YALE JOURNAL OF BIOLOGY AND MEDICINE 96 (2023), pp.267-273.

PERSPECTIVES

YALE JOURNAL OF BIOLOGY AND MEDICINE
YJBM
CELEBRATING 95 YEARS 1928–2023

The Economics of Scientific Publishing

Azmaeen Zarif[a,b,*]

[a]*Cambridge Judge Business School, University of Cambridge, Cambridge, UK;* [b]*Gonville & Caius College, University of Cambridge, Cambridge, UK*

The peculiar nature of scientific publishing has allowed for a high degree of market concentration and a non-collusive oligopoly. The non-substitutable characteristic of scientific journals has facilitated an environment of market concentration. Acquisition of journals on a capabilities-based approach has seen market concentration increase in favor of a small group of dominant publishers. The digital era of scientific publishing has accelerated concentration. Competition laws have failed to prevent anti-competitive practices. The need for government intervention is debated. The definition of scientific publishing as a public good is evaluated to determine the need for intervention. Policy implications are suggested to increase competitiveness in the short-run and present prestige-maintaining alternatives in the long run. A fundamental change in scientific publishing is required to enable socially efficient and equitable access for wider society's benefit.

BACKGROUND OF THE SCIENTIFIC PUBLISHING MARKET

Scientific communication today is built on the foundation of dissemination via papers published in journals. With its 17th-century origins stemming from the *Philosophical Transactions of the Royal Society*, science has relied on the platform of journals to share original research, undertake debate, summarize knowledge with reviews, and provide opinions and commentaries on contemporary issues. Yet, while this platform of scientific publishing has provided an invaluable method of supporting human progress, its development has intrinsically relied on economic nous. And as the market has grown, its mechanics coupled with the actions of a few dominant publishing houses have resulted in the development of inefficiencies which violate central ethical principles underlying governing capitalistic markets and the spirit of science. Bioethics concerns itself with the implications and applications of the life sciences. In the process of engaging with it, we undoubtedly must rely on the available literature to form our arguments. Yet this exercise would not be complete if we do not apply the same principles to the very platform enabling the literature to be produced and available in the first place. We address this by undertaking economic and ethical analyses of the current state of the scientific publishing market to identify market failures and violations of governing ethical principles in order to present potential corrective actions needed for fundamental change within the industry.

The peculiar nature of scientific publishing has allowed for the development of a high degree of market concentration and a non-collusive oligopolistic market structure. Scientific journals, defined by narrow scopes, are not substitutes for one another. Articles contained within outline unique discoveries of viewpoints and, as per the Ingelfinger rule [1], the same material cannot be published in more than one journal. This has led to the

*To whom all correspondence should be addressed: Azmaeen Zarif, Gonville & Caius College, Cambridge, UK; Email: az397@cam.ac.uk; ORCID: 0000-0002-1837-4460.

Keywords: Antitrust, competition, government intervention, oligopoly, public good

