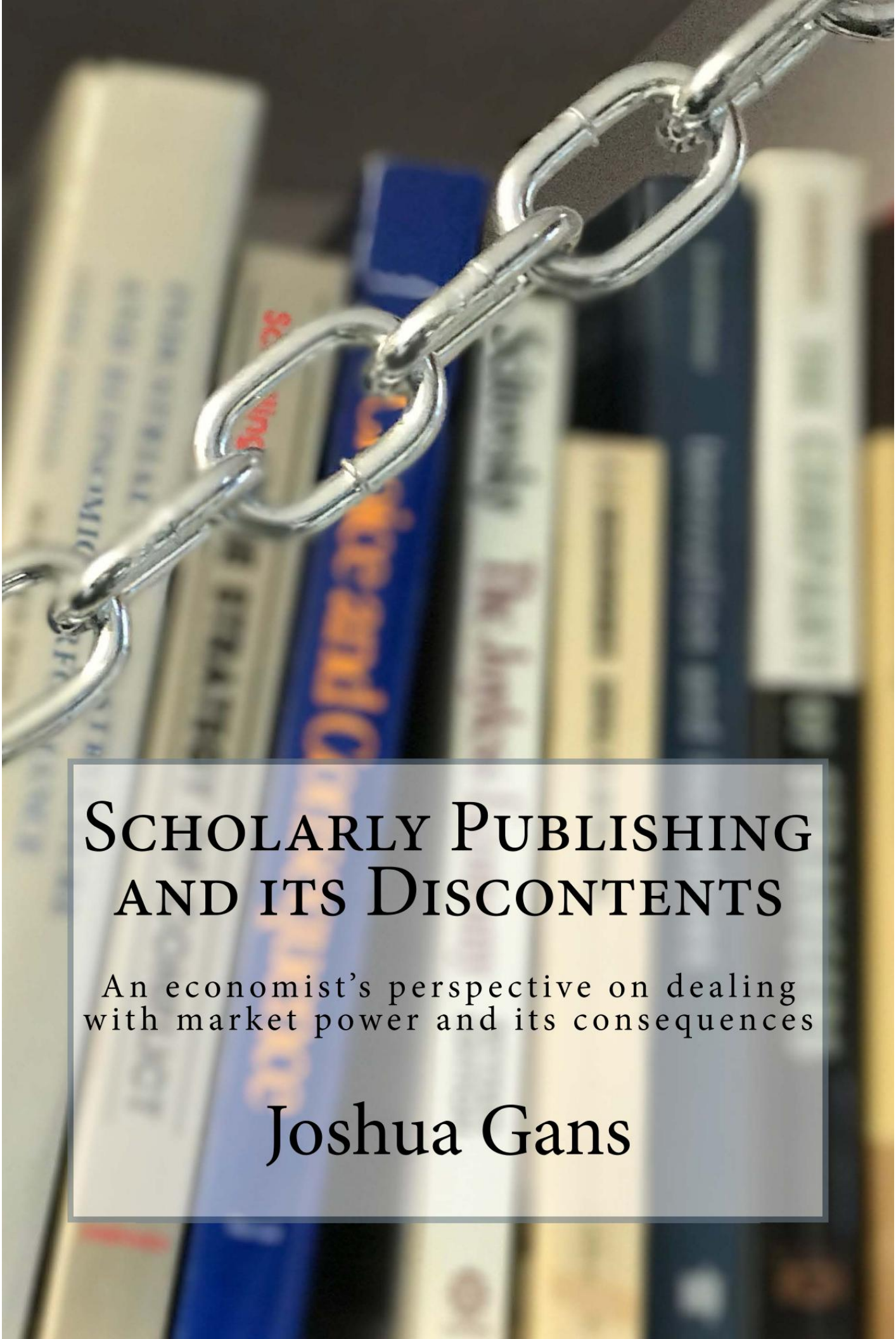

Scholarly Publishing and its Discontents

An economist's perspective on dealing with market power and its consequences

Joshua Gans

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Chapter 1: The Context

In 2011, the young activist Aaron Swartz was charged with a raft of offenses related to an unusual act. In late 2010 and early 2011, Swartz had taken a laptop to MIT and downloaded the entire contents of JSTOR—one of the largest digital collections of scholarly publications. For this, the criminal risk to Swartz turned out to be up to 50 years of imprisonment. The trial never proceeded, however, as the then 26 year-old Swartz tragically took his own life a year later.

On the scale of issues regarding digital piracy, this act stood out. Swartz was not looking to read the contents himself but believed that the knowledge contained in the thousands of academic articles in JSTOR (some going back a century or more) should be available publicly without a usage fee. JSTOR charged institutions and individuals for access to its repository, much of which it had scanned itself to preserve older physical documents.

During the prosecution, in January of 2012, Tim Gowers—a Fields Medalist in mathematics—wrote a blog post targeting various practices of Elsevier and calling for a boycott of the academic publisher.[1] Gowers cited the publisher's high prices, bundling practices, tough negotiating tactics, and Elsevier's support for various public policies, including those for which Swartz was a leading opponent. Soon after, other leading mathematicians launched a petition supporting a boycott, and within six months 12,000 researchers had signed the petition.[2]

Such calls were not new, especially among librarians. However, interest from academics grew over time. One prominent example occurred a decade earlier when economist Ted Bergstrom drew the connection (or lack thereof) between the expensive journals to which libraries subscribed and the wealth of free labor provided by academics in support of those journals.[3] He outlined various actions that might be taken, including shifting support to free online journals and encouraging libraries to cancel journal subscriptions for the least valued journals.[4] This work, and the work of others that followed, helped motivate some academics to take action. A notable example was the resignation of the entire editorial board of the Elsevier mathematics journal *Topology* in 2006. Two years later, a new alternative, the *Journal of Topology,* began publication independently of Elsevier, and soon after *Topology* ceased publication.

But what has been the broader effect? On the day Gowers woke up and published his call to boycott Elsevier, Reed Elsevier's share price was 5.98 euros. Four years later, in November 2016, it was 15.12 euros, and its rise in the intervening years had been steady. The assault on Elsevier's market power by its main suppliers of labor simply did not register in its market value.

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[1] Timothy Gowers, "Elsevier — my part in its downfall," https://gowers.wordpress.com/2012/01/21/elsevier-my-part-in-its-downfall/

[2] See http://thecostofknowledge.com/ where the total as of March 2016 was 15,770 signatories.

[3] Theodore C. Bergstrom, "Free Labor for Costly Journals?" *Journal of Economic Perspectives*, 15 (3), Summer 2001, pp. 183–198.

[4] One of the worst offending journals was the *International Journal of Social Economics,* in which, I am sad to say, I published a paper in my youth. The journal was not worth the many thousands of dollars in annual subscription fees that only a few libraries around the world bothered to pay.

The discontent from academics that led to this activism lies at the core of the rationale for science: The production of scientific knowledge relies on building upon knowledge acquired in the past. Isaac Newton argued that his important work was made possible precisely because he stood on the "shoulders of giants" who had come before him. For the economy, the way that the production of knowledge today relies on the stock of knowledge previously acquired produces persistent improvements in output per capita.[5] However, those processes can only occur if the scientists of today have access to the knowledge of yesterday. To the extent that the system of scholarly publishing does not give access to those scientists who will use that knowledge, the consequences are potentially widespread and felt over generations.

It is amid this context that this book emerges. While the effects of activism on publishers has appeared to be minimal, these movements stimulated research into the existence and consequences of market power and even the entire structure of scholarly publishing. The study of market power is squarely an economic issue. So, while other academics, especially those in library science and informatics, have pointed out its consequences, economists like myself devote our energies toward studying how to deal with market power. Economists know that market power is not simply an apparent concentration of business organizations but also how those organizations can use pricing and other factors to generate profits. Moreover, even when market power is exercised, determining how to deal with it is a complex matter. For that reason, my intention here was to set aside the work of others and focus on the research by economists into this particular industry. If other voices seem excluded in the treatment that follows, this is intentional. It is not to diminish those voices but to focus on others with a particular expertise for examining and dealing with market power in scholarly publishing.

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[5] This is at the heart of endogenous growth theory. See, for instance, Paul Romer, (1990), "Endogenous Technological Change," *Journal of Political Economy*, 98, S71–102. It also impacts the functioning of labor markets for scientists (see Paula Stephan, *How Economics Shape Science*, Harvard University Press: Cambridge, 2012.)

Disruption

Consider the many predictions that the Internet would lead to disruption of the scholarly publishing industry. The word *disruption* is an overused term, but in this case its use was appropriate: A view existed that the firms that had dominated scholarly publishing for decades would be upended as the Internet permitted the entry of new journals and other modes of dissemination of scientific research.

The logic was clear. For instance, as Michael Clarke noted in 2010,[6] the Internet removed the physical journal as the primary mode of disseminating research as well as provided an alternative means of registering discoveries. Moreover, the Web itself had been designed by Tim Berners-Lee with these purposes in mind. And, as many had demonstrated, innovation by smaller entities was occurring at an intense rate as entrepreneurs sought to fill what they perceived as a future vacuum left by the demise of physical publications.[7]

To be sure, the Internet has brought about large changes and has made scholarly publications more accessible than ever. Other innovations have allowed new journals and dissemination mechanisms to be experimented with that operate largely outside of traditional publishing and largely in the absence of their fees. But, at their core, traditional publishers have hardly been disrupted. They remain in their dominant position. Yes, you can now get your scientific knowledge using the Internet, but the toll gate there remains firmly under publishers' control.

To economists, claims that the Internet, or something similar, might disrupt an industry, are usually taken with a grain of salt. This is because we know that real market power—the kind that persists for decades—exists for a reason, and it is rare that technological change alone can upend it. What gives publishers their power might have been

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[6] Michael Clarke (2010), "Why Hasn't Scientific Publishing Been Disrupted Already?" *The Scholarly Kitchen*, https://scholarlykitchen.sspnet.org/2010/01/04/why-hasnt-scientific-publishing-been-disrupted-already/

[7] See, for instance, Michael Nielson (2009), "Is Scientific Publishing About to Be Disrupted?" http://michaelnielsen.org/blog/is-scientific-publishing-about-to-be-disrupted/

thought to be their capabilities in providing physical products but instead turns out to be their historical reputation and their expertise in convening editorial boards—qualities that did not immediately die when the Internet arrived. To be sure, they could be challenged, but their historical position buys traditional publishers time. And that time has been used to develop new technological capabilities.[8]

This perspective is particularly useful when examining whether the business model associated with traditional publishing is outmoded. Many have argued that it is important that scientific knowledge be widely disseminated but that high prices charged by traditional publishers are a barrier to that end. Consequently, it has been argued that someone other than the readers of scientific journals should pay for the production of those journals. This may, for instance, be the scientists themselves, their home institutions, or their funders. The core argument of the open-access movement has been a call for the basic business model for scholarly publication to change dramatically.

Once again, an economic approach can be uniquely informative regarding the impact of a change in business model. For instance, economics are skeptical of claims that a change in who pays can give rise to large changes in welfare and efficiency when the underlying costs (including those imposed by providers with market power) are unchanged. This is not to say that a business model might be chosen for reasons other than maximizing welfare (i.e., to maximize shareholder value), but that the mere change of the business model will itself cure an industry of all its market power ills.

For these reasons, this book takes an exclusively economic approach in analyzing market power and its consequences in scholarly publishing. I do this precisely because the apparent outcomes of market power (suffering from walled-up and not openly available scientific knowledge) is very evident, while the underlying structure of the industry is complex, making reform difficult. Economics can give us insight as to what might work and what definitely will not work.

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[8] This is a common pattern regarding disruption and is outlined in greater detail for industries other than scholarly publishing in Joshua S. Gans (2016), *The Disruption Dilemma*, MIT Press: Cambridge.

The Plan

This book gathers the bounty of economic research into scholarly publishing, its efficiency, and its operation that has been conducted over the last decade. In that regard, it is a survey of theoretical work on business models and empirical studies of the impact of innovations such as online distribution and open access. However, it is a survey with a mission. That is, my goal is to demonstrate that the research itself gives insights into why some of the activist movements to counter publishers' market power have been unsuccessful, and why the goal of changing the system of scholarly publishing is one that will require a much broader, coordinated effort. I do not have answers as to what that coordinated effort should be, but I will list ideas that suggest a much more radical state of affairs that will require resources to grow alongside traditional publishing. Specifically, *rather than opening access to journals, I believe that scholarly publishing reform should focus on disseminating the knowledge contained within them.*

The outline of this book is as follows. To build up this thesis, I begin in Chapter 2 by stepping back and considering the purpose of the system of scholarly publishing, with its goals centered on the truth, importance, and communication of knowledge along with a set of measures for ensuring accountability of those participating in it. This is something an economist does as a matter of course. We want to distinguish the goals of a system from the activities that combine to foster those goals. Chapter 3 then turns to these activities. It considers the tasks of the system of scholarly publishing that must be undertaken to meet its broader purpose. These include the creation, review, curation, formatting, preservation, search, and attribution of scholarly content. This typical economics approach will help us better understand the inputs required to run the system.

Chapter 4 then describes the bridge between the tasks and the purposes. It considers the myriad models that have emerged for organizing tasks and what their likely outcomes are in terms of meeting the purposes of the system. We'll consider benchmarks for efficiency and alternative models presented by non-profit associations and commercial publishers and what these mean for consequences such as journal quality. I then take an extended look at various forms of open

access before considering some more radical unbundled journal structures.

Chapter 5 then looks back, considering the economic theory of the operation of scholarly publishers and activism options for countering the ill effects of market power and exclusion that arise in the system. I examine boycotts, strikes, the use of voice, regulatory options, and copyright practice changes. These forms of activism, while potentially effective, face large hurdles to bringing about disruptive forces that many believe ought to be in operation.

The evidence of the effectiveness of new innovations such as online access and open access are examined in Chapter 6. I'll demonstrate that while these innovations have improved the dissemination of scholarly knowledge, they have not had the impact that some would have expected in spreading that knowledge beyond the walls of universities in richer countries and in the market power of publishers.

Chapter 7 provides a largely unstructured list of potential changes that could be deployed to have a larger effect. Mainly, these involve some form of unbundling of tasks from the wheelhouse of traditional journals, including broader options for peer review, innovations in the structure of the article, and a system for sharing annotations and notes.

The final chapter concludes with a call to reorient our view of reform in scholarly publishing away from opening up access to journal content and toward ways in which the knowledge contained within them can be disseminated more broadly.

One final caveat before we proceed. The things economists have emphasized have not been studied exclusively by them. Many others have touched on these and highlighted their importance. My approach is to highlight those issues with an economics lens, but that should not be taken as meaning that I have been the first to uncover them. I might make that claim occasionally, but I will do so explicitly in those instances. I do this is because I am trying to communicate these issues outside of the bubble of those who are convinced of the merits of open access and who want to see traditional publishing disrupted. An important audience, for instance, are economists working with governments and organizations who are concerned about cost–benefit analysis and effectiveness. They expect issues to be presented within a particular framework and seek evidence of a certain form. My

approach here is to strip away all but an economic approach in order to address those audiences.

Chapter 2: The Purpose

> "A record, if it is to be useful to science, must be continuously extended, it must be stored, and above all it must be consulted."
> Vannevar Bush, 1945

What is the scholarly publishing system's purpose? This question is the appropriate starting point for evaluating whether current practices are likely to generate socially desirable outcomes. However, as with many such systems, it can be difficult to identify one single outcome. That said, ultimately the system of scholarly publishing exists to ensure the distribution of knowledge. The question is, how it can do so when it also impacts the production of knowledge and when the notion of the distribution of knowledge includes many dimensions, including timeliness and quality?

In this chapter, I consider the purpose of the system by identifying four key outcomes—truth, importance, communication, and accounting—that we want a system of scholarly publishing to achieve.[9]

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[9] These are related to but are not quite the same as Henry Oldenburg's 1665 criteria for a journal: dissemination, registration, certification, and archive. The reason for the difference is to bring them closer to terminology used by economists and also to decompose some of these into more basic purposes.

In each case, costs are associated with achieving those outcomes and it is how those costs are traded off against benefits ideally (in this chapter) and then in practice (in subsequent chapters) that will guide the recommendations of this book.

Truth

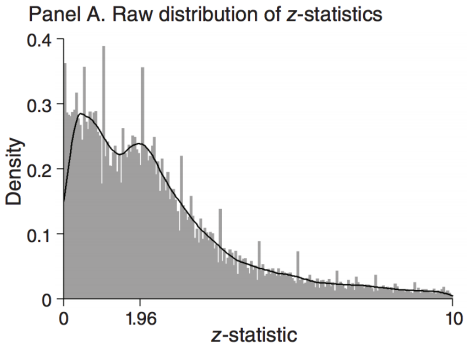
When it comes to scientific knowledge, truth is an easy to understand value: The knowledge we publish should be correct. Of course, scientific knowledge often turns out to be false. For theoretical knowledge, propositions are designed to be falsifiable, and so it should not be a surprise that some turn out to be false. However, a truthful theory is really one for which the claims of the theory—for instance, the clear statements of assumptions flowing to logical conclusions—are themselves correct even if the theory does not represent something true in the larger world.

