

Article

Open Access, Innovation, and Research Infrastructure

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Abstract: In this article we argue that the current endeavors to achieve open access in scientific literature require a discussion about innovation in scholarly publishing and research infrastructure. Drawing on path dependence theory and addressing different open access (OA) models and recent political endeavors, we argue that academia is once again running the risk of outsourcing the organization of its content.

Keywords: innovation; Open Access; research infrastructure; scholarly publishing; green open access; gold open access; diamond open access; journal flipping

1. Introduction

In a groundbreaking statement from May 2016, the Competitiveness Council of the European Union called for immediate open access to all scientific articles by 2020 [1]. It is now common sense that academic research should be free for everyone to distribute and read. However, opinions regarding the implementation of open access (OA) differ sharply. A promising strategy is flipping the journal business model from subscription-based to gold open access, which is a system supported by publication fees. This strategy however bears the risk of reproducing academia's dependence from commercial publishers. In its endeavor to transform the system for scientific publications, academia has tended to forget that sustainable OA requires more than changing publishers' business models. Drawing on path dependence theory and addressing different OA models and recent political endeavors, we argue that academia is once again running the risk of outsourcing the organization of its content. We conclude that, in addition to a business model and licensing debate, scholarly publishing in a digital age requires a discussion about innovation and infrastructure.

2. Open Access in a Nutshell

2.1. Green and Gold Open Access

Broadly speaking, open access means that research outputs, such as articles and research data, are free of restrictions on access and free of restrictions on use. A simple distinction may be made between gold and green OA.

Gold OA essentially works like traditional publishing: An author hands in an article. The journal organizes the peer review and, if accepted, publishes and promotes the article. Unlike traditional publishing models, in this model, authors (or their institutions) pay a charge, the article processing charge (APC), to the journal in order to make the article free for everyone to read and to distribute. This system is comparable to broadcast television, where those who are interested in disseminating content pay a production fee upfront so that their content is broadcast to a wide audience [2]. The market for gold OA has both commercial and not-for-profit players (e.g., the successful open

access journal PLoS is not-for-profit). There are also hybrid models, where journals with traditional subscription models offer researchers the opportunity to pay a “ransom” to publish individual articles on an open access basis. Here, there is a danger that publishers will charge both APCs for gold OA and subscription fees, a practice termed *double dipping*. Little is known about the economic damage of double dipping since there is a shortage of hard data about overall spending on APCs. Pinfield *et al.*'s study from 2013, however, gives a good indication: The authors surveyed the APCs of 20 UK institutions across the six largest publishers, including Elsevier. In 2013, the institutions under survey spent approximately 18 million euros on subscriptions and 1.2 million euros on APCs in hybrid journals from Elsevier. Without hybrid OA, the total subscription costs for the 20 institutions would still be 18 million euros; the additional 1.2 million euros likely come from double dipping [3].

Gold OA reverses the payment logic from “paying for reading” (subscriptions) to “paying for publishing” (APCs). It is at the core of what is often referred to as *journal flipping* away from subscription business models.

Green OA means that articles can be published in a non-OA journal but are also self-archived in a public repository without a mandatory peer review. There are different shades of green, for example, “pale green”, which limits self-archiving to preprints only, or “dotted green”, which limits self-archiving to postprints [4]. Repositories may contain both preprints and postprints of articles. In disciplines like physics, green open access is already widespread. The widely used preprint repository arXiv is especially noteworthy in this respect. Some communities, for example the economics community, also offer renowned working paper series with invited authors (for example, NBER Working Papers, Ifo Working Papers, or SOEP papers, which are published under OA licenses online). What is often overlooked is the fact that green OA exceeds gold OA both in proportion and growth rate [5].

The two essential differences between gold and green open access are that one offers a quality control via peer review and charges a fee (gold open access) while the other one does not charge a fee and offers no integrated quality control (or to a certain extent only). Of particular note are so-called overlay journals that select preprints or articles that are in the public domain, conduct a peer review and eventually publish the article in their journal. They combine the green OA route with traditional modes of quality control.