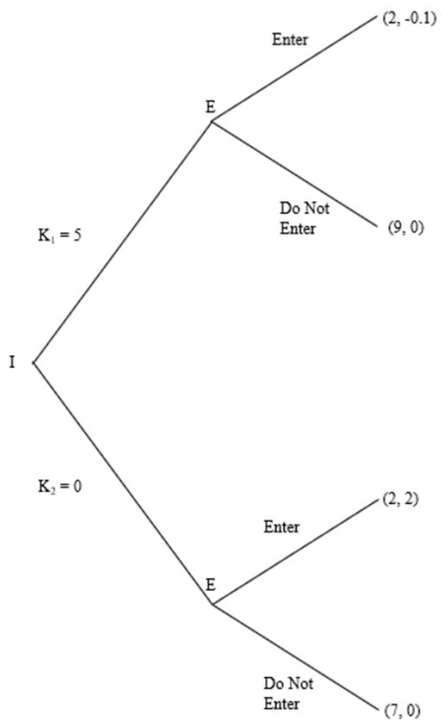

Figure 1. **Strategic entry deterrence game in scientific publishing**. K_1 refers to publishers choosing to invest in "capacity" (eg, 'the big deal') and K_2 refers to no action. Payoffs (incumbent, entrant) represent example citation indexes (a proxy for journal "value"). The Nash Equilibrium is the optimal strategy of a non-cooperative game involving two or more players where each would achieve their desired solution without deviating when their opponent's decision is accounted for. Where incumbent publishers have invested (K_1), by leveraging their established position, they can derive greater "value" compared to new entrants such that the Nash equilibrium would be for new entrants to not enter the market. Even without investing (K_2), the time-in-market and reputation built by incumbents may still represent a significant obstacle for new entrants.

creation of new journals as necessary to meet (or indeed, create) academic demand which underlies the expansion in scientific output [2,3]. Such has enabled market concentration as publishers acquired existing journals [2]. At the same time, lax competition laws have failed to adopt a correct framework to judge and prevent market concentration as customary market share rules may not be applicable for academic publishing [4]. The print market concentration mechanism has been further accelerated by the digital era. Variable costs (eg, printing and postage of journals) have reduced while the nature of journals has changed from rival goods to non-rival goods as access by one individual does not require the production of an additional copy [2].

By adopting Porter's Five Forces framework, it can be shown that the root cause of sustained concentration is due to the absence of competition [5]. The peculiar nature of the industry is grounded in the lack of negotiating power of buyers and suppliers. Demand, primarily from academic libraries, demonstrates inelastic price elasticity of demand as the non-substitutable journal content is required for essential study, teaching, and research purposes [6,7]. At the same time, suppliers, ie, authors, are subject to the Faustian grip of academia's prestige principle [8]. While they are not paid for providing journals with their articles, they are rewarded in prestige (and subsequent citations, grants, and promotions) linked to journal "impact factors," of which the biggest publishers control the leading journals [9]. Furthermore, existing competitors are not competing on price or quantity, instead, they focus on product differentiation (due to journal scopes) [10]. The nature of today's scholarship against a backdrop of "publish or perish" is such that it is affordable for few, yet mandated for many, presents a scientific publishing economy ripe for predatory agents to exploit the chase for publications and "impact" by facilitating pay-for-publication services with lax-to-no peer review, hidden charges, misrepresenting editorial board members, and violating *de facto* publishing standards and ethics [11]. As mentioned, increased competition in the form of similar journals cannot drive prices down. Publishers occupy greater negotiating power when the position of authors is considered – the product of scientific publishing, ie, papers, must be created by the very authors who

then have to buy it back in order to build on each other's scholarly contributions. As such, publishers can exploit said asymmetries in negotiating power to further mitigate the threat of substitutes (eg, from non-profits) in the form of the "big deal." High-demand journals are bundled with newer or lower-profile journals and libraries are forced to subscribe to more journals than they otherwise would have chosen to, thereby leading to cuts in subscriptions to similar journals from other publishers [12]. By considering the strategic barriers implemented by publishers (the ability to leverage low marginal costs and existing editorial boards to form comparable journals which can then be bundled to force increased visibility), this may be categorized as an investment in "capacity," which may further be conceptualized as a strategic entry deterrence game (Figure 1) [13]. As established agents in a mature industry, the relevant Nash equilibrium is that incumbent publishers can enforce significant sunk costs via investments in "capacity" such that potential entrants do not enter. In addition to structural entry barriers for new entrants (investment in servers, editorial salaries, back-office hiring, lack of reputation and prestige), it is evident that there is a low threat of change in concentration.