Even logic, however, can be costly to evaluate. In 2012, mathematician Shinichi Mochizuki posted four new papers on his website (500 pages in total), proving among them the famous *abc* conjecture. Without going into details, this claim, if true, would be one of the most significant results in number theory. Three years later, as of the writing of this book, the proof remained unverified.[10] It was estimated that a complete check of the conjecture might take 400 hours to complete. Even so, it should not surprise us that even with less complex works, mistakes may sometimes be hard to catch.

For experimental or empirical work that evaluates theories and describes the world, the challenges of truth can be more difficult. An experiment's methodology may be clear, but the experiment itself may not have been conducted appropriately. Even leaving aside direct falsification of results, other factors may be at play. For example, the "HeLa" scandals in biological research arose because genetic samples in the peer-to-peer network supporting the exchange of biomaterials were, in very large measure, contaminated by other materials. A researcher who believed they were doing research based on healthy

[10] Davide Castelvecchi, "The biggest mystery in mathematics: Shinichi Mochizuki and the impenetrable proof," *Nature* 526, 178–181 (08 October 2015) doi:10.1038/526178a

Figure 1



male heart tissue may instead have been working on cancerous cells from a woman. The contamination casted doubt on hundreds of articles published over a decade or more.[11]

In other situations, statistical inference can play a role. To take a case from economics, researchers examined 50,000 hypotheses tests published (between 2005 and 2011) in three top economics journals (the *American Economic Review*, *Journal of Political Economy,* and *Quarterly Journal of Economics*) and examined the significance of reported results.[12] Significance is usually indicated using a *p*-value of a certain percentage of confidence that a hypothesis can be rejected. For instance, if a *p*-value of 0.02 is found, then a researcher is claiming that if tests and sampling were performed repeatedly, a hypothesis would be rejected only 2% of the time. Alternatively, one can represent this using an equivalent *z*-score that indicates the percentage that a hypothesis would be accepted.

Figure 1 shows the outcome for the *z*-statistics plotted in a frequency distribution. Notice that the distribution is double peaked. One peak occurs around a *p*-value of 0.05 and another around 0.12. The fact that there are any peaks at all is surprising, as the distribution of statistics should be decreasing between the two intervals.

The *p*-value of 0.05 (or *z*-value of 1.96) is a trigger point for conclusions of statistical significance. Usually, when scores fall below 0.05 (or above a *z*-value of 1.96), the result is highlighted (in bold or with an asterisk).[13] When a score falls below 0.12, the result may still

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[11] Scott Stern, *Biological Resource Centers: Knowledge Hubs for the Life Sciences*, Brookings: Washington (DC), 2004.

[12] Brodeur, Abel, Mathias Lé, Marc Sangnier, and Yanos Zylberberg. 2016. "Star Wars: The Empirics Strike Back," *American Economic Journal: Applied Economics*, 8(1): 1–32. doi:10.1257/app.20150044

[13] Of course, researchers also try to find excuses when the thresholds are not quite met. For examples, see https://mchankins.wordpress.com/2013/04/21/still-not-significant-2/.

be highlighted but is of weaker significance. Consequently, in stating results, if a researcher could present a result that met this threshold, as opposed to one that did not, they will favor the 'better looking' outcome. This is what potentially accounts for the dip between the two peaks. Some results that would fail to meet the threshold are not presented and are favored by those that do. In other words, the equivalent of "grade inflation" is occurring, which is estimated to be effectively misreporting 10%–20% of the published results in those journals. That is, marginally statistically insignificant results are under-represented as opposed to those that are marginally statistically significant.[14]

This suggests that "truth" can be difficult to evaluate because of what is not stated, as opposed to what is actually stated. And, not surprisingly, norms or standards in evaluation may shape what is stated rather than what is left out. A variation of this is the so-called *filingdrawer effect* that arises when researchers conduct analyses but then evaluate them to be uninteresting. For instance, if prevailing conventional beliefs and evidence support a particular theory, and a test fails to reject the notion that an alternative theory is correct, it is more likely to be published than a test that did provide that rejection and confirm existing intuition. This can lead to published results that, taken together, give a distorted picture of reality—that hypotheses tested and not rejected are, in fact, false.[15]

One way to examine such distortions is to reproduce existing results. Two recent studies in psychology and economics have done just that—taking a random sample of published papers and expending resources to replicate their findings. In psychology, 100 experiments were redone drawn from 100 papers published in the three important journals in 2008. Only one third to one half of the original findings were replicated.[16] In economics, 67 papers published in 13 journals

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[14] The authors report that the degree of under-representation does depend on whether the journal uses an asterisk to highlight results, whether the paper has another (say, theoretical) contribution, and whether the researcher is untenured.

[15] De Long, J. B., & Lang, K. (1992). Are All Economic Hypotheses False? *Journal of Political Economy*, 100(6), 1257–1272. Retrieved from http://www.jstor.org/stable/2138833

[16] Open Science Collaboration, "Estimating the reproducibility of psychological science," *Science* 349, aac4716 (2015). doi:10.1126/science.aac4716

were examined using original data and code.[17] Only around half of the papers emerged completely unscathed (even with assistance from the authors).[18]

While fraud does arise in science, widespread fraud is unlikely. What these findings suggest is that the system is introducing biases and those biases are significant. Recall that even when a conclusion is found to be statistically significant, there is a non-significant possibility that it is still something that has arisen out of luck. A statistically significant result suggests that, if we were to replicate the study, it would be very surprising to overturn the result. But what if only results that were surprising to begin with were published?

If journals preferred publishing interesting and new results, then new studies that merely confirmed established hypotheses would be of limited interest. Instead, something surprising would grab attention. Thus, if your average scientist were conducting numerous experiments in their lab (or field), then when a result was not surprising it could be discarded and put in a file drawer. If, instead, a result was found interesting, it would be written up and submitted. The incentives baked into the system generate a potential selection effect.[19]

It can get worse than that. For instance, scientists have considerable discretion in terms of how extensive an experiment they choose to run. If they conduct numerous small-scale experiments, the results of any one of them are not likely to be strong. Sheer chance dictates that they will come across a surprising and statistically significant finding. They can then submit that finding for publication.

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[17] Chang, Andrew C., and Phillip Li (2015). "Is Economics Research Replicable? Sixty Published Papers from Thirteen Journals Say 'Usually Not,'" *Finance and Economics Discussion Series* 2015–083. Washington: Board of Governors of the Federal Reserve System, http://dx.doi.org/10.17016/FEDS.2015.083. For experimental economics, similar replicability issues were found with over two thirds of papers published in the area in the *American Economic Review* and *Quarterly Journal of Economics* not meeting replicable standards. See Colin F. Camerer, et al., "Evaluating replicability of laboratory experiments in economics," *Science*, 3rd March 2016, doi:10.1126/science.aaf0918

[18] For medical sciences, see the famous paper Ioannidis JPA (2005) "Why Most Published Research Findings Are False." PLoS Med 2(8): e124. doi:10.1371/journal.pmed.0020124

[19] See R. Vohra (2016), "Replicability and Publication" in The Leisure of the Theory Class. https://theoryclass.wordpress.com/2016/01/16/reproducibility-and-publication

However, instead, perhaps they should undertake replicating that result themselves prior to submission, or at the very least report their other experiment results.

This is a very tricky issue, and there have been suggestions that replication be mandated and that pre-commitment and communication of the set of experiments proposed be required so as to mitigate these selection effects. This is not something I will examine here. However, note that these policy responses have costs, and sometimes considerable costs. A theme of this book will be that whichever system we choose must economize costs like these. The point I raise here is that truth is an objective of the system, but even truth has its cost. This is so much so that perhaps the response to selection effects is to have no selection at all and publish all results without investigation. In a later chapter, I will consider these approaches in more detail.

Importance

The second purpose of a system of scholarly publication is to assess knowledge for its importance. This immediately conjures up notions of clear applications for basic scientific research, but that is not the sense of importance the system is often aiming to achieve. Instead, given that the attention of those consuming scientific knowledge is scarce, it is often thought that the system should sort information based on how important new knowledge is and give more important knowledge priority. This is akin to the curation function that arises in publishing elsewhere.

Whether scholarly publishing can sort knowledge based on its importance is a matter of considerable controversy. In economics, for example, it was found that many of the most significant works—including many that won Nobel prizes—were initially rejected by the top journals in the field.[20] The suggested reason was that it was often

[20] Joshua S. Gans and George Shepherd, "How Are The Mighty Fallen: Rejected Classic Articles By Leading Economists," *Journal of Economic Perspectives*, Vol.8, No.1, Winter, 1994, pp. 165–179.

difficult to assess the value of advances in economics because the field was evolving its scientific norms.

The same, however, could not be said of medicine. A recent study examined the accept/reject decisions of over 1,000 manuscripts submitted for consideration by the *Annals of Internal Medicine*, the *British Medical Journal,* and *The Lancet*—three leading medical journals.[21] Of these, 62 were accepted, while 757 were rejected but eventually published elsewhere. All these papers were then examined with regard to their citations—an indication of their eventual performance. If the system was working appropriately, the most highly cited papers would have been published in the leading journals. But the 14 most highly cited papers were all rejected by these journals. Twelve of them were "desk-rejected," meaning that they were not sent out for peer review. This suggests that, like economics, editors may have trouble seeing novel results when first presented with them.

In general, however, journals can assess importance, and in the top journals, published papers tend to receive more citations on average than those that appear elsewhere.[22] However, it is hard to know whether this tendency is a consequence of those results being more likely to hold the truth than from their importance. Of course, the two may go hand in hand in practice, but, conceptually, truth and importance are separate criteria. It's interesting that the practice of peer review usually asks that peers assess both for truth and for importance. While one might presume that the two criteria might have a strict ranking—that is, first determine whether a result is true and then assess its importance—one wonders whether there is a trade-off between the

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[21] Siler, Kyle, Kirby P. Lee, and Lisa A. Bero. 2015. "Measuring the Effectiveness of Scientific Gatekeeping." *Proceedings of the National Academy of Sciences*, Vol. 112(2), pp. 360–365.

[22] This is not exclusively an issue with journal publications. For instance, a recent study examined the impact of the order of papers in the NBER's weekly email distribution of new working papers and found that papers higher up in the order received more citations than those that appeared lower down. This was interesting because the papers' order in the email was effectively random (based on the order in which an administrator received the papers) rather than anything that might have been correlated with quality. See Daniel Feenberg, Ina Ganguli, Patrick Gaule, and Jonathan Gruber, "It's Good to Be First: Order Bias in Reading and Citing NBER Working Papers," *Review of Economics and Statistics*, forthcoming.

two. As noted earlier, truth is difficult to establish and sometimes can only be assessed probabilistically. Consequently, it is possible that truth might be exchanged for assessed importance by the scholarly journals.[23]

Once again, assessing importance is difficult, costly, and uncertain. While there is a certain economy of attention in the ability to curate current knowledge based on its likely future importance, and therefore signal it to command the attention of readers, there is also a sense in which placing the assessment of importance alongside the time of publication may itself be a fruitless task. The alternative may be to publish all and leave the issue of importance to the marketplace for ideas.

Communication

The third purpose of scholarly publishing is communication. Knowledge is of little use if it is kept in the minds of one or a few individuals. Instead, it must propagate. There are, of course, numerous paths by which knowledge is diffused. The spoken word is of clear importance with academics, long having organized themselves into conferences, workshops, seminars, and other informal gatherings. Similarly, knowledge is taught directly to students in universities and colleges. But scholarly publishing is designed to be (a) more diffuse than in-person gatherings and (b) more permanent a record than the outcomes of those gatherings. Thus, it is both spatially and temporally more ambitious than other forms of knowledge diffusion.

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[23] Recent research gives some insight into this by looking at how journals themselves function as knowledge platforms. (See Daniel C. Fehder, Fiona Murray, and Scott Stern, "Intellectual property rights and the evolution of scientific journals as knowledge platforms," *International Journal of Industrial Organization*, Vol.36, September 2014, pp. 83–94; doi:10.1016/j.ijindorg.2014.08.002). They examined publications in *Nature Biotechnology* and *Nature Materials* that also were associated with a patent. Such patents could have a negative impact on the citations of the associated paper, but this was confined to the first few years of a journal's establishment. Later, the association was positive. Patent grants also had a disproportionately larger impact on researchers in private labs as opposed to public institutions. These results suggested that journals played a complex role in serving as platforms for disseminating knowledge.

Despite this, one of the criticisms levelled at the scholarly publishing system is that it is difficult to comprehend, understand, and assimilate the knowledge contained therein.[24] The issue is that academic articles evolve their own language, terminology, and methodological underpinnings that are part of the language of the discipline from which they come. That is, they appear to be written in a "code." Codes can, in fact, be efficient in conveying information when those writing and reading have the appropriate context. Jargon is only jargon to the uninitiated. To the initiated, it can represent clarity of thought and a quick way of digesting what has been written.

This highlights the open question concerning for whom that knowledge is published. Is it for insiders who understand the practices of the field? Or is it for others who may not. As insiders are vastly more likely to be consuming published works, efficiency would dictate economizing communication for them. But then again, the need to disseminate knowledge suggests that wider access is desirable. As I will remark on later in this book, both sides have points. But it puts too much strain on a particular mode of publication to presume that multiple audiences can be accommodated by the same instrument. The answer, therefore, is to consider how instruments can be expanded and then tailored for different use cases.

The purpose of communication applies not just to the initial communication of knowledge but to its entire corpus. As discussed earlier, truth is a key purpose of the system, but we cannot necessarily expect it to be achieved perfectly by any publication system. Consequently, errors will be discovered, and in some cases, the initial authors may want to issue a retraction. From the perspective of someone then coming to look at a particular article, they need to be informed of changes in the article's status. Retraction would be an obvious example, but prior to the digital age a person happening upon a work in a library may have read it without being informed that it had been retracted in a subsequent issue of a journal. Thus, another set of reference materials needed to be built with the requirement that individuals check those materials to ensure that the published knowledge they have found has not altered.

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[24] For a discussion, see Steven Pinker, "Why Academics Stink at Writing," *The Chronicle of Higher Education*, September 26, 2014. http://chronicle.com/article/Why-Academics-Writing-Stinks/148989/

In the digital world, retraction is perhaps easier to signify but what of revisions short of retraction? Absent an explicit acknowledgment of error or change, work must be undertaken to ensure that changes in an article and how it is received are indicated in the published entry. This highlights a challenge of communicating knowledge: that publication cannot simply be thought of as fixed and immutable, and that some method of evolution must be built into the system.

The broader issue is that communication goes well beyond the content and style of a particular published article. First, even aside from the distinction between insiders and outsiders, people may consume an article in different ways and for distinctly different purposes. The communication needs of a PhD student digesting an article deeply to understand their own research topic differs from a researcher examining an article loosely to see whether it is of relevance to their own investigations. Second, the reference needs of researchers must be met. An article exists not in isolation but as part of a corpus of knowledge, and the article itself must be a node in that network and not a separate unit. Thus, an article's citations and summary of its own context are critical for a particular article to be an efficient part of the overall network. Finally, published work must make itself easily searchable. The entry point for those consuming knowledge is not a cover to cover reading of every page of a journal. Instead, they will enter the network based on a search for particular concepts and requirements. The communication purpose requires that the search process itself be as efficient as it can be. Unfound published knowledge might as well not be published at all.

Accountability

The final broad purpose of the scholarly publication system is to provide a record of accountability. This is, of course, a natural extension of other purposes—notably truth and communication. But it is worthwhile reflecting here on why.

First is the issue of reliability. Knowledge is of use when it can be relied upon without having to check and recheck whether it is correct. Publication itself is a certification of the state of knowledge, and thus represents what should be a reliable record that people can use to frame the next step in knowledge. This is of particular importance

when new knowledge is a combination of insights and results from several sources. If one source was proven unreliable, then the whole edifice could be unstable.

Second, having a record of account is important in avoiding duplication. It is efficient to discover knowledge just once. If a discovery is not recorded and accounted for, then others may end up "reinventing the wheel," leading to inefficiency. Efficiency is recognized in the patent system whereby patent holders are required to disclose their inventions if they are going to be granted exclusivity. The alternative would be to keep an invention secret, but it is such secrecy that can lead to duplicative efforts. Likewise, the scholarly publication system needs to ensure that duplication is avoided.

Interestingly, a consequence of accountability is another sundry purpose often extended to scholarly publication—a system of reward. Not only is knowledge published, but scientists are noted and accounted for as authors of that knowledge. This provides the advantage of being able to discover the source of any error in that knowledge should one be discovered later. But the clear intent is to give people a reward in terms of priority that can be used for career advancement. And that is precisely what it is used for. In particular, the publication system can be critical in acknowledging the date upon which knowledge was discovered but also in ensuring that deference is paid to researchers in terms of acknowledgment, discussions, credit, and citations. Each of these serves the dual role of ensuring communication of the corpus of knowledge, but attaching names to that knowledge provides a signal of the quality of an individual or team's contribution rather than the contribution of the knowledge itself. For this reason, scholarly publication matters not simply for the dissemination of knowledge but also for the role it plays in the career rewards of scientists. As I'll discuss in a later chapter, sometimes these dual purposes can conflict.

Summary

A lot is asked of the system of scholarly publishing. It must aspire to truth and curate items in terms of importance—both of which are related and tend to evolve over time. Scholarly publishing needs to communicate results effectively in a world that includes diverse

audiences with differing abilities to digest knowledge. And finally, it has to account for itself not only in terms of providing an immutable record but also to mold incentives and rewards for achievement. This is a lot to ask of a publishing system, and so we turn now to consider the set of tasks that must be achieved along the way.