2.2. Setting the Scene: The Rationales Behind Open Access

Those calling for OA to articles often refer to the fact that the scientific community completes essential parts of the publishing process, *i.e.*, they write the articles and review them. Nonetheless, most of the research—which receives considerable public financing—is hidden behind pay walls [5]. The situation is aggravated by the fact that libraries are increasingly struggling with high license fees for journals and debatable package deals [6], while publishing houses like Elsevier, Wiley, or Springer are highly profitable [6]. To put it provocatively: The costs to access research outputs are being paid for twice by the taxpayers: for the researchers who conduct research and produce articles and for (mostly) the libraries that purchase them through journal licenses. The debate about OA is often concerned with this dichotomy between production and quality inspection on the one hand (academic researchers) and the organization of this process and the profit-oriented distribution of articles on the other hand (publishers).

There are many more advantages of OA: OA allows researchers to access and use content for their own research. In that respect, OA has a utilitarian dimension that many research funders, including the European Commission, sees as a pathway to innovation [7]. Moreover, researchers that choose an OA option have in principle a citation advantage over those who do not [8]. OA also benefits researchers in developing countries [9]. One could argue that OA is a direct translation of the principle of *communism* (as the common ownership of scientific results) of the eminent sociologist Robert Merton (“Mertonian norms”) for the digital age [10]. It is good scientific practice.

In addition to the economic argument (libraries' shrinking budgets, high profits by publishers), there are also ethical arguments concerning good "democratic" science as well as efficiency arguments for research funders and direct reputational rewards for open access authors.

2.3. Increasing Support for Open Access

In light of the benefits of OA, it is now common sense that scientific output should be freely available online. With new online distribution channels, the traditional mediator role of scientific publishers has come under scrutiny. Research funders, research associations, institutes, and universities alike have developed OA strategies, proving that the demand for OA is no longer an idealistic one.

In November 2015, representatives from the leading Austrian research organizations announced that all publications financed with public funds will be available online without restrictions by 2025 [11]. In October 2015, the Berlin Senate (the state government) mapped out an OA strategy for publicly financed research in Berlin [12]. *The Association of Universities in the Netherlands (VSNU)*, a consortium of 14 institutes, has negotiated major deals with publishers to provide free access to articles with Dutch authors. In October 2015, the *Joint Information Systems Committee (JISC)*, a non-profit body representing UK higher-education institutions, negotiated a deal that made articles with UK-based authors free in 1600 Springer subscription journals [13]. The *Max Planck Digital Library* has published a white paper on the transformation of the subscription-driven market for scholarly publications. In their careful quantitative analysis, the authors show that access to scholarly literature can be opened at no extra costs compared to the present subscription model (by implementing gold OA) [14]. Inspired by the Max Planck white paper, in March 2016 a number of leading international research organizations, including almost every noteworthy German research organization, published an expression of interest in joining forces to shift the market for scholarly publishing from a subscription-based to an open-access model [15]. The statement from May 2016 by the EU Competitive Council—a gathering of ministers of science, innovation, trade, and industry—brings the issue of access to scholarly knowledge to a new level. According to the statement, all scientific articles should be freely accessible by 2020 [1].

3. The Path Dependence of Academic Publishing

Despite increasing support, there is considerable additional scope for the further expansion of OA. For example, Laakso *et al.* [16] showed that the share of articles published in OA journals, of all peer reviewed journal articles, reached about 8% in 2009. Overall, however, the authors found significant growth of OA publications between 1993 and 2009. According to a monitoring report for the *Universities UK Open Access Co-ordination Group* from 2015, the number of articles published globally in journals with an immediate OA option grew faster between 2012 and 2014 than did the articles in subscription-based journals, although both did increase in absolute terms. Growth was fastest in the OA option in hybrid journals, whereas the take-up of publishing in fully-OA journals without APCs was static [17]. In summary, journals with an immediate OA model accounted for less than 17% of global articles in 2014. Especially gold OA is forging ahead. In general, OA is gradually gaining traction in the academic community, but it is not fulfilling its potential. There is still a considerable discrepancy between the ideal of barrier-free access to scientific literature and the reality

A conceptual explanation for academia's reluctance to adopt OA as the new paradigm for scholarly communication is path dependence. Path dependence is a concept in the social sciences that explains how the set of decisions in the present is limited by the decisions one has made in the past, even though the contextual factors shaping the past decision no longer apply [18].