THE NEED FOR INTERVENTION

Whether government intervention is necessary for the scientific publishing market is up for debate. We will analyze the arguments using an ethics lens to demonstrate the relevant viewpoints beyond the economic rationale. Economics and ethics are inextricably bound. Economic behavior is a fundamental aspect of human nature and with the fundamental economic problem of scarcity of resources, the central tenet of economic modelling presents individual transacting agents as utility maximisers. Adam Smith's pivotal work outlined how the free market, under the guidance of the "Invisible Hand," thereby enabled the maximization of societal utility by facilitating transactions as per the underlying principle of ethical egoism which dictates that decision-making should be guided entirely to fulfill atomistic self-interest [14]. This can only be achieved in perfectly competitive markets with underlying moral principles respecting buyers' and sellers' negative rights. Such can be briefly summarized as markets with numerous buyers and sellers, each acting to maximize their utilities, where none has a substantial market share (negative right from coercion to ensure none are forced to accept terms or go without) due to there being no barriers to entry or exit (negative right of freedom of opportunity). There is perfect information and perfectly substitutable goods. Moreover, there is no external intervention concerning quantity, price, or costs (negative right of consent). The antithesis to the free market doctrine is the pure monopoly where a single supplier dominates, and the aforementioned principles break down. While an in-depth discussion of monopoly economics is beyond the scope of this essay, it nonetheless serves as a useful reference point to allow us to evaluate oligopolies. In an oligopolistic market structure, there are two essential features of perfectly competitive markets missing. Only a few sellers retain significant market share and they can enact, collusively or otherwise, barriers to entry which reduces competition.

To analyze the ethical implications denoted by an oligopolistic market structure, we must briefly summarize the potential ethical principles at play: utilitarianism, the moral rights approach, and the role of justice. Utilitarianism defines actions to be ethical when actions benefit the greatest number of people at the minimum level of costs. Moral rights ethics on the other hand dictates that decisions are only ethical when they are consistent with fundamental rights and privileges (eg, the right to privacy, property ownership, etc.). Finally, the justice principle of ethics concerns itself with fairness of distributive justice. It states that inequalities are permissible and not intrinsically unjust provided that opportunities are fair and open for all to access and that the most disadvantaged are disproportionately favored to a greater extent [15]. Oligopolies violate said ethical principles in a multi-faceted manner. Utilitarian principles are not adhered to given market inefficiencies arising due to the market concentration of dominating publishers which means incentives for resources to be used as efficiently as possible are lost. The moral rights approach is violated given that negative rights are not respected by preventing effective entry of competing publishers, forcing buyers to purchase unwanted goods (via the "big deal") and effectively rendering them price-takers with an inability to effectively influence market dynamics. Finally, publishers can extract "rents," in other words, they can charge supra-normal prices as the market is not at equilibrium and it is not the case that the most disadvantaged are the most benefitted as price barriers exclude those without adequate endowments to publish nor access papers and journals, respectively.

From the economic viewpoint, journal publications can be seen as information goods since they are not spent when consumed and, given the low to non-existent marginal costs of digital publication, they can be cheaply reproduced. However, publishers can exclude consumers should they not have institutional access or be unable to pay for individual downloads. Therefore, they are not pure public goods. As a result, they do not suffer from under-provision that otherwise would be expected in free markets, thereby presenting no need for corrective intervention.

Moreover, as libraries primarily exercise demand in the market for journals and given that they are consumers