Chapter 3: The Tasks

The previous chapter outlined the broad purposes of the scholarly publishing system. This chapter now considers the tasks that system will perform. The idea is to highlight the costs associated with those tasks as well as the purposes those tasks are directed at achieving. While traditionally some tasks have been allocated to specific individuals, one of the goals of this chapter is to outline the tasks in a manner that leaves the allocation of those tasks as a choice that may differ between alternative models of scholarly publishing.

Creation

The creation of knowledge—while a critical input for scholarly publishing—is not so much a task as an input, and a starting point. That said, it is likely that much knowledge creation would not occur without the system of scholarly publishing. Consequently, the efficiency of that system matters for the creation of knowledge. In particular, when knowledge is cumulative, scholarly publishing is also an input into the creation of knowledge. The two systems are symbiotic in terms of both operation and incentives, as scientists are motivated

by a desire for created knowledge to be an input into newly created knowledge as well as new applications.

This symbiosis aside, some tasks emanate from the publishing system and contribute to the creation of knowledge. This occurs when publishers commission surveys that synthesize bodies of work and when publications cover debates over controversial research issues. Often, such surveys play a critical aggregation role in providing an efficient touchpoint for those trying to access knowledge. Consequently, we must list the creation of synthetic knowledge as an important function of the system in facilitating communication.

Review

All publishing systems have a process of review for ensuring that the published content matches the goals of the publisher (a potentially varied group). As discussed in the previous chapter, scholarly publishing has purposes that require the evaluation of content for meeting certain standards including truth and importance as well as editorial concerns regarding communication and accountability. Interestingly, that review is undertaken mostly by peers—those who are also responsible for supplying scholarly knowledge. While there are some exceptions (for instance, *Science* and *Nature* have dedicated professional editorial teams) for most published works, the entire review process is handled by peers.

The peer-review process has several advantages. The most obvious arises from the adage "It takes one to know one." Scientific work can be complex and, as already noted, can have a language and context of its own. Consequently, the review process is placed in the hands of those who are likely to understand that context. The idea is that deep expertise of knowledge creation is required, which is prioritized above the ability of others to read and digest the work. The trade-off made favors truth rather than other criteria. There is no conflict between truth and other criteria per se, except that allocating the task of review to peers exclusively does mean that a trade-off occurs.

The second advantage of peer review is that the peers have "skin in the game." They are insiders who have been selected because they are likely to have an innate or expressed interest in preserving the quality of the system. Scientists want to be able to build on published

knowledge and therefore have an interest in it being readily available. Often, a prerequisite of being able to rely on existing knowledge is that it has been peer reviewed. Consequently, by performing this task, scientists are contributing to the system that benefits them. The flip-side of this interest is that insiders will tend to judge by the standards of insiders. There is concern that novel work might have greater barriers to being published as a result. Of course, while this may be because of the review process, it also could be because novel work is harder to evaluate, and even if a review process had lower barriers, broad acceptance of the work would still be a challenge. Similarly, peer review also comes with the concern about peers using the reputation of those producing knowledge to judge quality. Consequently, for many outlets, blind or double-blind review processes (for which the authors did not know the referees, and the referees did not know the authors) are used. This is still the case, although the Internet has made it harder to ensure that reviewers are unable to identify authors.

One consequence of this alignment of interests, however, is that reviewers might not need to be paid for their work. Reviewing is a difficult job. It takes considerable time, and, moreover, the system relies upon it being done well. This sort of task is normally directly compensated in the economy. However, much peer review is in fact uncompensated, and where it is compensated there is usually a nominal amount paid for timely completion of a review or perhaps a free subscription to the journal concerned.

Why does this arise? The simple answer is that because reviewers have an interest in the review system working, they agree to perform their function without compensation. In this respect, it is a kind of gift exchange for being part of the system. Indeed, 15 years ago, Bepress—an online journal publisher—made that gift exchange contractual; they waived submission fees if a person supplied or agreed to supply three reviews.

But, even if someone is intrinsically motivated to review, that does not mean their motivation and effort is not immune to being improved through monetary compensation. However, the review process, by its very nature, has some checks on this. Importantly, reviewers are selected and typically must agree to provide a review before they actually undertake the task. Thus, a reviewer who passes on that task (a) misses the opportunity to evaluate the work and have their own

expertise and judgment certify its quality and (b) will cause delay in the system as a new reviewer would need to be found from a potentially diminished pool of experts. In this situation, money might lubricate each person's willingness to accept a review assignment. However, to the extent each person was factoring in the difficulties of finding an alternative should they reject an assignment, this mitigates the increased incentives they would otherwise obtain from monetary compensation.[25] In short, when reviewers care about the system, money loses some of its bang for its buck, which is perhaps why it is not used as a part of the peer-review process.

Interestingly, some have argued that peer review may be causing some "gumming up" of the system in the form of longer review times and increased paper lengths. Glenn Ellison documented increased paper length (both in pages and in references) from the 1970s to the 1990s in a variety of fields.[26] Over the same period, the time from initial submission to acceptance doubled over most fields, although notably not for science journals such as *Nature*. Some argue that this slowdown may be a good thing, as it deters mediocre or half-baked papers from being submitted to journals.[27] However, Ellison has postulated that evolving norms and standards may lend themselves for reviewers to ask for more revisions and extensions to papers as they perceive that the standards for publication are high, given difficulties and requests they themselves face when submitting papers for publication. Thus, a vicious cycle of increasing requirements can become entrenched in the system.

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[25] Maxim Engers and Joshua S. Gans, "Why Referees Are Not Paid (Enough)" *American Economic Review*, Vol.88, No.5, December 1998, pp. 1341–1349.

[26] Glenn Ellison, "Evolving Standards for Academic Publishing: A $q=r$ Theory." *Journal of Political Economy*, 110(5), 2002a, 994–1034; Glenn Ellison, "The Slowdown of the Economics Publishing Process," *Journal of Political Economy*, 110(5), 2002b, 947–93. One recent approach to counter this in science is the website *Matters* (https://www.sciencematters.io). This website allows scientists to publish very small units of knowledge—at the level of an observation. They do not curate knowledge but publish it if the observation is sound.

[27] Ofer H. Azar, "The Review Process in Economics: Is It Too Fast?" *Southern Economic Journal*, 72(2), 2005, 482–91; Ofer H. Azar, "The Slowdown in First-Response Times of Economics Journals: Can It Be Beneficial?" *Economic Inquiry*, 45(1), 2007, 179–87.

One way of dealing with this has been to remove referees from the process to some extent. This has happened by including an initial stage handled by a journal editor whereby a paper is desk rejected. As described in the previous chapter, this carries a risk that more novel research may be dismissed quickly without deeper investigation. However, desk rejection does permit some speeding up of the system.

Regardless, review is a necessary task in the system of scholarly publication. How it interacts with standards and requirements though gives rise to the potential of creating inefficiencies. Ironically, because such standards are so dependent on developed social norms, they may be difficult to alter when they become entrenched.[28]

Curation

One of the principles of science is that it is *open*—that is, anyone has a right to contribute scientific knowledge. Such openness does often extend to scholarly publishing. Journals have open calls for papers allowing anyone to submit one for consideration. They do not have to be accredited or even have a degree. And they do not need to be employed by a standard institution of higher education. That's just as well; otherwise, Einstein's miracle year (1905) of four ground-breaking publications might never have seen the light of day, as his full-time job was as a patent clerk at the time.

Openness creates an issue in that more knowledge is produced than any one person can consume. This is not a problem in itself, but a scarcity of attention gives rise to a demand for curation—that is, someone who will examine knowledge and certify it. Certifying it for accuracy is one dimension of this; the purpose of which is to provide a foundation for the reliability of the knowledge should someone want to make use of it. The other dimension, however, is certification for relevance. In this function, curation is directed at the scarcity of

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[28] A recent experiment at the *Journal of Public Economics* explored these issues. It was found that reports would be submitted earlier when deadlines were shorter and that cash incentives accelerated review times. But most effective was publication of turnaround times that opened up tenured referees to social pressure. See Chetty, Raj, Emmanuel Saez, and László Sándor (2014), "How Can We Increase Prosocial Behavior? An Experiment with Referees at the *Journal of Public Economics,*" *Journal of Economic Perspectives*, 28(3).

attention, as it provides a signal to readers that the attention should be commanded. Thus, some certifiers will be able to build a reputation for signaling relevance and in the process move themselves up in terms of priority for attention—especially close to the time of publication.

Given this, it should not be surprising that scholarly publishing is organized into journals with differing ranks of "quality." Publishing in a top-tier outlet is a signal to all that a work is likely to be of more relevance and importance than one that is published in a second-tier outlet. What is interesting is that such curation does not play simply the role of a passive signal to readers. Instead, the signal becomes independently valuable to researchers, and they compete for a place in those top journals. Consequently, the certification function becomes perhaps even more important than the dissemination function of those journals. Moreover, academics are pushed to try ambitious strategies that involve submitting to top-tier journals and then moving down the list as rejections come in. In economics, acceptance rates at top journals have fallen from 18% to 6% in the last three decades.[29] This would not be an issue but for the fact that the review function is often being duplicated as a result.

This tendency toward tiers reinforced by the desire of researchers for certification, as opposed to pure dissemination, can lead to a reinforcement of tiers even when it is not in the interest of participants. A top-tier journal benefits from the fact that those who examine second-tier journals do not know, but suspect, that the articles published therein were first rejected elsewhere. If that were not the case, then there would be no stigma attached to submitting to a second-tier journal in order to, say, be published quickly or to signal to a more specialized set of interested readers.[30] Not surprisingly, even in a digital age, top-tier journals would, therefore, be interested in maintaining a scarcity of space.

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[29] Justin Fox, "Academic Publishing Is All About Status," Bloomberg View, Jan 5, 2016; http://www.bloombergview.com/articles/2016-01-05/academic-publishing-is-all-about-status

[30] Farhi, E., Lerner, J., & Tirole, J. (2013). "Fear of rejection? Tiered certification and transparency," *RAND Journal of Economics*, 44(4), 610–631. http://doi.org/10.2307/43186436?ref=search-gateway:828815ca8cb74c7e246c7ffccb0964f6

One consequence of this is that top-tier journals may prefer non-transparency and non-disclosure when they reject papers. Surely, those being rejected prefer this, but this actually pollutes the cause of second-tier journals because their readers cannot tell whether or not their submissions were initially rejected. Of course, if journals had begun with a weaker criterion—acceptance based on truth but not in terms of importance—then they would not organize themselves into tiers at all. But then others would likely move into the role of curation for attention. Nonetheless, the effective unbundling of functions may dissipate publisher market power and allow libraries to pay for the functions they want (the knowledge) rather than the functions they do not want (curation). I will discuss this in more detail below.

Formatting

On July 4th, 2012, CERN scientists announced their identification of the Higgs boson. This was a very significant scientific announcement leading to a Nobel prize the next year for those who had posited its existence four decades earlier. However, for our purposes here, the interesting thing about the announcement was the choice of font the CERN scientists used in their PowerPoint slides: **Comic Sans**. This font is typically used in comic strips, so its use in a statement of authority was certainly out of place. Evidence shows that font choice can matter in terms of getting people to have confidence in what you are writing.[31]

There is no strong science on font choice, but Baskerville has come to the fore in some studies, followed by the font Computer Modern. That font is used by mathematicians and is also the basis for the TeX typesetting program. For that reason, it is also often used in scholarly publishing. It is hard to know whether the use of Computer Modern with authoritative documents caused it to be associated with authority or vice versa, but it is believable that font choice can impact, well, impact.

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[31] http://opinionator.blogs.nytimes.com/2012/08/08/hear-all-ye-people-hearken-o-earth/?utm_source=slashdot&utm_medium=slashdot&utm_campaign=slashdot&_r=0

The other use of fonts in conjunction with formatting is, of course, ease of reading. It seems strange that I might raise readability as an explicit goal worthy of discussion here. However, as I glance over an Elsevier publication written in what appears to be a 9-point font (that is, this small) I believe I can make a case. Readers have their own preferences over fonts, font sizes, and other aspects of typographic style (such as text justification and margin sizes). Modern e-readers such as Amazon's Kindle allow readers to choose some of those aspects. Of course, as is well known, this poses challenges for locating particular bits of text, but that is surely a problem that could be solved by some future standards-setting organization.

This suggests that formatting is a key function of scholarly publishing and not an afterthought. How a paper is presented and laid out can assist in the assimilation of knowledge. When publications were disseminated purely in print, layout would matter. Edward Tufte, who has done more than anyone to emphasize the visual display of information, argued that the text of a paper should be in a thick column with tables, graphs, and illustrations alongside in a thinner column.[32] That way, the flow of digestion of one kind of information would complement rather than break up the other. In the thin margin, he would include notes (rather than footnotes or, even worse, end notes).

Interestingly, these best practices in layout seemed never to be a strong consideration for many researchers. Instead, digitization has taken over and with it has come some new expressions into formatting. As of the writing of this book, the PDF (or portable document format introduced by Adobe) reigns supreme. This suggests that alternative formats that have been used on the web and elsewhere are still not as comfortable, readable, or understandable as layouts developed as if the digitized paper would still be printed.

Thus, it appears that the formatting decisions today are still guided by the constraints of physical (paper) publishing. Some articles do appear as web pages, but those seem to present themselves as relatively unapproachable and without great options for readers to make the task user-friendly. One of the main writers about the difficulty in reading on digital devices is Craig Mod. In 2012, he argued for "subcompact"

[32] http://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0002QF

publishing—a metaphor related to the subcompact car that economized on gasoline.[33] He argued that modern platforms existed that would allow text to be uploaded (including links to the open Web) but that otherwise would present a minimalist approach for those who wanted to read the text. He noted, importantly, that readers might have different preferences for things like page structure and, in fact, whether pages existed at all—in favor of, say, an infinite scroll.

In this discussion, I have of course focused on text. Beyond that is the use of other media such as videos, presentation slides, interactive diagrams, equations that can be manipulated, data that can be reanalyzed, references that can be deep linked (right to the relevant part of the cited article), and the like. These pose special challenges, but surely given that the price of other modes relative to text has fallen dramatically, the provision of these media comes under the task of formatting.

As such, I hope I have convinced you that the task of formatting is a key aspect of scholarly publishing. It provides a structure to an academic piece and potentially a sense of familiarity that can allow readers to find information. Thus, it is not surprising that articles within a field tend to look the same and have the same standards—right down to the use of asterisks for highlighting statistical significance. Here I've pointed out that formatting is a task, and an important one. As I will revisit in a future chapter, formatting is also an area with considerable innovative potential.

Preservation

Talk with any librarian and they will tell you that their biggest concern regarding digitization of scholarly publications is preservation. This is not surprising, as one of the primary functions of a librarian was to acquire a journal collection and ensure that it was available and complete. Digitization removed the reason for library control of the primary asset, and scholarly publishers moved toward access and

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[33] Craig Mod, 2012, "Subcompact Publishing," http://craigmod.com/journal/subcompact_publishing/

license fees as opposed to a transfer of asset ownership. Nonetheless, preservation remains a critical task for the scholarly publishing system.

This is something that Vannevar Bush anticipated in his famous 1945 essay "As We May Think."[34] But as Bret Victor pointed out, Bush presumed that each user would be able to host their own library of all the information in the world.[35] Bush envisioned a "library of a million volumes compressed to one end of a desk." This is not unprecedented: Our own cells each house our full DNA. However, it's interesting that the modern Web does not pursue this model. For much digital information, there are few duplicates.[36]

Part of the preservation function, of course, evolves around digital security and ensuring that the actual primary content of scholarly articles is not lost by accident. The destruction of the Library of Alexandria by fire on several occasions looms large in the minds of librarians. Protection against such disasters is costly and, moreover, unlike the preservation of physical collections, it is not something that comes as a free consequence of the dissemination of those collections. In principle, the digital collection need only be housed in one location and then be accessed from everywhere. Thus, preservation needs to be a more conscious and planned activity.

This becomes even more critical when one considers how different articles link to one another. Again, it was Bush who saw the potential of digitization to fully realize a web of knowledge:

> Moreover, when numerous items have been thus joined together to form a trail, they can be reviewed in turn, rapidly or slowly, by deflecting a lever like that used for turning the pages of a book. It is exactly as though the physical items had been gathered together from widely separated sources and bound together to form a new book. It is more than this, for any item can be joined into numerous trails.

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[34] Vannevar Bush, "As We May Think," *The Atlantic*, July 1945; http://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/

[35] http://worrydream.com/#!/TheWebOfAlexandria

[36] Interestingly, the Web poses a different problem regarding retractions. If an article is published and then retracted, a record is included with the journal, but if the paper exists as a working paper, notice of its retraction may not appear in, say, Google Scholar. It may be very difficult to remove that working paper from the Web.

Bush saw these links—or *memex,* as he termed it—as being an ever growing way in which the knowledge stock would grow in terms of its value. "Wholly new forms of encyclopedias will appear, ready made with a mesh of associative trails running through them, ready to be dropped into the memex and there amplified." The modern Web looks like this vision but, at the same time, when the individual nodes in the Web—the articles—are not preserved, then the links themselves are lost and with them their value.

