welling, M. Laakso, P. Majlender, T. Hedlund, and G. Gudnason. Open access to the scientific journal literature: situation 2009. *PloS one*, 5(6):e11273, 2010.

[9] M. Laakso, P. Welling, H. Bukvova, L. Nyman, B.C. Björk, and T. Hedlund. The development of open access journal publishing from 1993 to 2009. *PLoS One*, 6(6):e20961, 2011.

[10] M. McCabe and C. M. Snyder. The economics of open-access journals. SSRN working paper, 2006.

[11] S. M. Shieber. Equity for open-access journal publishing. *PLoS Biology*, 7:e1000165, 2009.

[12] J. Beall. Predatory publishers are corrupting open access. *Nature*, 489:179, 2012.

[13] J. Beall. http://scholarlyoa.com/2012/12/06/bealls-list-of-predatory-publishers-2013/.

[14] T. C. Bergstrom and C. T. Bergstrom. Can 'author pays' journals compete with 'reader pays'? *Nature*, 2004. Web Focus on Open Access Publishing. http://www.nature.com/nature/focus/accessdebate/22.html.

[15] A. E. Attema, W. Brouwer, and J. Van Exel. Your right arm for a publication in AER. SSRN working paper, 2012.

[16] S. Dallmeier-Tiessen, R. Darby, B. Goerner, J. Hyppoelae, P. Igo-Kemenes, D. Kahn, S. Lambert, A. Lengenfelder, C. Leonard, S. Mele, et al. Highlights from the soap project survey. what scientists think about open access publishing. *arXiv preprint arXiv:1101.5260*, 2011.

[17] P.O. Seglen. Why the impact factor of journals should not be used for evaluating research. *BMJ: British Medical Journal*, 314(7079):498, 1997.

[18] J. D. West, T. C. Bergstrom, and C. T. Bergstrom. The Eigenfactor metrics (TM): A network approach to assessing scholarly journals. *College and Research Libraries*, 71:236–244, 2010.

[19] M. Rosvall and C. T. Bergstrom. Maps of random walks on complex networks reveal community structure. *Proceedings of the National Academy of Sciences, USA*, 105:1118–1123, 2008.

[20] S. Pinfield. Paying for open access? Institutional funding streams and OA publication charges. *Learned Publishing*, 23:39–52, 2010.

[21] A. B. Wagner. Open access citation advantage: An annotated bibliography. *Issues in Science and Technology Librarianship*, (60), 2010.

[22] S. Harnad. The green road to open access: A leveraged transition. 2007.

[23] S. Harnad. No-fault peer review charges: the price of selectivity need not be access denied or delayed. *D-lib magazine*, 16(7):5, 2010.

[24] W. Gerritsma. http://wowter.net/2011/01/06/the-impact-factor-of-open-access-journals/.