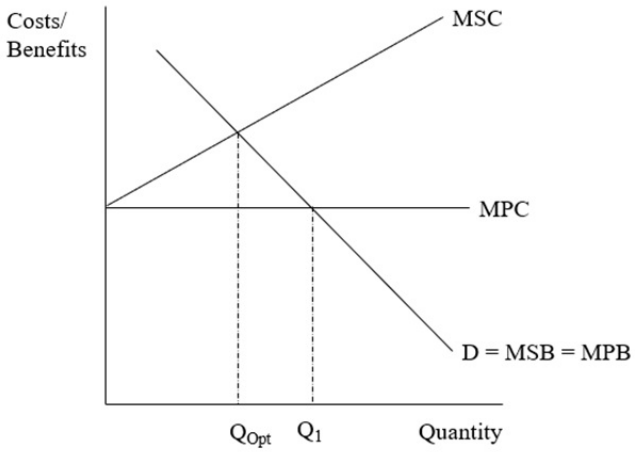

Figure 2. **Conceptualization of the potential externality of provision by publishers**. An externality may be defined as a cost or benefit caused by a producer that is not incurred by the producer. In modelling a private market, the demand for goods (such as journals) is equivalent to the marginal private benefit (MPB) to the consumer of consuming that good. The marginal social benefit (MSB) refers to the benefit that wider society derives from individual private consumption. In this example, we assume MSB = MPB in that the knowledge gained and applied from the scholarly community accessing research via journals translates to direct societal benefit in progressing science through basic and translational research. The marginal private cost (MPC) is the unit cost incurred by producers in providing the goods, ie, publishers producing journals. As mentioned, in the era of digital publishing, there may be low-to-no marginal costs, so we assume MPC to be negligible in this example. The marginal social cost (MSC) is the unit cost incurred by society as a whole as supply increases. This may be conceptualized as either the impact of public funding of research being diverted to pay for increasingly-larger APCs away from other societally-beneficial initiatives or how inaccessible research may prevent society benefiting from their applications should they otherwise have been available. Per increase in provision, it is assumed that restricted access, and thus costs of benefits forgone, increase linearly. The socially-optimal outcome (Q_{Opt}) occurs where MSC=MSB. However, as the private market only accounts for MPC, and not MSC, the current market equilibrium is conceptualized as Q_1, indicating MSC is greater than MPC in current conditions, resulting in a cost, ie, negative externality, incurred by wider society.

who will spend to the limit of their budget, it can be expected that the free market will allocate efficiently based on budget constraints. This would avoid the unnecessary bureaucracy and waste of resources involved with government intervention.

At the same time, the broader underlying normative assumption that market concentration is undesirable must be tackled. By reframing the current concentration as an indication of competitiveness due to ineffective journals that are low value-add in disseminating knowledge, it may be argued that their eventual acquisition (and subsequently the increase in market concentration) reflects the capabilities-based approach (reputational, the managerial skill of editorial boards, technological advances in submission systems and peer reviewer identification) of existing firms which have survived. Free market dynamics, therefore, present a market structure in which unnecessary government intervention may threaten a surplus of poor-quality publications.

However, this line of thinking fundamentally fails to address the nature of scientific research as a pure public good [16]. Knowledge gained from research is non-excludable since any may use it, and its use does not deplete another, so it is non-rivalrous. Journals, simply put, are a medium of knowledge dissemination. As a result, the exclusion of readers by publishers (via "big deals" or unaffordable single-paper fees), and therefore any benefits of knowledge readers are denied, implies a market failure due to a sub-optimal outcome. This may be extended to suggest that wider society suffers a negative externality of publishers' provision due to potential benefits forgone (Figure 2). In essence, this is an exemplar of rentier capitalism – oligopolistic publishers have privatized a public good and are imposing an education tax for its access [9,17]. Combined with the current triple-pay system the state suffers from funding research, paying the salary of academic peer reviewers who provide their services for free to publishers, and then buying the products through educational grants indicates, as Figure 2 shows, that the provision by private publishers needs to be reduced to the optimal quantity, Q_{Opt} [18]. Furthermore, while this quantity may be efficient, it may still be inequitable. Institutions with less generous endowments may still be unable to access articles.