It is this aspect of preservation that is at risk today. By its nature, there is no single owner of the record—both content and the links between them. Consequently, a rot has emerged.

> The overwriting, drifting, and rotting of the Web is no less catastrophic for engineers, scientists, and doctors. Last month, a team of digital library researchers based at Los Alamos National Laboratory reported the results of an exacting study of three and a half million scholarly articles published in science, technology, and medical journals between 1997 and 2012: one in five links provided in the notes suffers from reference rot. It's like trying to stand on quicksand.[37]
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> The footnote, a landmark in the history of civilization, took centuries to invent and to spread. It has taken mere years nearly to destroy. A footnote used to say, "Here is how I know this and where I found it." A footnote that's a link says, "Here is what I used to know and where I once found it, but chances are it's not there anymore." It doesn't matter whether footnotes are your stock-in-trade. Everybody's in a pinch. Citing a Web page as the source for something you know—using a URL as evidence—is ubiquitous. Many people find themselves doing it three or four times before breakfast and five times more before lunch. What happens when your evidence vanishes by dinnertime?"

[37] Jill Lepore, "The Cobweb: Can the Internet be archived?" *The New Yorker*, January 26, 2015; http://www.newyorker.com/magazine/2015/01/26/cobweb

Librarians were well aware of this possibility years before it started to happen. And, indeed, the work of the Internet Archive and its Wayback Machine that captures web pages at different points of time is a reaction to that. But much damage has been done.[38]

For scholarly publishing, these issues are receiving attention, but the entire way in which content and links are preserved remains in flux. Some problems have been addressed, and footnotes now include a "retrieved on [date]" stamp. And there are attempts to link those pages directly to pages in the Internet Archive. But there is so much content and so much evidence that the task still appears to be unplanned, uncoordinated, and an afterthought. The challenge of preservation of content has been helped by digitization, but the challenge of preservation of knowledge and record is still there to be solved.

Search

Thus far, we have talked about the tasks involved in creating a reliable repository of knowledge. However, unless this knowledge can be easily located and drawn upon, it is unlikely to be of real use. Bush anticipated this in his essay:

> So much for the manipulation of ideas and their insertion into the record. Thus far we seem to be worse off than before—for we can enormously extend the record; yet even in its present bulk we can hardly consult it. This is a much larger matter than merely the extraction of data for the purposes of scientific research; it involves the entire process by which man profits by his inheritance of acquired knowledge. The prime action of use is selection, and here we are halting indeed. There may be millions of fine thoughts, and the account of the experience on which they are based, all encased within stone walls of acceptable architectural form; but if the scholar can get at only one a week by diligent search, his syntheses are not likely to keep up with the current scene.

[38] Several recent ventures also address this problem, including CrossRef.org and perma.cc, which are designed to help scientists create permanent records of other work they cite. Of course, this is a potential resolution for future links but is also only as effective as it is adopted.

How knowledge is found depends on a mixture of activities by those who create and publish the knowledge as well as those who use it.

The traditional means of finding knowledge is by way of a classification system. The idea is to take a unit of knowledge—an article or a book—and assign it to a broad category (for example, economics, mathematics, biology, etc.). Then you assign it to narrower categories. A classification system records and cements the hierarchical nature to knowledge. This has some advantages. If you know what category what you are looking for, the classification takes you straight there. In addition, you can find a set of knowledge. Thus, even if you go straight to a source, the organization of, say, a library, allows you to browse and see what is next to it. This classification scheme was so natural that Yahoo used it to first organize the Internet. It didn't create a search engine but instead a directory. The problem, however, as with all hierarchies, is that they are bound by history. If some subcategories become more important or if knowledge spans them, it is hard for the classification system to evolve.

A hierarchical classification system—like a file system—involves, as Clay Shirky has noted, a physical metaphor of a shelf or drawer.[39] Therefore, it works well when the corpus of knowledge is physically constrained, and when you employ expert people to classify that knowledge. If the corpus of knowledge becomes huge, then the classification system breaks down on several fronts. First, classifiers cannot keep up. Second, classifications become constraining as the path to knowledge becomes less optimally hierarchical. That is, knowledge exists in multiple categories, and perhaps distant ones.

One way to transition away from the hierarchy was to tag knowledge. The idea is that knowledge creators as well as knowledge users would create tags (or keywords) that would represent signposts for others searching for knowledge. In this manner, the classification could evolve, and it need not be hierarchical. For scientific knowledge, creators put in place a corpus of links (i.e., citations and discussions) so that knowledge they have relied upon can be found by others.

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[39] Clay Shirky, 2005, "Ontology is Overrated: Categories, Links and Tags," http://www.shirky.com/writings/ontology_overrated.html?goback=.gde_1838701_member_179729766

Others then could create indexes and surveys that provide gateways to that knowledge.

We are now accustomed to finding knowledge bases on algorithms created by search engines. Google most famously built on Bush's idea and used the notion of citations as indicators of authority and quality. This allowed them to rank responses to queries by those searching for information. They then brought the same engine to scholarly publishing in the form of Google Scholar.

As wonderful as algorithmic searching is, academics rely on citations and on informal knowledge from other academics to navigate the stock of knowledge. However, these mechanisms are only as good as the links contained at the time an article is written and on the local knowledge of those in proximity—both physically and socially. It is hardly a wonder that there are concerns that critical bits of insight might be missed.

Searching, therefore, remains a key task of the system of scholarly publishing. Aside from a few big interventions, however, it is a task given little attention for continuous improvement. For instance, a theme I will return to in a later chapter is whether the article form itself is conducive to the efficient search for knowledge.

Attribution

The final task of the system of scholarly publishing is attribution. This is where credit for the creation of a unit of knowledge is assigned. Of course, the assignment of credit is related not to the dissemination of knowledge but rather to incentives for its creation. This is essential in terms of scholarly publishing's role in the system of scientific reward.

Attribution is also important for ensuring accountability. This includes some assignment of responsibility if errors are published but also includes directing scientists away from duplicating knowledge and instead acknowledging where knowledge they rely upon already exists. In principle, this can occur with actual assignment of names to acknowledge created knowledge. In practice, that assignment assists in policing content, and therefore incentives for clearly citing already published knowledge acts as an input into the creation of new knowledge. In other words, it is part of the process of cumulative knowledge accumulation. Newton's giants should be named.

Interestingly, as a task, attribution can be a costly one. Editors and referees are asked to ensure that attribution has been stated clearly. What is more, part of the expertise they bring to this task is their own knowledge of the locations of existing knowledge. As the stock of knowledge grows large, and especially as it extends beyond disciplinary boundaries, attribution can be a challenge. Consequently, sometimes mistakes or omissions in attribution are discovered only once a work has been published, requiring the system to implement processes for correcting earlier mistakes.

The costs also arise precisely because different people may have different views of the importance of a past unit of knowledge in producing current knowledge. This impacts not only the degree of attribution but also the significance of a contribution. When journals are ranked in terms of quality including that contribution significance, judgements over attribution will impact the rank of a journal to which a piece of knowledge is assigned. Once that assignment is made, however, mistakes cannot be easily undone. While significant knowledge that misses the cut at a top-tier journal might find a new life when its significance is determined, the benefits authors receive of articles that do not belong in a top-tier journal cannot easily shed. This is a cost associated with establishing journal quality rankings, but the task of attribution becomes more important precisely when that is the case.

Summary

To achieve its purpose, many tasks must be undertaken in any system of scholarly publishing. These include creation of knowledge in the first place, to a review of its quality and an assignment of its relevance. The knowledge must then be formatted and made searchable, and creator assignment to its constituent parts must be provided. Each of these tasks has costs, and each is related to the others. Not surprisingly, therefore, numerous constellations of task choices that must be made play distinct roles as to whether the system's purpose is achieved. We review those constellations, or models, next.

Chapter 4: The Models

What molds tasks into purpose is a model, and we evaluate models based on how well they achieve their purpose. Scholarly publishing includes a variety of models. The most talked about is a commercial model wherein the publishers themselves are motivated by profit. However, much of academic publishing is operated by non-profits—associations formed to foster the common interests of academics. But what of other models? What of hybrid or open-access approaches that preserve, say, for-profit publishing while at the same time regulating some of the choices those publishers can make? And what of publishing models that complete most of the tasks listed in the previous chapter by taking a decentralized approach without mediating platforms? In this chapter, I examine these models in order to describe their differences and how well they are likely to achieve the purposes outlined in Chapter 2. I will also examine whether new models can lead

to a dissipation of the market power of traditional publishers. In subsequent chapters, I will then review studies of these models to see how well theory has translated into practice.

A Framework

While scholarly publishing is a system beyond the journal, for our purposes it is convenient to think of the journal as the platform and the article as the unit of production. A journal is a platform in that it creates the rules by which articles can be included on the platform and also creates conditions by which articles are matched with readers. Journals incur costs associated with both certification and the dissemination of knowledge. Those costs must be paid for by somebody.

Also, part of the mix are agents—specifically, authors and readers. Authors face costs associated with producing articles and, and they face even higher costs for producing articles that meet more stringent conditions. However, authors also benefit from their articles being read as widely as possible. Being "read" is somewhat of a euphemism for the impact of their work. Readers face costs in reading articles and derive benefits from them if those articles are true and important. The problem readers face is that they must incur some reading costs before finding out whether an article is of value to them. Therefore, any help they can receive in signaling that value is important.

Journals who do not attract readers will not attract authors and vice versa. However, someone must pay for journal costs, and this generates a tension and a distinction between alternative models that can underlie a journal. Interestingly, the choice of quality standards for a journal will determine its value to both readers and to authors as well. If there is no quality standard, readers will not receive a value signal from the journal, and few would read it. Likewise, few authors would publish in a journal with no quality standards. By contrast, if the standard is set too high, there may be many readers but only a few published articles. Somewhere in the middle is an optimal quality standard that maximizes the sum of value received by readers and authors. We will consider here how the chosen standard deviates from the optimal one.

An Optimal System

Before turning to the models, let's consider what an optimal system might look like. First, note that authors want to be published and see their research widely disseminated. Second, note that a constraint on that dissemination is the attention of readers. If readers have a given amount of time to devote to consuming knowledge, then what readers want to do is consume only the relevant knowledge. Consequently, when a journal operates well, it can sort among the articles it could publish, culling inferior articles and publishing only the highly-ranked ones. Then, of those articles published, readers' attention should be fully absorbed.

Two factors will lower readers' ability to absorb all the articles published. First, if there is a price on accessing those articles, readers will allocate less attention to reading them. Second, if more articles are published than readers can give attention to, readers must incur costs in finding those they want to read. This will also absorb some of their attention. This suggests that, from the readers' perspective, they will value the service more if it does not put a price on reading and does not divert them from reading the information they seek. Any given author will want their article to be published and read. However, as there is a constraint in terms of reader attention, then, in aggregate, author value will be maximized if the best articles are published. Any article published that is not read when it should be represents a social loss.

This suggests that, from a social perspective, subject to the constraints of actually covering costs, most journals will want to maximize readership. This means providing as low a price as possible to readers and having a stringent quality requirement that allows readers to minimize time allocated to searching.

Non-Profit

The earliest model for the scholarly journal was as a journal published by a scientific association. For instance, the United Kingdom's Royal Society published the first scientific journal, *Philosophical Transactions,* in

1665. The Royal Society now has a suite of journals, but more importantly, most scholarly societies have followed their lead.

The goal of these associations is typically not to make a profit from journals but instead to merely cover their costs. However, if profit is not their goal, what is the aim of the journal? For instance, a journal may be published for the benefits of their members as readers. Alternatively, it may be published to have a broader impact—loosely for the benefits of their members as authors. Finally, it may be a means of generating income to cover costs elsewhere in the association. Many will include a mix of these objectives, but it helps to see how the two extreme objectives would impact the model for a journal.

Consider a journal that maximizes benefits for its readers. Recall that those readers want their journal to have certification standards that minimize their costs of searching, but they also do not want to pay to access the journal. Thus, what is termed *open access* (where readers do not pay to access a journal) is a likely publishing model for this type of association. However, those associations do tend to charge their members for journal access, and in some cases, explicitly more (i.e., when journal subscriptions are not bundled in association fees). The likely reason for this is that the association needs to recover journal costs. If it does not recover the costs from readers, it probably needs to recover them from authors—through submission fees and perhaps publication fees. However, if the costs of supplying the journal to readers exceeds the amount that authors are willing to pay for submission, the journal may not receive sufficient content. This, in turn, would not be in readers' interests. Consequently, such an association will require readers to pay some amount to ensure that budget constraints are met.

There is an interesting consequence of a model that requires readers to pay.[40] The association wants to maximize reader benefits.

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[40] This consequence and many of the conclusions of this chapter are drawn from Doh-Shin Jeon and Jean-Charles Rochet, "The Pricing of Academic Journals: A Two-Sided Market Perspective," *American Economic Journal: Microeconomics*, 2 (2), May 2010, pp. 222–255. Other papers also generate some of these same effects. For example, see Mark McCabe and Christopher Snyder (2007), "Academic Journal Prices in a Digital Age: A Two-Sided-Market Model," *The B. E. Journal in Economic Analysis & Policy* (Contributions), vol. 7, no. 1, article 2; ark McCabe and Christopher Snyder (2005), "Open Access and Academic Journal Quality," *American Economic*

Typically, this means they desire more readers. Different readers have distinct incentives for becoming part of the association and subscribing to the journal. This in turn means that there will be a reader who is indifferent—"on the fence" between subscribing and not subscribing to the journal. If that reader must pay to subscribe, they will need an additional benefit to induce them to do so. A good candidate for that benefit is providing a more stringent quality or certification standard to ensure that reader's search costs are minimized. Thus, the more an association requires readers to pay for access to the journal, the more likely it is that the association will impose more stringent quality standards. This will become important when we consider models based on open access below.

What would happen if a journal wanted to maximize impact rather than just maximizing the benefits of readers who happened to be members of the association? In this situation, it would not want to impose any fees on readers and would likely therefore choose to recover costs from association members in other ways. It would also favor imposing fees on authors as much as possible. Given that those authors prefer impact, more readers would allow incurring the fees. In this case, however, the marginal reader is not necessarily a member of the association. Consequently, in the absence of a payment, the association does not have to impose as stringent quality standard—in effect, passing on more of the search costs to readers.

In summary, we see that non-profit associations forced to recover the costs of a journal from readers will likely end up choosing a higher quality standard. As the costs of producing a journal fall (perhaps due to electronic rather than physical distribution), it is likely that reader fees will decrease, and associations—regardless of their precise objective—will be able to relax quality standards as they are no longer required to induce readers to pay those fees.

Review Papers and Proceedings, vol. 95, no. 2, pp. 453-458; and Mark Armstrong (2015), "Opening Access to Research," *The Economic Journal*, *125*(586), F1–F30. http://doi.org/10.1111/ecoj.12254

Commercial

While scholarly publishing had its origins in non-profit associations, today a large share of scholarly journals is operated by for-profit, commercial companies. Consequently, their fees are not constrained. The question then becomes, where will those journals choose to make their profits—from authors, readers, or both? If the willingness or ability of authors to pay is constrained, then, as was the case for non-profit associations, commercial journals will look to reader fees to gain higher revenues.

Let's consider the reader side of the revenue equation first. The reason for starting there is obvious: The current concern about the market power of commercial scholarly publishers arose partly because of the high fees charged to libraries.[41] Thus far, I have not made a distinction between reader fees paid by individual readers themselves as opposed to fees paid by organizations of whom they are a part. While institutional fees exist within scholarly associations, they are not necessarily considered the primary revenue source. Commercial publishers, on the other hand, appear to have focused almost exclusively on institutional subscriptions. Consequently, one must consider carefully why an institution might have a different demand profile from a collection of readers within that institution.

The issue pertains to what is being purchased. To date, the discussion has been in terms of reading. We have readers with a fixed attention span, and they consume scholarly publications. While this is true, scholarly publications also have what we should call an *option value*. When searching for existing knowledge as part of a productive undertaking (such as academic research), what is of value is not necessarily any specific article or even journal but instead the stock of knowledge to which you have access. So, while an individual might subscribe to journals to own them and access them on their own terms, an institution provides subscription services for its entire constituency. The value of the option to all institution members in aggregate drives the demand by institutions for a journal subscription. In other words, any one of us can think of articles that we have found so valuable that we would pay hundreds of dollars for access to them. However, before

[41] For scholarly societies, library sales may also make up a large share of their revenue.

purchasing an article, we must find that article out of a forest of others. Thus, the value of the forest is the option value of articles we may want to find within it.

For this reason, the option demand of individuals is pooled to become the option demand of a larger group. The institutional subscription allows any member of that group "all you can eat" access to the journal. Moreover, because searching involves failures—reading articles that turn out to be less valuable before finding the valuable gem—thinking about a "pay as you go" approach invariably puts strain on the search process and undermines its value.

In this regard, the value to an institution is the value all of its members place on optional access to the library. In other words, an institutional subscription builds into the very same rationale for the library itself—pooled access to knowledge in the face of uncertainty over the needs of any one individual. Add to that the notion that these days all that is needed is digital access, absolving libraries from the need to house physical copies, on a per user basis, it is easy to see why there is a substantial willingness to pay for such access.