A frequently used example explaining path dependence is the typewriter. In 1867, Christopher Latham Sholes developed the prototype of a simple typewriter. One of its many initial flaws was the fact that the type bars would constantly block each other. Sholes finally arrived at the QWERTY sequence (according to the type bars top left of the keyboard). With the QWERTY sequence, the type bars did not block each other because the most used letters were positioned as far apart as possible on the keyboard. Soon after typewriters were manufactured industrially, QWERTY was used as the

norm. In 1932, August Dvorak developed the DSK-keyboard (Dvorak Simplified Keyboard) with a more intuitive keypad that enabled users to type up to 40% faster. At this stage, however, QWERTY could no longer be stopped. By the time there were no more mechanical type bars that could block, QWERTY was already the norm and its design was directly transferred to the computer keyboard.

Path dependence is often used to explain why technological innovations prevail and others disappear, even though they are at least equivalent (e.g., VHS dominance over Betamax). Path dependence also explains why OA is making slow progress.

The commercial market for academic publishing is relatively young. Until the 1960s, journals were mainly published by scientific societies [19]. The success of commercial publishers can be attributed to three main reasons that build on one another: First, with the expansion of universities and research institutes in the 1960s the demand for scientific literature increased. Second, with the introduction of the *Journal Citation Index* (SCI) core journals emerged, for which the demand was inelastic in respect to costs. Finally, third, many scientific societies sold their journals to commercial players in order to get rid of a financial and administrative burden [19]. With the sellout of core journals, the academic community also lost control of its gatekeeper function, at least from its administrative organization. Today, publishing scientific literature is a small but highly profitable market of about 9 billion USD and profit margins of 20% to 30% [20]. With regard to the core journals, *i.e.*, those with the highest impact factors, one can observe a lock-in effect—publication in these journals defines career success, informs evaluations and justifies funding. Naturally, (reputation-driven) researchers orientate themselves towards these core journals [21]. The entrenched division of labor between academia and commercial publishers worked well in an analogue world, but is gradually taken ad absurdum in an increasingly digital world of scholarly communication.

Scholarly publishing is path-dependent because it still heavily depends on a few players that occupy crucial nodes in the scientific information infrastructure. In the past, these players were scientific associations, but now these players are commercial publishing companies. One could even go a step further and say it is path-dependent because it is trapped in a reward system from an analog past that overvalues article publications and undervalues digital research products such as data and code (see, for example, [22]). The path dependence of academic publishing concerns both the organization of academic value creation and the market for scholarly output. Academia is not innovative as it used to be, but academia is a QWERTY world.

4. Open Access, Innovation, and Infrastructure

One way out of the self-inflicted path dependence of academic publishing is innovation. Innovation is defined here as the application of solutions that meet new requirements through better products and processes [23]. In markets for information goods, such as scientific publications, innovation is naturally fostered and enabled by the Internet as it allows for new types of products and their efficient distribution.

A suitable analogy to understand the transformative potential of the Internet on scientific publishing is the newspaper industry. What is often referred to as the “decline of newspapers” is in fact a mere reorganization of the market for information goods. Old players position themselves anew (e.g., newspapers test new content formats and payment models), new players emerge (e.g., clickbait journalism), and less strong and innovative players disappear. The news market reacts to new customer needs and consumption habits (e.g., mobile news) and makes use of new technologies and formats (e.g., live video).

A similar process holds true for scholarly publishing, where traditional publishers distribute their articles online with new business models (e.g., gold OA and hybrid models) and new players emerge that offer new products and services (e.g., mega journals, social networks for scientists, scientific blogs).

Looking at the new and innovative players in scholarly online publishing, one can see that many have a commercial background. In an interview with the German news platform *irights*, Lambert Heller from the *Open Science Lab* of the *Leibniz Information Centre for Science and Technology in Hannover*,

critically pointed to the market power of startups and traditional publishers that cleverly invest in digital infrastructure [23]. This, according to Heller, applies not only to online journals but also to other academic services such as literature repositories reference managers (e.g., Mendeley), code and data repositories (e.g., figshare), and social networks for scientists (e.g., Researchgate). These players experiment with “new” and valuable products (e.g., research data) and services (e.g., social literature management) and—more or less successfully—with impact scores (e.g., RG score). They react to the path dependence of academic value creation and foresee the modularity of increasingly collaborative research in a digital age [24–26].