This begs the question as to what extent private publishers should be allowed to exert such significant control over access to a public good such as research by subjecting them to an artificially-imposed, non-governmental education tax. In the context of Western liberal, democratic societies, there remains an implicit but clear delineation of the boundary between public and private domains. Actors within the private sphere are free to pursue their own interests while public actions regulate the private domain to safeguard public interests [19,20]. For individual scientific publishers, "firms" to generalize, the application of business ethics relies on a normative assumption of moral obligations; any controversial firm actions thus may only violate moral obligations but vis-à-vis can therefore only attract moral blame [21]. Unlike public institutions, there is no mechanism for democratic accountability regardless of the nature of the goods provided. However, such is a reductive view which establishes a false dichotomy. If we instead reframe our view of major publishers, having acquired smaller "firms" (publishers), thereby becoming corporations, they therefore occupy a third, grey sphere between public and private domains [21,22]. As such, we must grapple with if the oligopolistic publishing market structure needs to be subject to greater scrutiny. Revisiting the principle of justice one may argue that current oligopolistic agreements which have diminished consumer power, coercing them to face the results of market inefficiency and pay higher prices from which they cannot escape given the professional research obligations intrinsic to academia, demonstrates the need for political legitimization [23,24]. Short of a complete restructuring of the scientific publishing industry via nationalizing it, the implication is clear – government economic intervention is necessary.

POLICY IMPLICATIONS

Any policy implementation must increase competition in the short run and present a prestige-maintaining alternative in the long run.

Subsidies represent one potential route. Universities' repositories, academics' websites and/or non-profit hosting face structural barriers to entry. Therefore, subsidies may be provided to expand hosting. This may be funded by a Pigouvian tax to account for the difference in the negligible marginal costs of digital provision and the social costs of potential benefits forgone based on estimates of those prevented access to publicly-funded research results. As a result, the externality can be internalized. The obvious limitation is the difficulty of determining the optimal tax to levy and subsidy to provide.

While universities retain repositories of output by their academics, copyright laws may prevent them from storing the peer-reviewed final version (for which authors often sign away copyright to publishers). Thus, property rights changes may be pursued to address the asymmetries in the authors' negotiating power. The potential to retain the copyright for a fee may be one option. Legal approaches may also include referring scientific publishers to antitrust authorities. Preliminary analysis indicates that mergers in the industry have increased subscription costs with economies of scale achieved, if any, not passed onto subscribers [4]. Therefore, adopting appropriate antitrust frameworks to assess competition in the scientific publishing market is necessary.

In the long run, interventions may include the stipulation of publicly-funded institutions to form an alliance. The resulting bilateral monopoly would allow for collective bargaining to address the limitations of suppliers' negotiating power, as evidenced by Germany's *Projekt DEAL* with Springer Nature and the Netherlands' institutions with Elsevier [25,26]. There has been a trend towards emphasizing open access publishing to encourage contestable markets which would leave incumbent publishers at the risk of "hit-and-run" entrants due to the current high mark-ups [27-29]. The common example is *Plan S* where by 2020, publications arising from publicly-funded research granted by national and European research councils and funding bodies were required to only be published in open-access journals [28]. However, such a policy is limited given barriers due to high article processing charges (APC) which may now prevent authors from disseminating knowledge, especially for authors from low-to-middle-income countries, while the intrinsic problem remains – the same dominant publishers also receive the largest share of APCs [30,31]. Price ceilings may be applied to prevent exorbitant fees, both for authors and libraries. Nonetheless, the lack of prestige of most open-access journals (excluding leaders such as the Public Library of Science (PLOS) which still charge significant sums of money, placing the burden on authors instead) fails to address the inertia of prestige culture and renders such a policy quixotic [27].

Policy must tackle the issue of prestige as a fundamental intervention. Library budgets may be diverted to the establishment, and independent oversight, of an institution-based platform which uses universities' identities as a proxy reputational prestige, thereby removing the need for commercial publishers. This may be extended by altering grant and promotion decision procedures to emphasize variables beyond high-impact factor publications towards alternatives such as merits of the research, mentorship efforts, practice history, and leadership qualities. A change in how scientific research is communicated is required to enable efficient and equitable access to all for the benefit of wider society to reflect the very nature of scientific knowledge as a public good.

Funding: none.

Conflict of Interest: none.