Herein lies the possibility facing a commercial journal publisher. It can increase its prices up to that institutional willingness to pay for access, precisely because articles have an option value such that willingness to pay can be very large. For normal economic goods, making one more unit available usually involves diminished marginal value. But for goods like scholarly journals, an additional article does not diminish the value of other articles in the library, while at the same time it makes the option value over the entire set (driven by the likelihood of finding some useful knowledge) that much larger.

The possibility of earning large revenues from institutional subscriptions makes it imperative that commercial publishers secure the highest-quality articles for their journals.[42] Only by doing so can they make the case for continuing subscriptions. This means that as journals compete for those articles, they will want to make submission and publication by authors as low cost as possible—not only low cost or even free, but also offering other services that may attract the authors. Thus, we have a rationale for why the balance of revenue

[42] As demonstrated by Jeon and Rochet, *op.cit.*

comes predominantly from readers rather than from authors for commercial publications.

Interestingly, because articles themselves represent a "competitive bottleneck," competition among journal publishers is unlikely to have a big impact on the prices of institutional subscriptions. The idea is that, having secured an article, libraries cannot access that precise, same article from other sources. Thus, a journal becomes an effective monopolist over access to that content and can exercise its monopolistic power accordingly.[43] It is not a pure monopoly, however, as publishers need to make competitive investments to secure authors, but from the library's perspective, it will not look much different.

Why can a publisher become a competitive bottleneck? This occurs for any type of publisher, but only for commercial publishers does the exercise of that monopolistic power loom large. Under some kinds of open-access rules, the ability to exercise monopolistic power is diminished—as I will discuss below. But even absent these powers, a combination of factors confer a bottleneck on those publishers. First, copyright laws restrict copying by others. Publishers secure copyrights, and authors give exclusive licensing to those rights. Why authors do so is another matter, but so long as they do, no one else can publish that material. Second, the actual content in those articles is prevented from being duplicated by some key norms in scientific discourse; namely, that authors are not supposed to publish the same knowledge in two places claiming to be the original source. The reason for this is to prevent them from receiving credit twice. However, as a consequence, each article is, by design, highly differentiated in what it can offer compared to all other articles. Thus, the combination of copyright exclusivity and scientific norms serves to make the article a source for knowledge that cannot be easily bypassed.

These factors can become more intense when one considers that over time a journal's market power can grow. The power a journal publisher has comes from its exclusive provision of particular knowledge (i.e., articles). Over time, it has increasingly more of this power. This means that, over time, it can charge increasingly more to

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[43] For a longer discussion, see Armstrong, Mark. (2015). Opening Access to Research. *The Economic Journal*, *125*(586), F1–F30. http://doi.org/10.1111/ecoj.12254

readers. Recently, McCabe and Snyder investigated the possibility that this might lead to subscription fees that are excessively high, even from a commercial publisher's perspective.[44] They note that because authors prefer impact and lower subscription fees for readers, once their article is placed in the journal, the journal is not constrained to maintaining low fees. Once the articles are there, they need not be attracted again. But anticipating this, authors may shy away from publishing in such journals. This will, in turn, make it difficult for journals to charge higher subscription fees. Journals face a Catch-22 situation in which they cannot commit to reasonable subscription fees and therefore cannot attract scholarly content, which in turn limits their ability to charge sufficient fees to be profitable. McCabe and Snyder see open access as a crude way of circumventing this dilemma; something I'll discuss further below.

In summary, because commercial academic publishers can make a profit, they will strive to do so, and they will likely earn part of higher profits from higher journal prices. The best potential for those higher prices comes from the reader side rather than the author side, because the authors generating the product can create the highest returns—so publishers establish low author costs, or no author costs, to encourage those authors. Moreover, for various reasons, competition among publishers will not check higher prices even though competition will manifest itself in other ways. The result is not necessarily a lower-quality product nor one that fails to adhere to the broader scientific norms or that differs in terms of reliance on peer review to hold standards and guide what gets published. In fact, in many respects, it is surprising how similar the end products are despite very different organizational goals among various institutions.

Open Access

We have seen that, regardless of their goals, unregulated journal publishers will tend to collect fees from the reader side of the market

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[44] Mark McCabe and Christopher Snyder (2016), "Open Access as a Crude Solution to a Hold-Up Problem in the Two-Sided Market for Academic Journals," *Working Paper*, No.22220, NBER.

and will exclude those who have not paid those fees for accessing the knowledge. The open-access movement, whose history was recounted in Chapter 1,[45] has focused on the exclusionary aspect that arises from journal subscription and access fees. In particular, it tends to exclude lay readers, reading and scanning by machines (e.g., for the purposes of building a search engine), and also researchers in poorer regions and universities. As noted earlier, such exclusion is an issue not only to the extent that units of knowledge cannot be disseminated everywhere they might be used, but also because that knowledge cannot be searched in order to find useful knowledge. A typical journal publisher might charge, say, $35 to access a particular article. However, while someone in need of that article might be willing to pay for it, someone who wants to merely search the article text when it is unlikely that it will contain what they need will have a much lower willingness to pay.

Open access has a variety of forms. For instance, *gold* open access refers to a model whereby the journal's papers are freely available, and author fees fund the journal. I already explained how this model may impact the quality standards of a journal and why it may not be favored by commercial publishers. Below, I will consider what happens when journals are regulated to allow such gold open access.

While gold open-access journals have become more common, many traditional publishers have taken a hybrid approach whereby open access is decided at the article (not the journal) level. Under *hybrid* open access, journals give authors the option of publishing their paper and having no access fees imposed on it for any potential reader. This is an option they can exercise if they pay for publication. The question is, will an author pay for publication?

Note that if a library already has a subscription to the journal (and its back catalog) in which the article is published, then when authors pay it is likely not for other researchers to access the article but for others outside of the research community. However, scholarly authors normally place most weight on the use of their article by their peers. Thus, if their peers are likely to have access, then authors are unlikely to pay for additional access by others.

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[45] See also Armstrong, *op.cit.*, and the comprehensive book by Peter Suber, *Open Access*, MIT Press: Cambridge (MA), 2012.

What if an author is required to exercise open-access options? For instance, this might arise if the author's research was funded by an organization that made this a requirement (and possibly included funds for such payments). In this case, the author will pay for open access, and that article will then be freely available. This is valuable to readers who know they want to read that article. However, it is of little value to people who are searching for knowledge (an article that is freely available does not make the search process much easier). It is also of little or perhaps no value to libraries and others paying for access. In principle, every time an author pays for open access, reader-side fees should fall. The additional revenue will allow not-for-profit publishers to reduce other charges, but commercial publishers have no economic forces that will drive such price reductions. Recall that they can charge for access to all articles in a journal. If only a fraction is freely available, institutions will pay for access to the others. If library budgets are fixed, then nothing has changed and a journal publisher need not reduce the prices they charge institutions. It is only when most articles (including the back catalog) become freely available that institutions will be willing to discard subscription access and some pricing pressure can be applied.

The above analysis considers author decisions when they can opt in to open access at an article level. Of course, some calls for regulation of scholarly publishing have suggested that entire journals be made gold open access while some non-profit associations have opted for precisely this model (e.g., the *PLOS* set of journals).[46] Aside from the special difficulty regarding back catalogs (something I will return to in Chapter 5), this amounts to a regulation that reader-side fees be set at zero but that author publishing fees remain otherwise unregulated. What will likely happen under journal-level gold open access?

The first and most obvious effect is that authors may be less willing to publish in a journal. This depends on several factors including the price the journal is charging authors, but also on the author's other options. An author with a high-quality paper will likely be able to have it published in an alternative non-open access journal

[46] Some new platforms have offered interesting variants on author payments. For instance, rather than paying by the article, PeerJ (peerj.com) charges $199 for the first submission and then allows you to submit one article per year for the rest of your life. This makes PeerJ more like a publishing club you pay to join.

and, as noted earlier, their incentives to pay for open access itself may be muted. However, this may not be true of an author with a lower-quality paper. For them, the open-access journal may be relatively more attractive—that is, if the journal will publish their paper.

What standard of quality is an open-access journal likely to choose? When readers were paying, as noted earlier, journals had to be concerned about their value and the costs imposed on them for having to sort articles based on their quality. If the journal had a high quality standard, those costs would be reduced and readers would be willing to pay for that function. By contrast, for an open-access journal, the reader value is less and perhaps of no concern. In this case, the journal will have an incentive for relaxing quality. Some of this relaxation may be beneficial as the quality standards may have been too stringent to serve readers who pay rather than the whole corpus of potential readers. But there is also a distinct possibility that a journal that is making money from authors will want more of those paying authors. Specifically, a journal will be willing to relax its quality standards, as it can earn more revenue from authors that way and does not care about the costs this imposes on readers. Of course, this gives authors with high-quality articles even further reason to avoid open-access journals.

Interestingly, while the logic is easy to see for commercial journal publishers—that they may relax quality standards in the pursuit of more revenue—it also applies to some extent to non-profit publishers.[47] Those journals, if they are open access, must recover their publication costs from authors. Thus, their fees will equal those costs but, importantly, they may not care about how high those costs are if their objective remains on the reader-side (through the association or a desire for impact). Moreover, as the pressure to recover costs of publication from readers are reduced, the non-profit can afford to relax quality standards and save on costs that arose from having to assess articles more carefully.

Weaker variants of open access have been proposed instead of its gold variety. One example is *green* open access. This is a situation where a pre-print or working paper (usually non-journal formatted) can be made available elsewhere even after publication in a journal. The supposition here is that such freely available articles will be of lower

[47] Jeon and Rochet, *op.cit.*

quality and perhaps harder to find than published articles. Thus, it is a weaker form of open access, but it potentially mitigates some of the access issues that precipitated the open-access movement. Importantly, green open access moves the role of the journal from reader fees for access to reader fees for access to the published article version.

The extent that green access constrains the fees that journal publishers can charge and the level of value of green access to those who do not pay for journal access are two sides of the same coin. If green access increases the ability of those who do not pay for journal access to receive the value of the journal in other ways, then those who are considering paying for access will be less likely to accept high fees. For a journal that has been more recently founded, green access value to non-payers may be significant. But for a journal with a significant back catalog (that is, a substantial collection of previously published journals), the green access value may not be very significant as most knowledge will be unavailable elsewhere. This is certainly true of pre-digital publications. In addition, the value of green access to non-payers will be contingent upon how easy it is to find articles outside of journals—that is, the ease of searching. Google Scholar is of great assistance, but as time goes on the issue of link rot discussed in the previous chapter may impact green access articles not housed in some permanent repository.

An interesting variant of open access called *delayed* open access involves journals making all articles freely available after some embargo period (say, 12 months). In this situation, journals are effectively charging readers for immediate access but otherwise make their products free. For some non-profits, this has the advantage of providing enough revenue to cover costs. However, as access to the entire searchable stock of knowledge is potentially what is valuable to institutions, we would expect that delayed open access would not be chosen by commercial publishers in the absence of a regulatory constraint.

Open Clubs

Along these lines I want to suggest an alternative open-access arrangement that I will term the *open club*. Clubs are normally closed

entities. They have insiders, and they exclude outsiders from their benefits. I suggest a model for a club that does not exclude outsiders but collects payments from insiders. In effect, this would be a gold open-access journal paid for by the readers (and libraries) who most benefit from the journal's existence, while being free for everyone else (other readers and authors).

This seems both counter-intuitive and potentially impractical, so I must explain how it might work. The starting point is to consider the economics of price discrimination.[48] This is where a supplier charges different prices to different customers based on observations of the group for which they are members (think student or pensioner discounts). In the case of scholarly publishing, the idea would be to charge those groups who have demonstrated their greater willingness to pay for journals and to charge others less, or in this case, nothing at all. So, an open club for scholarly publications would charge institutes of higher education and larger corporations in richer countries (and also law firms for legal scholarship, etc.) while allowing everyone else open access. Indeed, from a technological perspective, everyone can have open access so long as those who intended to pay do so anyway.

The natural objection to this proposal is, why would those institutions pay? To date, practical experiments along these lines such as the Open Library of the Humanities, have attempted to find coalitions of benevolent libraries to fund their activities or, in the case of Knowledge Unlatched, a crowdfunding approach. But, from an economic perspective, a sustainable model requires making it in the self-interest of those we want to pay to actually pay up.

Put simply, price discrimination unravels if those who should pay can masquerade as the group getting the better free deal. In this case, however, the institutions we want to pay are readily identifiable based on their past behavior and with respect to digital access can easily be identified via their IP addresses. Therefore, unless they go to great lengths, they remain excludable because at the moment of attempted access they are already identified as members of the insiders group. Thus, as a practical manner, it is technologically feasible to enforce this pricing rule. The twist is that we must be willing to deny access to the targeted institutions if they do not pay for the journal's activities.

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[48] Technically, third-degree price discrimination or group pricing.

The benefits are obvious. Those institutions would pay what they are paying now, but everyone else who is currently excluded obtains open access. In this regard, the desirable quality of open access—everyone gets access—is achieved without the cost of funding the journal from non-readers. This does not remove issues of market power and the like but, as I have argued, neither really do other forms of open access. Nonetheless, the open club is another possible model: a club for which payments are exclusive and not necessarily tied to the activity.

Distributed

Thus far, all the models considered have been based on the traditional journal publishing model. That is, the product is a journal, which is a package of articles. Consequently, all the journal's services—certification, curation, archiving, dissemination—are provided by a single organization. But what if these services could be separated or distributed among different organizations?

This idea is currently being tried in the form of overlay journals. These are journals that operate almost identically to traditional ones except that the articles are housed in an open repository such as arXiv. arXiv was established in 1991 to hold electronic preprints of scientific papers. As of 2014, it exceeded one million papers in mathematics, physics, computer science, and some other quantitative fields. Apart from some minimalist oversight for ensuring that submissions are relevant for the field with which they are associated and a voluntary endorsement system that allows researchers to endorse papers (akin to a social media "like"), it is a pure repository. The mathematician Grigori Perelman uploaded a proof of the famous Poincare conjecture to arXiv in 2002. It was never submitted to journals for publication, and Perelman was offered the Fields Medal for his effort.[49]

The idea of an overlay journal is that, apart from housing the content in an open repository, the journal reviews submissions and has its own "table of contents" with links to the papers in the repository. Interestingly, once the certification and curation tasks are completed, the journal effectively has no control over anything of value. Thus, it

[49] Perelman refused that award as well as the Clay Mathematics Millennium Prize.

cannot charge readers for access to anything. In principle, it could charge authors, but as Tim Gowers, the Fields Medalist and managing editor of *Discrete Analysis* has posited, that journal is *diamond* access—charging neither readers nor authors.[50] It does have monetary costs (amounting to $10 per submission) but currently absorbs them. Other overlay journals rely on management software that is currently freely available, such as that provided by episciences.org.

These initial forays indicate the potential for a distributed model of publishing whereby different tasks are handled by different organizations. In this case, content hosting and distribution is separated from peer review and curation. But such distributed models could easily go further. Imagine models whereby submissions are not even required, and different editors select and certify content on the repository. Of course, they would have diminished power to negotiate for revisions. The models could also involve new tasks such as post-publication review that considered evolving knowledge in a field. Finally, content housed in open repositories might be reformatted and repackaged into other forms that may allow for innovation in formatting. Access to these reformatted versions may involve some reader payments even if the original content remains openly available. This would ensure that such formatting is of value in itself rather than bundled with access. Finally, there is no reason a single article need reside in a single journal. Overlay journals could have articles that were already "published" and curated elsewhere. This would allow a new layer of competition at the editorial level.

Competition Among Models

As noted earlier, if they publish an article, a journal publisher has the ability to charge readers for access to it indefinitely. Thus, competition among journals is really competition to attract authors and their research. Because authors have their own incentives for providing research and typically are not paid by scholarly journals to publish, this

[50] Ball, Philip, "Leading mathematician launches arXiv 'overlay' journal," *Nature* 526, 146 (01 October 2015) doi:10.1038/nature.2015.18351

means that a journal that is successful in attracting authors can be profitable—even when competing for authors against other journals.[51]

Interestingly, the same cannot be said when gold open-access journals compete. These journals do not charge readers and must, therefore, recover costs from authors. In this case, absent other differentiators, open-access journals will lower submission fees to just cover costs. Hence, competition does eliminate the ability of such journals to earn higher profits. In this sense, open-access requirements do mitigate the adverse consequences of market power if competition is possible.

In reality, traditional journals have (a) an existing stock of content and (b) the right to continue to charge readers rather than be open access. The question, therefore, is whether the entry of new open-access journals mitigates the market power of traditional journals?

In this competitive environment, the open-access journal has one advantage—it can offer a wider readership and, hence, impact authors. Henceforth, it is entirely possible that the "best" research will find its way into the open-access journal, leaving the traditional journal with a lower quality and consequently diminished capacity to charge high reader fees. However, it is also possible that these forces could go the other way. If a traditional journal, through its historical legacy, has a reputation for higher-quality publication, then authors with higher-quality research may still favor those journals over other competitors. In this situation, while the open-access journal provides competition, that competition may be nominal, and the traditional journal may still occupy the top of the quality spectrum and earn commensurate profits. This suggests that historical legacy is an important constraint on the ability of competitive forces to mitigate traditional market power.

Summary

Most academic publishing models in practice are distinguished by their ownership and broad goals and not by where the money comes from—usually from readers or libraries rather than authors or outside parties. However, good social reasons for reducing the burden on

[51] The analysis of this subsection is based on the analysis by McCabe and Snyder, 2016, *op.cit.*

readers—that is, to allow more dissemination of knowledge and offer library-style optional demand broadly—has necessitated a consideration of models that move away from reader-side payments.