Looking at the old players in scholarly publishing, one can see that they are also experimenting with new formats and services (e.g., Nature and Science both have mega journal spin-offs, Nature has its own data journal called Scientific Data); they are purchasing innovative companies (e.g., Elsevier’s acquisition of Mendeley and SSRN; Macmillan Publishers has with Digital Science its own science start-up accelerator) and—perhaps more importantly for OA—they are changing their business models from subscription to gold OA (journal flipping).

Most of the big initiatives undertaken by research organizations at the moment are banking on exactly this strategy. Journal flipping and gold OA, which are generally desirable and demanded by the OA community, could, however, have a negative long-term effect. If a shift from “paying for reading” to “paying for publishing” is the sole instrument to push OA, academia will run the risk of reproducing its path dependence on commercial players by bringing the same old parties to the negotiating table, publishing houses. This, one could argue, would not be a transformation of scholarly publishing but simply a reallocation of its costs with the same dependencies for academia.

The historian Philip Mirowski consequently sees a neoliberal project in the overall development of open access [27]. Jeffrey Beall, the initiator of Beall’s list of “predatory” open access publishing, even compares the *real* OA movement to anti-corporatism and calls for a collectivization of production and an organization of scholarly knowledge solely within academia [28].

One does not have to go as far as to describe the development in scholarly publishing as a purely neoliberal project or even call for expropriation. What is true, however, is that commercial players (again) occupy many critical nodes in the digital information infrastructure and that the business model and licensing bias in the current OA endeavors entails the risk of reproducing the dependence on the same commercial players.

5. How Academia Can Free Itself from Its Path Dependence

When the research organizations in the EU member states now work on implementing the ambitious plan to open up the market for scientific publishing by 2020, they have a few more options besides changing the business models of scientific publishing from subscription-based models to OA models (through journal flipping, publication funds for gold OA, and offsetting agreements). The reorganization of scholarly publishing in a time of digitization provides a unique opportunity to regain the organization of its content through targeted investments in the communication infrastructure, at least to a certain degree. The ultimate aim is to further research by providing worldwide OA to high-quality research results. And it is clear from an economic point of view that OA cannot be accomplished without spending public money.

One strategy is funding and developing new key journals. The financial support of academic entrepreneurship in the realm of scholarly services could be a viable strategy for sustainable OA, especially in emerging disciplines and interdisciplinary research fields that do not yet have core journals. The *German Research Foundation* (DFG), for example, has a funding line to support the launching of OA journals in its funding area *Scientific Library Services and Information Systems* (LIS). As the recent case of the linguistic journal *Lingua*—where the entire editorial board withdrew to start the OA journal *Glossa* with funding of Dutch research organizations—shows, it is also possible to reorganize established journals if the publishing house is unwilling to adopt OA policies [29].

Moreover, in the context of the recent announcement regarding the development of a *European Open Science Cloud* for scientific data and the ongoing support for OA, one could provocatively ask why research organizations do not join forces to found their own journal platforms for excellent research articles [30]. Such a platform would need to be backed by leading research organizations, the most renowned scientists in the field (as editors), and core libraries (as publishers). After all, reputation is the biggest asset academia has to offer.

Last but not least, academia has to anticipate innovation in scholarly collaboration and experiment with new publication models and scholarly outputs. A promising publication model is the diamond OA model. Here, the costs of editing, peer review, and publication or hosting are covered by an academic institution or fund. Academic institutions make their infrastructure (e.g., repositories) available while the editing and reviewing work is—as usual—accomplished by academics in their roles as authors, editors or peer reviewers. This model avoids the costs for both publishing and reading an article, while essentially working like a traditional journal (e.g., the journal *Discrete Analysis* that builds on arXiv) [31]. This overlay model has the capacity to combine the best of two worlds by implementing the quality control of gold OA while using a public infrastructure as in the green route to OA. (Side note: It seems not unlikely that Elsevier will apply such overlay models on SSRN).

As implied by path dependence theory, the decisions of the present define and limit the decisions in the future. Academia now has the opportunity to free itself from its self-inflicted path dependence by including information infrastructure as well as innovation in its OA endeavors. It is an opportunity that academia should not miss.

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