REFERENCES

1. Altman LK. The Ingelfinger rule, embargoes, and journal peer review—Part 1. Lancet. 1996 May;347(9012):1382–6.
2. Larivière V, Haustein S, Mongeon P. The Oligopoly of Academic Publishers in the Digital Era. PLoS One. 2015 Jun;10(6):e0127502.
3. Buranyi S. Is the staggeringly profitable business of scientific publishing bad for science? [Internet]. The Guardian. 2017 [cited 2021 Apr 29]. Available from: https://www.theguardian.com/science/2017/jun/27/profitable-business-scientific-publishing-bad-for-science
4. Savenije B. Economic and strategic analysis of scientific journals: recent evolutions [Internet]. LIBER Q. 2003 Sep;13(3–4):207–21. [cited 2021 Apr 29] Available from: https://www.liberquarterly.eu/article/10.18352/lq.7735/
5. Porter ME. How Competitive Forces Shape Strategy. Harv Bus Rev [Internet]. 1979 Mar [cited 2021 Apr 29]; Available from: https://hbr.org/1979/03/how-competitive-forces-shape-strategy
6. Ware M, Mabe M. The stm report An overview of scientific and scholarly journal publishing [Internet]. Outsell Inc. 2012 [cited 2021 Apr 29]. Available from: www.outsellinc.com
7. Puehringer S, Rath J, Griesebner T. The political economy of academic publishing: On the commodification of a public good. PLoS One [Internet]. 2021 Jun 1 [cited 2023 May 15];16(6). Available from: /pmc/articles/PMC8211248/
8. Parks RP. The Faustian Grip of Academic Publishing [Internet]. J Econ Methodol. 2001 Feb;9(3):317–35. [cited 2021 Apr 29] Available from: https://ideas.repec.org/p/wpa/wuwpmi/0202005.html
9. Monbiot G. Academic publishers make Murdoch look like a socialist. The Guardian [Internet]. 2011 Aug 29 [cited 2021 Apr 29]; Available from: https://www.theguardian.com/commentisfree/2011/aug/29/academic-publishers-murdoch-socialist
10. de Camargo KR. Big publishing and the economics of competition [Internet]. Vol. 104, American Journal of Public Health. American Public Health Association; 2014 [cited 2021 Apr 29]. p. 8–10. Available from: /pmc/articles/PMC3910061/
11. Elmore SA, Weston EH. Predatory Journals: What They Are and How to Avoid Them. Toxicol Pathol [Internet]. 2020 Jun 1 [cited 2023 May 15];48(4):607. Available from: /pmc/articles/PMC7237319/
12. Greco AN. Academic libraries and the economics of scholarly publishing in the twenty-first century: portfolio theory, product differentiation, economic rent, perfect price discrimination, and the cost of prestige. J Sch Publ. 2015 Oct;47(1):1–43.
13. Dixit A. The Role of Investment in Entry-Deterrence. Econ J (Lond). 1980 Mar;90(357):95.
14. Northcott P. Normative ethical theories: an overview. In: Woldring K, editor. Business Ethics. Ontario; 1996.
15. Zarif A. The ethical challenges facing the widespread adoption of digital healthcare technology. Health and Technology. 2021 Oct 29 [cited 2022 May 18];12(1):175–9. Available from: https://link.springer.com/article/10.1007/s12553-021-00596-w
16. Walport M. Economic analysis of scientific research publishing [Internet]. Wellcome Trust. 2003 Jan [cited 2021 Apr 29]. Available from: https://wellcome.org/sites/default/files/wtd003182_0.pdf
17. Christophers B. Rentier Capitalism: Who Owns the Economy, and Who Pays for It? [Internet] Volume 1. 1st ed. Verso Books; 2020. [cited 2021 Apr 29], Available from https://www.foyles.co.uk/witem/business/rentier-capitalism-who-owns-the,brett-christophers-9781788739726
18. Braley M. Reed Elsevier: Moving the Supertanker. Deutsche Bank, Frankfurt: Company Focus: Global Equity Research Report. 2005.
19. Benn SI, Gaus GF. Public and private in social life. London: St. Martin's Press; 1983.
20. Weintruab J. The Theory and Politics of the Public/Private Distinction. Public and Private in Thought and Practice: Perspectives on a Grand Dichotomy [Internet]. 1997 [cited 2022 May 18];1–42. Available from: https://www.researchgate.net/publication/238352263_The_Theory_and_Politics_of_the_PublicPrivate_Distinction
21. Claassen R, Gerbrandy A. Doing Good Together: Competition Law and the Political Legitimacy of Interfirm Cooperation [Internet]. Bus Ethics Q. 2018 Oct;28(4):401–25. [cited 2022 May 18] Available from: https://www.cambridge.org/core/journals/business-ethics-quarterly/article/doing-good-together-competition-law-and-the-political-legitimacy-of-interfirm-cooperation/3099EEEE4CC12C0D0C97FD49053E3E34
22. Ciepley D. Beyond Public and Private: Toward a Political Theory of the Corporation [Internet]. Am Polit Sci Rev. 2013;107(1):139–58. [cited 2022 May 18] Available from: https://www.cambridge.org/core/journals/american-political-science-review/article/beyond-public-and-private-toward-a-political-theory-of-the-corporation/23BF8CB7FBBFC1BE29C5771A887862A9
23. Ripstein A. Authority and Coercion [Internet]. Philos Public Aff. 2004;32(1):2–35. [cited 2022 May 18] Available from: https://www.jstor.org/stable/3557980
24. Abizadeh A. Cooperation, Pervasive Impact, and Coercion: On the Scope (not Site) of Distributive Justice [Internet]. Philos Public Aff. 2007 Sep;35(4):318–58. [cited 2022 May 18] Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1088-4963.2007.00116.x
25. Press Release - German Rectors' Conference [Internet]. German Rectors' Conference. 2020 [cited 2021 Apr 30]. Available from: https://www.hrk.de/press/press-releases/press-release/meldung/springer-nature-and-germanys-projekt-deal-finalise-worlds-largest-transformative-open-access-agree/
26. Dutch research institutions and Elsevier initiate world's first national Open Science partnership [Internet]. Elsevier. 2020 [cited 2021 Apr 30]. Available from: https://www.elsevier.com/about/press-releases/corporate/dutch-research-institutions-and-elsevier-initiate-worlds-first-national-open-science-partnership
27. O'Donovan Ó. What is to be done about the enclosures of