That said, it is not clear that piecemeal open access will generate broad improvements in access itself. More critically, open access—to be truly valuable—must be broad-based. In this chapter, I suggested an open-club model that identifies those readers with high willingness to pay and charges only them while providing open access to all others. But the alternative is to drastically move away from some of the most expensive parts of the system—peer review, curation, etc.—and provide repositories and overlay journals that are effectively lean in their operations. By simply reducing costs or, at the very least, unbundling tasks and cost structures, a more favorable basis for *broad-based open access* becomes possible.

Chapter 5: The Activism

Two related factors have engendered active movements calling for change to the system of scholarly publishing. The first is the high price charged by commercial scholarly publishers for access to some journals. The second is the unavailability of scholarly knowledge beyond journals in general. These have led to consequent pressures for reductions in journal prices as well as calls for various forms of open access.

In the previous chapter, it was noted that these concerns have some foundation. High prices by commercial publishers are not checked by competition applied from the reader-side. Moreover, their quality standards weaken the ability of authors to use pressure to reduce reader prices. At the same time, it is not clear whether authors have sufficient incentives to exercise whatever power they might have. A lack of wide access is a consequence of the fact that reader fees exist

at all, which means that journal content resides behind paywalls. While various forms of open access may overcome this, the pressures for widespread open access likely need to come from a broader range of actors.

In this chapter, I will review various instruments that activists looking to change both of these aspects have deployed. I will evaluate their likely success and highlight potential unintended consequences from each.

Boycotts

A vexing issue for economists is how to think about the discipline of power. As stressed by Albert Hirschman,[52] the tendency is to place weight on the discipline of the market—specifically, the withdrawal of services. This is the so-called *exit* option. When consumers are dissatisfied with goods and services, they take their business elsewhere. When employees are dissatisfied with their wages and working conditions, they move to another position. If this happens often enough or by someone important enough, change might occur. Either the organization changes, or it ceases to be. But the use of exiting as a discipline device can itself be weak. It depends on the power of the individual in an individual–organization coalition. If the alternative options open to individuals are themselves poor, then even if they can choose to exit, they have no incentive to do so.

Ample evidence shows the revenues paid to scholarly publishing well exceed the costs. Andrew Odlyzko estimated the average cost to the consumer (namely, libraries) of a published article in 2013 was around $5,000.[53] By contrast, pure electronic journals that did not distribute through a traditional publisher had much lower costs—for some journals, as low as $188.[54] This translated into very high

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[52] Albert O. Hirschman, *Exit, Voice and Loyalty,* Harvard University Press: Cambridge (MA), 1970.

[53] Andrew M. Odlyzko, "Open Access Library and Publisher Competition, and the Evolution of General Commerce," *Evaluation Review*, 39 (1), February 2015, pp. 130–163. doi:10.1177/0193841X13514751

[54] B. D. Edgar and J. Willinsky, "A Survey of Scholarly Journals Using Open Journal Systems," *Scholarly and Research Communication*, vol. 1, no. 2, 2010. Available at http://journals.sfu.ca/src/index.php/src/article/view/24.

subscription costs to institutions, especially from commercial publishers. In the print publishing days, libraries could keep their existing stock of knowledge even if they cancelled a subscription. And, many libraries did cancel subscriptions to journals that were not seeing enough use but had high costs. This was, to some extent, a constraint on publisher pricing.

Digitization has fundamentally changed the landscape. Digital access is more efficient both for access itself and for search, so that it predominates the printed copies for users. Thus, the margin of purchase for libraries is no longer new journal issues but, to some extent, the stock of existing issues that are available digitally. The risk, therefore, is that a library that decides to cancel a subscription may lose access to the entire knowledge stock of that journal and not simply future issues. This could lead them to be vulnerable to ever increasing subscription prices for fear of losing access to past issues.

Fortunately, libraries in negotiations with publishers anticipated these issues and were able to push for various forms of "perpetual access" as a clause in digital subscriptions.[55] These clauses provided some guarantee of access to issues licensed while the agreement was in force should the library choose not to renew the agreement at some time. This mitigated the power that may have accrued to publishers and could allow libraries to continue to cancel individual subscriptions. However, the library may also lose hosting services from the publisher, including search and citation features.

So-called "Big Deals" have complicated this. These deals arise when publishers negotiate with an institution for access to their entire library of journal content. Thus, an institution that had previously subscribed to several of the publisher's individual journals is now offered an "all you can eat" deal to them all. Usually, the average price of a journal under this deal is less than the price of individual journals. The deal also confers the advantage that access to the publisher's platform for search, citation, and other tools is made available. Finally, publishers can engage in price discrimination. Institutions perceived to have a higher willingness to pay for those deals might be charged a

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[55] Mei Zhang and Kristin R. Eschenfelder, "License Analysis of e-Journal Perpetual Access," *The Journal of Academic Librarianship*, 40 (1), January 2014, pp. 62–69.

higher price than those who do not.[56] Significantly, as the deal prices are typically kept confidential, this allows the publisher to discount to poorer institutions without having to pass on the same discount to richer ones. This improves access to knowledge.

The difficulty with Big Deals is that they make it much harder for an institution to exit the deal. Institutions are incentivized not to worry about marginal costs of another journal subscription and instead think of the value of access to the bundle. Consequently, as time goes on, losing that access may involve much higher costs, especially as libraries are reconfigured and, importantly, as the work habits of researchers evolve. In other words, a cloak of secrecy and a bundle come alongside a weakening of the power of threats of exiting to constrain prices.

Big Deals also make it harder for groups of libraries to coordinate boycotts and exert collective pressure on publishers. These deals tend to be multi-year, and different libraries will have different renewal dates. In some cases, libraries—such as those in The Netherlands—negotiate deals as a group and can overcome this. But for most, joining a boycott simply is not feasible.

In sum, consumer exit in its various forms does not represent a very large constraint on the power scholarly publishers have because of their exclusive access to specific knowledge. Digitization has only enhanced that power, even if it has also provided some scope for more access to be negotiated with smaller and poorer libraries.

Strikes

Of course, demand-side exit is not the only form of market discipline. As scholarly journals rely on the work of academics—for articles themselves, through to editing and refereeing—the withdrawal of that labor can potentially be an important option. The idea is that by switching away from high-priced publishers to launching or supporting journals with low prices or open access, new research will

[56] There is substantial heterogeneity among libraries in what they pay for these deals. However, studies of these outcomes have not identified patterns consistent with usual assumptions of willingness to pay; it is likely a difference in negotiating ability. See Theodore C. Bergstrom, Paul N. Courant, R. Preston McAfee, and Michael A. Williams, "Evaluating big deal journal bundles," PNAS 2014 111 (26) 9425–9430; published ahead of print June 16, 2014, doi:10.1073/pnas.1403006111.

be made available outside of the incumbent models. If it is effective, the incumbents will lose future journal content.

A strike or withdrawal of labor in a coordinated fashion can certainly change the model without the permission of current incumbents. This might be done by academic authors but calls for the withdrawal of labor included for refereeing and editorial services. In some cases, entire editorial boards have left the journals of commercial publishers.

However, this change would only open up future knowledge, while access to past knowledge remains in the control of those incumbents. Nonetheless, this could cause financial damage to current incumbents should libraries and other institutions cancel subscriptions because of this. They can potentially do this if they have reliable perpetual access. Otherwise, for reasons discussed above, even a drop in quality for future issues may not cause subscriptions to be cancelled. Similarly, if libraries have Big Deals, a drop in quality because of a withdrawal of labor would not necessarily have a consequent impact on the publishers' revenues.

If conditions are not favorable to a library response, the exit of editors, referees, and authors may give rise to unintended consequences. Such labor is given freely because of the likely impact of the journal. However, if a journal is priced so high that it is distributed narrowly, that labor may not be forthcoming. A publisher, therefore, is constrained in the normal course of events to ensure prices are not so high that distribution is curtailed. This means that should a strike take place, publishers may no longer feel so constrained and may increase the price of access to the back catalog of the journal. Thus, exiting may lead to precisely the opposite result than that intended by the strikers.

This means that exits may represent a short-term wakeup call to publishers, but if exiting becomes widespread—effectively shutting existing publishers out of the process—they may act in a manner befitting their monopoly. For libraries that have acted to ensure preservation in contracts, this is not an issue. For others, a long-term, widespread exit may not be a panacea.

Voice

As an alternative to exiting, Hirschman posited the use of voice to address grievances with a firm. In this situation, consumers or suppliers would express their dissatisfaction by raising a voice to issues while continuing to remain with or to purchase from an organization. Voice is not without its own challenges. It is costly to those complaining. Moreover, unless it can be backed up by some threat, it is likely to be vacuous. Thus, when genuine dissatisfaction will likely result in an exit if not addressed, voice will have its most power.

While there have been prominent examples of exits (especially supply-side exits) in scholarly publishing of late, it seems fair to say that most changes—from changes in journal prices to new open-access options—have come because of voice. For instance, editors of the *American Journal of Physical Anthropology* were able to convince their publisher, Wiley, to reduce the 2001 price of the journal from $2085 to $1390. Similarly, in 2015, the Dutch government convinced Elsevier to implement a range of open-access options for Dutch researchers.[57]

This suggests that voice backed up by an exit option may be a promising strategy for activism. However, part of its use comes in accepting more incremental change in scholarly publishing—a goal that may not be sufficient for all activists.

Regulation

In relation to open access, some funding agencies have moved to require that all peer-reviewed and published papers arising out of research they have funded be deposited in a public repository within a year of publication. For instance, the National Institutes of Health (NIH) require that all their funded research be placed in the PubMed repository. The private Wellcome Trust and the Bill & Melinda Gates Foundation have similar policies and also provide additional funding to pay for fees associated with gold open access. Universities such as Harvard have enacted similar policies that have promoted green access.

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[57] Declan Butler, "Dutch lead European push to flip journals to open access," *Nature*, 6 January 2016, http://www.nature.com/news/dutch-lead-european-push-to-flip-journals-to-open-access-1.19111

These policies represent an extension of broader mandates from public and philanthropic funders interested in the broad impact of research they fund rather than other motives such as commercial profitability. Because much research relies on such funding, the disclosure policies of the funders are an effective regulatory instrument.[58] Moreover, unlike restrictions on commercial exploitation of research, open access policies are unlikely to change the mix of funding sources for researchers, as their interests are broadly aligned with achieving greater impact.

However, as with all regulations, there are potential costs. In this case, mandates to require and fund open access can be potentially expensive. Gold open access fees differ among publishers but can reach significant amounts of many thousands of dollars. Thus, this will likely diminish the amount of funds that can be allocated to research activities. Unless the open access fees are themselves regulated—for instance, funding for them is capped— their level will be dictated by the market power of publishers—something that we have already argued can be significant.

This is reflected in a recent study commissioned by the Mellon Foundation examined the costs to US Universities if there were a complete switch to gold open access.[59] Interestingly, the study found that prices paid by research-intensive universities would exceed the amount they currently pay for journal subscriptions (while the opposite is true for less research-intensive institutions). While this is unsurprising, the baseline issue in evaluating a flipped model is the underlying costs of journals rather than estimates based on the prices journals have been able to charge. If legacy publications must be compensated for lost subscription fees from open access, the flipped model quickly becomes financially unattractive.

A potentially better approach would be for foundations themselves to fund green open access repositories and insist on those requirements of their grant recipients.[60] In this way, they can afford unregulated fees to publishers while still achieving their ends in terms

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[58] Joshua S. Gans and Fiona Murray, "Funding Scientific Knowledge: Selection, Disclosure and the Public-Private Portfolio," *Rate and Direction of Inventive Activity*, J. Lerner and S. Stern (eds), NBER, 2012, Chapter 1.

[59] "Pay It Forward," June 30, 2016.

[60] This is something the Wellcome Trust has made significant moves toward.

of impact. While this itself could be costly, if foundations and government agencies were to get together, these repositories could be funded economically.

Copyright

Publishers are protected by copyright laws. In most cases, publishers require authors to reassign copyrights to publishers or to grant them an exclusive license to their work. In some situations (e.g., the UK), governments have restricted such reassignment and instead copyrights lie with the government for research by public employees. For everyone else, publishers usually require at least an exclusive license to publish the work in all its forms.

This sometimes applies for open-access journals and not just other publications. If your copyright is reassigned to an open-access journal, that journal could change its policy and become closed access. This happened when the open-access economics journals of the Berkeley Electronic Press were sold to de Gruyter.[61] The new publisher did not intend to make the existing and future articles open access and, thus, authors who had submitted on that basis were left without recourse. Had copyrights not been reassigned or if there had not been an exclusive license, this change would have been a minor issue but not a substantial one. Existing journals could have been reconstituted outside of the de Gruyter paywall. Of course, in that situation, it is unlikely that de Gruyter would have bought those journals.

Why, then, do authors sign away their rights? The obvious answer is that publishers will refuse to publish their work unless they do so. However, when they are backed by a significant funder, the bargaining power shifts, and such refusal may be possible.

That said, conventions and options aside, it is useful to reflect on whether it is important for publishers to hold those rights. Their rationale is that they will invest in the article and disseminate it and do not want that ability undermined by having the article copied. In other words, publishers incur costs and want to recoup those costs. The

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61 http://www.digitopoly.org/2012/01/26/berkeley-electronic-press-closes-up-journals/

simple logic is that if they could not prevent copying, they could not recoup those costs.

But is that logic correct? Publishers invest in formatting, searching, and hosting infrastructure. If an article is deposited elsewhere, whatever benefits users obtain from those investments by the publisher are lost. Hence, they would be willing to pay for access to the value provided by them. A lack of copyright protection is not an issue then, unless others can outperform publishers in those dimensions, in which case publishers do not deserve to have such costs recouped.

What of expenses associated with editing and reviewing publications? The certification provided by this can be copied when an article is deposited elsewhere, and the costs associated with these will not be recouped. Recall, however, that the bulk of those costs are provided by editors and peer reviewers who are typically not compensated. Thus, there is an argument that the costs incurred directly by the publisher are not substantial in this case. Once again, the argument for recoupment is weak.

This implies that, while copyrights are certainly valuable for publishers (as it gives them a monopolistic position), it is far from clear that they are necessary for the system to operate. Indeed, if what publishers do is valuable, users will be willing to pay for access to it. In this situation, a lack of copyright protection may assist in disciplining the market power of publishers.

This suggests that an appropriate type of activism would be for scholars not to sign away copyrights but instead to offer an exclusive license for a period of time. Moreover, that period is unlikely to be the many decades inherent in many copyright lengths around the world. Instead, the license might be for a more limited duration: 10, 5, or even 1 year. This would then allow the possibility of eroding the market power of publishers over time.

Piracy

Another form of activism comes from the unauthorized posting of articles online. This may have been at the heart of Aaron Swartz's JSTOR downloading. Posting articles online without the permission of the copyright holder is a form of what is termed "piracy." Not

surprisingly, commercial publishers have been aggressive in trying to prevent this kind of activity and actively search the Internet for violators.

Perhaps the most ambitious version of this comes from Sci-Hub. Sci-Hub was created by a Kazakhstan researcher, Alexandra Elbakyan, in 2011. This website bypasses journals by providing access to nearly every scientific paper published.[62] The way it works is that when someone searches for a paper, Sci-Hub first checks whether it is available on LibGen (a database of pirated content) and, if the paper is not there, it bypasses journal paywalls using access keys donated by academics at subscribing institutions. In effect, this search mechanism opens all papers to anyone with no payment required. There were 19 million Sci-Hub visitors between 2011 and 2015.

Sci-Hub is a not for-profit entity that runs on donations. It likely violates copyright laws, but Elbakyan's motives are activist based. She wants anyone to have access to the scholarly articles. Elsevier has filed suit in the US against the site, but it is far from clear that even with a likely positive verdict, Elsevier can close down the activity.

This type of reaction happened in music, video, software, and all manner of digital content. It is not surprising, therefore, that it was used as a tool of activism. In those other markets, piracy did constrain the business model of copyright holders. Interestingly, while there is widespread use of the site, it is far from clear that harm to publishers has occurred in the form of cancelled subscriptions because the site exists. Larger institutions in richer countries already pay for access and are likely to continue to do so rather than authorize the use of unauthorized material.

Summary

Activists have taken important actions that have highlighted publisher market power, high prices, and diminished access. However, their activities have been most directed at exiting—that is, withdrawing participation as consumers and as suppliers. In some cases, when this has been coordinated, it has been effective. But it has also been costly

[62] Simon Oxenham, "Meet the Robin Hood of Science," Big Think, 11 February 2016, http://bigthink.com/neurobonkers/a-pirate-bay-for-science

and, hence, not widespread. Moreover, it is far from clear that most academics are willing to incur the real costs associated with exiting. Therefore, such moves have had a limited effect.

Voice has probably had some effect in constraining even worse behavior from publishers, although this is hard to assess. Instead, third-party pressure—from funders and institutions—has led to important moves toward open access. Interestingly, pushes for gold open access are, for reasons I outlined in the previous chapter, unlikely to lead to more access and instead may prove beneficial to publisher profits. Green open access, on the other hand, has more potential to free up knowledge and is a demand that publishers seem far more willing to acquiesce to. This is because such behavior opens up access but does not, at least in the short-term, impact negatively on publisher profits. The same moves could be conducted with regard to copyright, which at least unlocks the possibility that others may provide the knowledge stock in the future. That said, despite now decades of activism, there is little to show for it. This suggests that a more carefully planned evolution, rather than a big-bang revolution, is required.

Chapter 6: The Evidence

Much of the discussion of what goes on in scholarly publication and what should be done about it is theoretical. While there are logical reasons why publishers might have market power and why they may charge prices that harm the dissemination of knowledge, this does not mean that those effects are borne out in reality. Moreover, even if they are, we need to know whether those effects are of sufficient magnitude to cause us to change how scholarly publishing is organized.

With this in mind, this chapter turns to consider the research many social scientists, including economists, have conducted to evaluate how scholarly publishing operates and the impact that changes to the model, notably open access, have on knowledge dissemination. As will be shown, while some of the effects discussed thus far do emerge, it is far from clear how significant they are.

Publisher Market Power

Once an article is published, its publisher effectively has a monopoly over access to that article. To access a particular article, a whole-journal subscription must often be purchased. Thus, it is predicted that publishers, especially those motivated by profit, will charge high prices for that access. Moreover, if they raise prices, they will not see a large reduction in subscribers. In other words, journal demand will tend to be price inelastic.

Determining this is a little tricky, however, as most journal demand comes from libraries, and libraries have fixed budgets. Thus, if a journal increases its price, it may not see a reduction in demand if it is highly ranked, but that action may cause a reduction in demand for other lower-ranked journals.[63] Interestingly, this can mean that if journals are owned by a common publisher and are sold as a bundle, there is an incentive for publishers to price a little lower than they might otherwise. In fact, this appears to be the case in empirical research using journal prices paid by libraries in the state of Georgia from 1988–2000.[64] Nonetheless, higher-quality journals still command higher prices. In addition, for-profit journal prices are three times those of other publishers.[65] And the multiples were even higher for Big-Deal bundles.[66]

In summary, the empirical literature confirms that journals are relatively price inelastic but that nuances constrain somewhat the exercise of market power by publishers. That said, the fact that commercial publishers charge so much more than scientific societies

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[63] Nevo, Aviv, Daniel L. Rubinfeld, and Mark McCabe. 2005. "Academic Journal Pricing and the Demand of Libraries." *The American Economic Review* 95 (2). American Economic Association: 447–52. http://www.jstor.org/stable/4132863.

[64] Mark McCabe, Aviv Nevo, and Daniel Rubinfeld, "The Pricing of Academic Journals," Revised Working Paper, November 2008.

[65] Dewatripont, Mathias, Victor Ginsburgh, Patrick Legros, and Alexis Walckiers. 2007. "Pricing of Scientific Journals and Market Power." *Journal of the European Economic Association* 5 (2/3). [Wiley, European Economic Association]: 400–410. http://www.jstor.org/stable/40005044.

[66] Theodore C. Bergstrom, Paul N. Courant, R. Preston McAfee, and Michael A. Williams (2014), "Evaluating big deal journal bundles," *PNAS*, 111 (26), pp. 9425–9430; doi:10.1073/pnas.1403006111.

suggests that market power is present and, therefore, there is potential for exploitation.

Online Benefits

One of the main reasons that scholarly publishing is being reexamined is the impact of digitization and with it the posting of scholarly content online. The obvious supposition is that online distribution will increase dissemination and impact. The major question is, by how much?

In 2001, one study examined medical journal articles posted online between 1995 and 2000 and found a 54% increase in citations for articles in online versus print journals.[67] Another study examined papers in conference proceedings in computer science and related fields that went online and found an extremely large effect: a 336% increase in citations on average (the median increase was also a large 158%).[68] The problem, however, was that this might reflect a bias in the selection of which articles were to be posted online—namely, the best ones.

Very few studies control properly for these biases in terms of quality and in terms of time (citations to papers change over time and technological distribution impacts citations). An exception is a study by Mark McCabe and Chris Snyder of 100 economics and business journals.[69] In their data, without considering quality, online distribution shows between a 300% and 500% increase in citations consistent with earlier studies. However, once quality and time effects are taken into account, the impact falls to 0.

Focusing on averages, however, masks some heterogeneity. McCabe and Snyder look at the impacts of going online with different platforms. For instance, they find the zero-online effect occurs for some platforms including Elsevier's ScienceDirect. However, for others such as JSTOR, there is a significant positive effect (around

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[67] Curti, M., V. Pistotti, G. Gabutti, and C. Klersy, "Impact Factor and Electronic Versions of Biomedical Scientific Journals," *Haematologica* 86 (2001), 1015–1020.

[68] Lawrence, Steve (2001), "Free Online Availability Substantially Increases a Paper's Impact," *Nature* 411, 521.

[69] Mark J. McCabe and Christopher M. Snyder (2015), "Does Online Availability Increase Citations? Theory and Evidence from a Panel of Economics and Business Journals," *Review of Economics and Statistics*, 97 (1), pp. 144–165.

10%). One of the reasons for that is likely that JSTOR has a higher fraction of older articles online that may be hard to locate without online access. Drilling into JSTOR further, the researchers found that online access helped authors from English-speaking countries and not non-English-speaking, European authors. The lack of a positive JSTOR effect seems instead to be due to greater reliance on national journals not represented in JSTOR by scholars in the non-English-speaking West. This may be because of different journal selection by authors who moved away from some of those journals housed in JSTOR. That is, when published from a developing country in a JSTOR journal, online access of citations was almost twice as large as that for, say, authors from the US. The study did not reveal any difference between widely read papers and those that might be considered in the "long tail"—something that stands in contrast to effects noted in e-commerce.

Impact of Open Access

Like online access, open access that allows anyone to read articles for free is intended to increase knowledge dissemination. Considering the evidence on online access, care must be taken to ensure that bias does not distort measures of impact such as those on citations. For instance, under gold open access, authors pay to make their articles openly available. In theory, we would expect authors to incur the costs of open access if they believe their article will have a higher impact. Thus, this may introduce a quality bias in terms of which articles are open access, and hence distort upward the measured impact of open access that does not consider such bias.

In the absence of such controls, the effect of open access on impact measures such as citations is measurably large. For instance, one study of physics articles where some were self-archived on the repository arXiv measured 298% more citations for those articles.[70] Another in oceanography found 280% more citations for articles

[70] Harnad, Steven and Tim Brody. (2004) "Comparing the Impact of Open Access (OA) vs. Non-OA Articles in the Same Journals," *D-Lib Magazine*, 10 (6).

where authors paid for open access.[71] In each of these cases, there is a plausible theory as to why self-archiving high-quality articles or paying open-access fees might introduce selection bias into these measures.

One recent study considered selection effects for high-quality papers and confirmed that, in fact, the impact of open access on citations was relatively low.[72] This was especially the case when pre-prints of published articles were available openly. They used the timing of article submission to take into account the possibility that at the end of fiscal year grant money would need to be spent under "use it or lose it" policies. The idea being that authors of articles published then were more likely to opt for paid open access, and so selection bias would be reduced.

Another study used a similar experimental procedure—or natural experiment—to examine the impact of open access as the working papers of institutions were released onto the Social Science Research Network.[73] This happened in a random way as institutions joined the network and offered their working papers. Some of these articles were already published in journals, so this was a move toward effective open access. This research found that open access increased citations by 10%, with larger effects for articles published in lower-tiered journals and for those citing scholars from low-income countries.

Of course, while citations of journal publications by other journal publications is a measure of impact, what is perhaps a more significant measure of impact is how the research influences applications arising from science. A study by Kevin Bryan and Yasin Ozcan[74] found that open access in medical journals increased citations of those articles between 25% to 51% in patent applications. To identify this effect, they used the open-access mandate from the National Institutes of Health (NIH) in the US that required all funded research to be made available in the public repository, PubMed, within 12 months of publication. While compliance with the mandate was imperfect, there

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71 Walker, Thomas. (2004) "Open Access by the Article: An Idea Whose Time Has Come?" *Nature Web Focus*, April 15.

72 Patrick Gaule and Nicolas Maistre (2011), "Getting cited: Does open access help?" *Research Policy,* 40, pp. 1332–1338. doi:10.1016/j.respol.2011.05.025

73 Heekyung Hellen Kim (2012), "The Effect of Open Access on the Diffusion of Scholarly Ideas," *mimeo*., MIT.

74 Kevin Bryan and Yasin Ozcan, "The Impact of Open Access Mandates on Invention," *mimeo*., Toronto, 2016.

was a significant increase in free availability. Interestingly, while there was a large and significant increase in citations in patents, there was no similar impact on citations in academic publications.

However, perhaps the gold standard for measuring impact was conducted by randomized control trials of the kind used in medical studies. Philip Davis, in several studies with numerous co-authors, conducted such trials. In one study, they took articles published in 11 journals of the American Physiological Society (1619 in total) and randomly assigned them to open access or subscription access. Open-access articles received 89% more downloads (full text), 42% more PDF downloads, and 23% more visitors. There were fewer abstract downloads. All of this occurred in first 6 months. But the critical finding was that open access articles are no more likely to be cited.[75] This same finding was confirmed in a wider, 36-journal study performed a few years later.[76] Thus, when the problem of selection bias was solved by removing the bias, open access appeared to have no effect on impact.

While this provides a picture of the initial impact or lack thereof of open access, there may be other important factors hidden beneath the averages. To examine these, McCabe and Snyder examined the top 100 journals across ecology, botany, biology, and multidisciplinary science for an extended time period (1996–2005).[77] They found that when taking into account journal quality, moving from paid to open access increases citations by 8%. More importantly, the impact was unevenly distributed. The benefits of open access were highest for top-tier journals and were negative for lower-tier journals. Specifically, those journals received a statistically significant reduction in citations.

This last result was puzzling, as it was presumed that open access could only help and not harm the impact of a paper. Instead, this seemed to indicate that open access could change behavior among those citing research. For instance, prior to open access, when

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[75] Davis, P.M., Lewenstein, B.V., D.H. Simon, J.G. Booth, M.J.L. Connolly (2008), "Open access publishing, article downloads and citations: randomised control trial," *British Medical Journal*, 337, a568.

[76] Davis, P.M. (2011), "Open access, readership, citations: a randomized control trial of scientific journal publishing," *The FASEB Journal*, 25, pp. 2129–2134.

[77] Mark, J. McCabe and Christopher M. Snyder (2014), "Identifying the Effect of Open Access on Citations Using a Panel of Science Journals," *Economic Inquiry*, 52 (4), pp. 1284–1300. doi:10.1111/ecin.12064

researchers had access to an abstract but not a full paper, they might cite the paper if it seemed related. But with open access, researchers might examine the paper more closely and dismiss the relationship. If that mechanism was true, then the negative impact on lower-tier journals would represent a positive benefit from open access in that it improved the quality of the citations themselves, and allowed those citations to be a more accurate depiction of the true web of knowledge.

McCabe and Snyder delved into this further and noted that the amplification effect—that open access increased citations at the top journals and reduced them at the bottom journals—was, in fact, stronger for medical articles placed on PubMed Central.[78] This repository would allow for more efficient cross-referencing than websites that focused only on particular journals. Consequently, the competition for citing authors' attention may be increased, explaining the amplification effect and reinforcing the notion that the distribution of impacts was reflective of increased efficiency from open access.

The above research has all been in relation to open access—either by choice or by author payments. However, hybrid open access has also been rolled out that allows authors to post pre-prints (the final versions of paper prior to publication) on their own websites. The impact of this milder form of open access was, for a set of interdisciplinary mathematics and economics journals, to increase citations to those papers.[79] The study took advantage of the agreements between Springer and several university systems, including The University of California, The University of Hong Kong, all universities in the Netherlands, and the Max Planck Institutes. Thus, selection was not necessarily a major factor. This suggests that pre-prints may be a good substitute for published articles. Indeed, if pre-prints are easier to read and access, they may be favored.

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[78] McCabe, M. and C. Snyder (2013), "Cite Unseen: Theory and Evidence on the Effect of Open Access on Cites to Academic Articles Across the Quality Spectrum," *mimeo.*, Dartmouth.

[79] Frank Mueller-Langer and Richard Watt (2015), "How many more cites is a $3,000 open access fee buying you? Empirical Evidence from a Natural Experiment," *mimeo.*, Canterbury.

Summary

The empirical evidence confirms some of the theories that have been posited in relation to scholarly publishing. It confirms that publishers have market power, although the impact of that power is more nuanced than the simple textbook logic of pricing high and excluding consumers. Online benefits do exist but appear not to be very large when controlled for research quality. Finally, open access has brought about improvements in access, but it is unclear what the impact is on the progress of science—in particular, does access improve the ability of researchers to rely on the stock of knowledge to produce more knowledge? It may help in singling out high-quality articles from all the noise, which perhaps will allow the entire scientific system to work more efficiently.

However, while there have been conjectures that open access may actually assist in reducing the market power of traditional publishers, there has been no study that I am aware of that has measured or evaluated this. This is surely an important area for future research.

Chapter 7: The Innovations

Having identified the issues—distortions to competition in scholarly publishing that lead to models that may limit dissemination—and explored how these manifest themselves—high journal prices and limited impact of radical shifts to alternative models such as open access, it is time to turn to some posited innovations that may improve the system. The purpose of this chapter is not to evaluate these fully—most are admittedly too speculative. Instead, the aim is to identify them as ideas with potential benefits in the hope that they may be explored more fully in other venues. The goal is to make you think about broader possibilities.

Portable Peer Review

One thing that makes it difficult for new journals, especially high-quality journals, to enter the market is that scholars prefer to submit their work to journals with an established reputation. As noted in Chapter 4, journals serve as platforms that signal quality and can thus garner attention.

In many fields, this can mean that scholars will try submitting their work to top-tier journals and then move down the list if their papers are rejected. This itself exposes an inefficiency in the system. Top-tier journals and their referees will end up performing functions that are duplicated later. Or, to think about this another way, lower-tier journals are duplicating activities already conducted by top-tier journals. More importantly, for our purposes, this means that any competitors to journals must themselves duplicate tasks that have already been done.

The American Economic Association recognized these issues when it launched four new journals in 2009. Those journals were to be in addition to its flagship *American Economic Review* but at the next tier of quality. That meant they would be competing with many already established field or specialist journals at that level. How could they convince economic researchers to support the new journals?

The answer was to change the peer-review system to operate more efficiently. What they offered was that for any article submitted to and rejected by the *American Economic Review*, at the election of the author, those rejected reviews could be sent to one of the four new journals. The journal editors would see the reviewer name, but these would still be kept from the authors. The benefit to authors is that if they were rejected from the *American Economic Review* not because their work was incorrect but because it was not of sufficient general interest, then the review process would be easier for the new journals. This gave those new journals a competitive advantage over others at the same potential level.

Of course, a natural question to ask is, why stop there? Why should reviews be passed around only under the auspices of one publisher?[80]

[80] There are some companies including Rubriq, Axios Review and Peerage of Science who are working to operate independently of particular publishers.

Why isn't there a system in which any review that has been conducted can be passed along to any journal to save on duplication of costs? There is no reason; it would only require the cooperation of journals on a system for transmission to make this possible.

Journal entry is difficult and will not be made easier by any one thing. However, by removing key barriers, especially where they represent duplicative efforts, the playing field for competition can be levelled.

The Great Unbundling

A redesign of peer review would see fields unbundle the peer-review function somewhat from the journal itself. However, a more radical form of unbundling would move more strongly away from the notion that a paper belongs and is evaluated by a single journal.

The inspiration for this comes from the overlay journals that were discussed in Chapter 4. Recall that these journals involved articles being placed in a repository (such as PubMed or arXiv) and the journal itself reviewing and curating those papers. The journal would effectively become a table of contents and would provide some form of certification.

But why should papers be in a single journal? One could imagine articles being accepted by multiple journals and satisfying multiple dimensions of quality standards and interest. A paper might be in a journal that also housed some form of post-publication peer review or that offered interactive add-ons. Others may provide alternative formatting. Some might be open access, while others remain behind a paywall. Some might involve deep linking to other papers.

A journal now obtains some degree of monopolistic power because an article can be published only in that journal. An overlay journal is one way that power can be mitigated. However, if there are multiple methods of organizing a journal, then why confer power on any one of them? Instead, if articles can reside in multiple journals, journals would be forced to compete and differentiate to be of relevance or achieve commercial profitability. This type of unbundling of content from other journal functions may lead to more experimentation and evolution in scholarly publishing.

Enhancing the Article

Behind the pressures to change scholarly publishing is digitization. This has fundamentally altered the distribution of scholarly content. Interestingly, however, the article itself would look completely recognizable to scholars from a century ago. To be sure, it is not on paper but displayed on a screen. However, it is of the same form and sometimes the same format (using a PDF) as the version that appears in print. This has been noted by some groups—notably FORCE11 (The Future of Research Communications and e-Scholarship)—who present alternatives. But it also goes to the heart of a market power issue—that is, whether traditional publishers are innovating rapidly as a justification for their market power.

This is at the core to how publishers—particularly commercial publishers—view themselves in the new digital economy. For instance, Elsevier, when responding to boycott calls in 2012, defended their role:[81]

> And we invest a lot in infrastructure, the tags and metadata attached to each article that makes it discoverable by other researchers through search engines, and that links papers together through citations and subject matter. All of that has changed the way research is done today and makes it more efficient. That's the added value that we bring.