the academic publishing oligopoly?* [Internet]. Community Dev J. 2019 Jul;54(3):363–70. [cited 2021 Apr 29] Available from: https://academic.oup.com/cdj/article/54/3/363/5523629
28. The lack of transparency and competition in the academic publishing market in Europe and beyond [Internet]. [cited 2021 Apr 29]. Available from: http://crimsonpublishers.com/cojrr/pdf/COJRR.000508.pdf
29. May C. Academic publishing and open access: Costs, benefits and options for publishing research [Internet]. Politics. 2019 Apr;40(1):120–35. [cited 2021 Apr 29] Available from: https://journals.sagepub.com/doi/pdf/10.1177/0263395719858571
30. Lawson S, Gray J, Mauri M. Opening the black box of scholarly communication funding: A public data infrastructure for financial flows in academic publishing. Open Library of Humanities [Internet]. 2016 [cited 2021 Apr 29];2(1). Available from: https://olh.openlibhums.org/article/id/4419/
31. Singh M, Prasad CP, Shankar A. Publication Charges Associated with Quality Open Access (OA) Publishing and Its Impact on Low Middle Income Countries (LMICs), Time to Reframe Research Policies [Internet]. Asian Pac J Cancer Prev. 2021 Sep;22(9):2743–7. [cited 2023 May 15] Available from: https://pubmed.ncbi.nlm.nih.gov/34582641/