One of those elements of added value is the format for the published article itself. Publishers are so confident that this adds value that they permit working-paper versions—prior to getting the publisher's magic touch—to reside freely on the Web. Articles are typeset and edited, and tables and figures are cleaned up to look good on paper. But does all that make it better for those looking for knowledge?

Publishers know there is more potential there. Elsevier has launched its "Article of the Future" experiment to show what digitization might make possible. If you examine their representation of a future mathematics article, the main text looks like a pre-print. It

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[81] Quoted by Josh Fischman, "As Journal Boycott Grows, Elsevier Defends Its Practices," *The Chronicle of Higher Education*, January 31, 2012.

is not a PDF but a webpage, and the equations are rendered via the LaTex equation editor. And, in my opinion, it looks awful. For reasons that are perplexing, it is hard to read. Things like that can be fixed, but having it out there does not inspire confidence.

But let's focus on other elements that they have put in. First, they have an interactive element that allows you to play with a graph of a formula. That looks like a good feature to have available to readers. Second, they have included a video abstract. This could be a good thing, but it shows one of the authors in front of a blackboard. This might be useful, and I can imagine that seminars could be embedded here and that such things may be of use to readers. In another prototype, there are videos throughout the article. Third, there are hyperlinks everywhere. The most useful of these link to Elsevier's database for references.

The things Elsevier is trying to do are sensible from the perspective of adding value. But those additions still augment print and are still fundamentally based in it. The problem is that as the technology for sharing information changes, we can refocus on what we should really care about. Print was a repository of knowledge. It allowed access and catered to the person who would spend time with an article. The additions Elsevier proposes are all about spending more time with the content. But I would argue that that is a narrow view of scholarly communication.

If you are like me, when you review a scholarly article, most of the time you want to spend as little time with it as possible. You want to look at it, see whether it is relevant, and move on. Better yet, you might wish to find what you are looking for quickly. The more context you are required to sift through, the worse the experience. Of course, there are occasions when you want as much as an article can give you. Invariably, print versions come up short in this respect, with their appendices moved elsewhere (to save on paper and printing costs), and little to no bonus content, such as PowerPoint presentations, interactive elements, or even video thoughts from the authors.

But how can you cater to those who need to access knowledge efficiently versus those who need to access it deeply? Here I will present a possible approach to doing that. It is focused on reading, and so I am imagining reading articles on a tablet. But I want it to be efficient. To that end, PDF is a poor format. First, you want readers

to be able to change font size easily without simply having to zoom in on parts of an article. The reason for this is that people are different, having various ages and different quality of vision. Moreover, I can imagine wanting a small font size if I am scanning an article to find the part I want but wanting a large font size when I want to sit back and read carefully.

Second, article structure must respect the different roles of text. For instance, in mathematically-oriented articles (and beyond mathematics, in applied-mathematics disciplines such as economics), you want to separate the proofs from the theorem. The idea is that proofs are for in-depth reading, while other stuff is not. So, imagine that, in portrait mode on a table, the article is presented in an equation or detail light form, but as you turn the tablet to landscape orientation, you get the full thing at the point you are at. In portrait, you can hide proofs, literature reviews, and all manner of other stuff secondary to the knowledge but that is often embedded in the article, requiring the reader to sort through it all. These would be revealed in landscape. Also, an author could present the proof as a PowerPoint presentation that allows you to work through it. These are often better than text proofs because they allow you to present steps and build upon them.

Finally (and this is the main point), we want a system that does not require the publisher to make these choices but instead allows the author to decide. The author is the best person to think about how to present the material in a paper. We take so much away from authors in the whole editing-for-print process that harms scholarly communication. Better tools would allow authors to put in enhancements as they see fit and compel them to think more about the reader.

These are not merely speculative ideas. I recently took an article I wrote 20 years ago and converted it to a modern reading format of the type just discussed. Using an Apple tool called iBooks Author, I explored options and was able to convert the article in about 6 hours.[82] I imagine that it would take about 4 hours to do that for your standard article. That is not much for greatly improving your readers' experience of your work. When you spend years on a paper, 4 hours making it

[82] You can see the result here: https://www.youtube.com/watch?v=1_DJdKZutSw

easier to read doesn't seem like too much to ask. If iBooks or some other tool were optimized for this, it would take even less time.

This is just a start, but I think it shows real potential in using new tools to enhance scholarly communication. But the key is to put the reader front and center ensure that authors can more directly communicate and represent knowledge to readers.

What is most interesting about this possibility is that with green open access (which allows authors to put their own, non-publisher formatted papers on the Web), authors could use these tools to make their pre-prints (or working papers) the preferred mode for reading papers. That might be the ultimate form of open access.

Discovery

Related to the notion of redesigning articles for their different purposes is a more deconstructive approach to articles themselves. In some fields (for instance, medicine), this happens with clear statements of the research problem, data, and methodology in what might be an extended abstract. But what if the structure of articles were standardized such that navigating them and parsing them for results was made easier?

Because we are so accustomed to an article being the construction of an argument from start to end, this is perhaps a hard concept to grasp. Moreover, I do not hold a fixed image in my mind of how to break up an article into "chunks," and I suspect that the optimal design would be different for different disciplines. But as an example, consider the review site Yelp. When you look at, say, a restaurant on Yelp, you can see various blocks for information, including the establishment's name, location, description, website, menu, and, of course, ratings and reviews. Each bit of information is in its place, so those returning to it can easily understand what they are looking at.[83]

Experienced scholars in a field can become good at honing in on the relevant parts of a paper, but there is an art to it. It is somewhat surprising that this is so because a paper should be something that means the same thing to everyone reading it. Thus, if there were an

[83] Wikipedia also forces entries into a structure, although these depend somewhat on the nature of the entry themselves.

appropriate structure and different elements were standardized to some degree, the task of parsing the paper would be easier. It is easy to imagine that there are costs to this in terms of conformity. However, it would be interesting to experiment with different forms.

Doing this would potentially improve the benefits of citations to a paper. Citations are supposed to be identifiers of knowledge. But a paper's citation might not pinpoint the part of the paper—the specific knowledge, result, or claim—being relied upon by others. If papers were appropriately broken up into chunks of information, then a citation might identify a portion (or portions) rather than an entire paper. This would make it easier for readers following a trail of citations.[84] Moreover, it would also make it easier for spurious or nonrelevant citations of the form discussed in Chapter 6 (notably the work of McCabe and Snyder on unseen citations) to be eliminated.

Annotation

What of the past stock of articles? If a future article had a certain structure to it, then previously published work may be harder to digest and absorb. This would only become worse over time, as the art of reading them is lost.

This is, of course, not a new problem. Standards change all the time, and part of the job of educating graduate students to become researchers is teaching them how to look at the standards and context from when an article was published to understand its findings and importance.

This juxtaposition suggests an opportunity. Graduate students and others routinely read articles and create their own notes and annotations for them. Those notes and additions are private, but they likely contain information that would be useful to others. What if such annotations could be shared?

This is an approach that hypothes.is has recently begun pursuing. The idea is that if articles were held in a suitable repository or format, then as people read them they would be given annotation tools that would be useful for themselves but also easily shared with others. In particular, if a standard structure for articles had evolved, those making

[84] Some organizations, such as Altmetric, are exploring innovations along this track.

annotations would want to highlight and identify those elements within older articles. In this way, when lifted from those articles, the articles could be reconstituted in a more familiar and useful form.

Consider how this might work for quantitative articles such as those in pure and applied mathematics. Annotations could identify and define variables. Definitions, theorems, and proofs could be noted. And if there were enough structure, those proofs could be laid out differently and perhaps explored using interactive elements. This could open up that knowledge to many others and also allow its deeper exploration.

The point is that just because some knowledge is stuck in a legacy format does not mean that we don't have the means to slowly lift it more efficiently from those pages. There are certainly some design challenges, both in terms of tools and incentives; however, the possibilities are there. After all, resolving that identical set of issues allowed all music tracks in the world to be digitally identified.[85]

[85] Dan Bricklin (2006), "The Cornucopia of the Commons," is the classic reference on this: http://www.bricklin.com/cornucopia.htm

Chapter 8: The Reorientation

This book began with the context of dissatisfaction and even open revolt against the operation of the current system of scholarly publishing. The main source of that discontent is the market power of publishers of scholarly articles and the consequences of exercising that power: restrictions on the dissemination of the knowledge they publish.

In this final chapter, I take a step back and review the findings of research into scholarly publishing and what we have learned about the sources of discontent and what actions have been undertaken to reform the system. I suggest that research points to a much broader direction of reform that targets the knowledge within articles rather than published articles themselves.

Research Findings

In this book, I have focused mainly on the work of economists to examine the operation of the system of scholarly publishing. The economic focus is not to set aside the work of those in the library sciences but instead to recognize that at the heart of scholarly discontents are issues of market power, which is squarely within an economist's domain of expertise.

That research uncovered some key takeaways. First, the current system of scholarly publishing is far from perfect in achieving its purpose. There are issues associated with identifying quality content and ensuring that false knowledge is removed from the system. In addition, finding knowledge remains an increasing challenge, and myriad distortions arise because of the way the system of scholarly publishing interacts with the systems of scientific reward and scientific career progression.

Second, the economic analysis of the likely operation of different models for scholarly publishing has reached a certain maturity. Publishing is a multi-sided platform, with journals bringing together researchers and those who would consume that research. While there are robust arguments as to why a system should rely on authors to pay for the costs of scholarly publishing, there are economic pressures that lead to situations where those costs are distributed almost completely to readers/users. Moreover, those same forces confer market power on publishers that they can use to extract very high fees from the user-side, if they so choose, when those users need access to each component of the stock of knowledge. Thus, open access has some desirable properties, but implementing it would require a large intervention in the system. However, the research notes that gold open access, when not universal but opt-in, is unlikely to improve matters at all, as it will not have an impact on user/library subscription fees while allowing publishers to earn another source of revenue.

Third, while it is true that academics who support and drive the system of scholarly publishing are able to effect change, those changes have not been widespread. The most important changes are those that bring in green open access that allows pre-prints or working papers to be hosted outside of the control of publishers. In some fields, this has become more organized than others. Nonetheless, despite this, the

period of activism has seen no apparent impact on the market power of publishers and their ability to extract considerable profits from their role in the system.

Finally, the evidence supports the theory in demonstrating that moves to reform scholarly publishing have had a positive but limited impact. Moves to place literature online and to open up that literature by removing paywalls have had positive impacts on the measures of impact of articles, but those impacts have been quantitatively modest. Open access worked best when it improved the impact of high-quality research and reduced that of lower-quality research. These effects were strongest in fields that had a large repository for that research.

Open access was supposed to directly counter the effects of market power and assist the dissemination of knowledge. However, we have learned from movements in that direction that their effect has been limited. This suggests that we need to look further into finding ways in which the system of scholarly publishing can be reformed.

The Core Issue

When we say that open access is socially desirable, what do we mean? The usual assumption is that this means free access to the published articles themselves. After all, those articles have been reviewed, vetted, and curated, and researchers are required to explain where they fit in with previous research. The articles have also been formatted and edited for clarity. However, moves toward green open access where the content of articles is available sans editing and formatting suggests that these are secondary considerations.

When published articles are not made freely available, what kinds of costs do we imagine? Note that we are not speaking of those people who already have access to those articles—for example, faculty and students at universities in, say, the OECD countries. We are speaking of those who do not have that access. For instance, consider a researcher in an emerging economy who cannot afford the subscription fees to journals. Or, consider parents whose child has symptoms their doctors cannot explain, searching knowledge themselves for information on a rare condition. They find themselves confronted with a paywall of 30-something dollars for each article they just want peruse to see whether it is relevant. They would be willing to

pay that fee for information that was surely relevant, but searches that may take them through hundreds of irrelevant research are far too costly.

While green open access is an apparent solution, it comes with a cost: The search engine being relied upon is the same Google or other search algorithm that you would use to find a recipe or DIY instructions for installing a water filter. With enough persistence, you might find what you want on Google Scholar, but that is still an imprecise and hardly optimized means of searching the corpus of knowledge. Instead, outsiders can avail themselves of the search infrastructure put in place by existing publishers. It is just that they must then check each result in Google Scholar to see whether they can find a corresponding pre-print or working paper.

To understand why this is an issue, let's consider where it is far less of a problem: open-source software. Software development is a process by which problems are identified and solutions are found. The solutions are coded, and parts of that code can then be reused by others to build out other solutions. Essentially, the stock of open-source software is a basis for the development of new software. For that reason, an open approach emerged whereby programmers contributed their code openly to repositories and in return could use and modify the code of others.

But there were challenges to this process. First, there was a desire for attribution, perhaps to assist programmers in their career prospects.[86] Second, code itself can have bugs and errors that may not be picked up as the code itself is used and reused. However, if a bug is identified and resolved, that knowledge needs to permeate back through all the places that code had been used. Imagine that as code is built out from a foundation, it has branches. When a bug is discovered on a branch that can be traced back to a root, you want the root to be augmented, as well as all other branches extending from that root.

Various institutions have been experimented with resolving these issues. A recent one that has proved popular is GitHub. GitHub is a repository that makes it easy for programmers to host their code but also provides systems that allow code to be downloaded, modified, and

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[86] Lerner, Josh, and Jean Tirole. "Some simple economics of open source." *The Journal of Industrial Economics* 50.2 (2002): 197–234.

uploaded with changes and versions clearly identified so that they can be pushed to others. It requires programmers to adhere to a structure (akin to a tree) that itself bakes in a means of both attribution and links.

GitHub and its like represent what can be achieved when a stock of knowledge is open from the start. The default to openness means that links and evolution can be conceived of in a greenfield manner. This is a much easier task than resolving issues by trying to modify a system that was born of an earlier stage and technology.

Not surprisingly, some academics have seen the potential for GitHub itself to be used as a means of generating an open-source approach to scholarship. However, these have emerged in some fields that are more closely aligned with code that resides in GitHub.[87] Nonetheless, these approaches demonstrate the potential for living documents that house multiple media elements and can be replicated and built upon by others.

Freeing the Knowledge

Thus far, we have considered various ways of unbundling within the scholarly publishing process. We could separate refereeing processes from being journal specific. We could also separate the published content itself from the editorial and curation functions of a journal. Each of these approaches would change the way scholarly publishing operates today. However, none of these steps would unlock knowledge that has emerged in the past, nor would they provide the types of links that have been assembled by the open-source programming movement.

Instead, what if academics were to reorient themselves to consider how knowledge itself could be unbundled from journal articles. On one level, this is an entirely natural activity that is performed repeatedly the world over—through teaching. Teaching and the provision of lectures, notes, and textbooks represents one way in which we take current knowledge and open it up for broader use. To be sure, it's

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[87] Kris Shaffer, "Push, Pull, Fork: GitHub for Academics," *Hybrid Pedagogy*, 26 May 2013, http://www.digitalpedagogylab.com/hybridped/push-pull-fork-github-for-academics/ For an example, see Musicianship Resources: http://kris.shaffermusic.com/musicianshipResources/.

important that the knowledge itself is drawn from tradition—from peer-reviewed scholarly publications. But access to the publications themselves is simply not necessary for retrieving the knowledge and allowing others to access it.

On another level, thinking of unbundling knowledge is a daunting task. Doing this for teaching purposes is fundamentally limited by the scant attention students have for absorbing knowledge. Moreover, in each case, it is usually someone other than the knowledge creator themselves who does the heavy lifting in unbundling. Assistance from the initial creator normally ends after their own research has been published. Moreover, that published research, while useful of course, is rarely delivered in a form that will make the job of those drawing from it for teaching dissemination an easy one.

What if, instead, knowledge was unbundled from the start and embedded in how researchers actually develop their knowledge? This is essentially what happens with computer code, where programmers are encouraged to use GitHub for their own repository and versioning processes. Imagine that instead of code, it was the experiments, observations, calculations, and so on, that researchers stored. They could then release those units for "forking" and development by others—all with attribution and updating built in. From that base, they could then write their journal articles linking straight back to the primordial elements of their own and others' research.

It is easy at a high level to think about how knowledge could be unbundled, but once a framework is developed, then graduate students who were learning and reading past knowledge would be encouraged to translate their own information into the new framework. The knowledge could be freed from the bounds of journals without undermining all the curation and attribution work that goes with them. And at the same time, a searchable database that is open by design would exist not for articles, pages, or PDFs, but for the knowledge itself.

The best thing about an evolutionary process that accompanies freeing knowledge is that it does not require the cooperation of existing publishers or any forced change to their business models. Instead, it can be conducted within the domain of copyright law and free expression. No text would be copied, only ideas. Consequently,

thinking in these terms can give rise to a permission-less form of innovation in scholarly publishing.

To be sure, breaking old habits and using a new system involves costs. As an academic myself, I am far from sure that my colleagues would embrace the change and incur those costs. But perhaps if they were to think about it this way: You have spent years researching, and many months writing and then getting your work through the publication process, so wouldn't it behoove you to take just a few days (eventually, just a few hours) lifting the knowledge from those pages and letting others access it without payment? You can have your cake and let others eat it too, so long as you are willing to do a little cleanup of the pan afterwards. Doing otherwise is like stopping your job half way through. If someone provides the tools, it is worth putting the icing on the cake.

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