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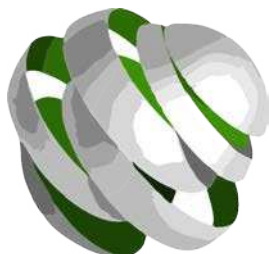
Economic Effects of Open Access to Scientific Publications

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ECONOMIC EFFECTS OF OPEN ACCESS TO SCIENTIFIC PUBLICATIONS

Икономически ефекти от отворения достъп до научни публикации

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Abstract: *With the development of digital technology and especially the possibilities for electronic publishing Open access publishing is becoming more and more a global phenomenon. Open access means unrestricted online access to scholarly research and research data. The paper presents the common definitions, the types and vehicles for delivering Open access to scientific publications. Because of its economic efficiency, the potential economic benefits of Open access might have an impact on many other groups besides the users and the authors themselves – publishers, scientific institutions, specific industries, etc. Economic effects of OA are analysed through the concept of its benefits which could generally be divided into two groups – individual and collective. Besides the economic benefits, one must also consider the “price” of OA, as well as its limitations. Together with the effects of Open access that support the development of science, its use could be regarded as a means to increase social welfare as well.*

Keywords: OA, OPEN ACCESS, OPEN ACCESS TO SCIENTIFIC INFORMATION, ELECTRONIC PUBLICATIONS, ECONOMIC BENEFITS OF OPEN ACCESS

1. Introduction: why does OA emerge?

Open access (OA) is direct online open access to research results, without the serious restrictions regarding their use which are commonly imposed by publishing contracts. It is a means for widening availability and hence for improvement of the absorption and application of research results. OA is useful not only for scientists but also for research institutions, countries and the entire society, because it contributes to increasing the effectiveness and efficiency of research.

Scholarly journals do not pay authors for their articles, and have not done so since the first journals were launched in London and Paris in 1665. Journals were started because they were timelier than books. They were better than books – readers could learn quickly about the recent work of others, while authors could share new work quickly with the wider world and establish priority over other people researching the same issues. Journals gave authors the benefit of a fast, public time-stamp on their work. Because authors were rewarded this way, they accepted the fact that journals couldn't afford to pay them. Over time, journal revenue grew but authors continued to write and publish articles for impact, not for money.

OA was physically and economically impossible in the age of print, even if the copyright holder wanted it. Prices were not only unavoidable for print journals, they were even affordable until the 1970's, when they began to rise faster than inflation. Journal subscription prices have risen nearly four times faster than inflation since 1986 (Suber, 2013). However, as journal prices were becoming unbearable, the internet emerged to offer an alternative.

The volume of published knowledge is growing exponentially and will always grow faster than library budgets. Thus, OA scales with the growth of knowledge while paid access does not. The society has long since reached the point at which even the biggest research institutions cannot afford access to the full range of research literature. Priced access to journal articles would not scale with the continuing, explosive growth of knowledge even if prices were low now and guaranteed to remain low forever.

The pricing crisis itself is just one factor in the rise of OA. Even if scholars did not turn to OA in order to bypass unaffordable access fees, they would turn to it in order to take advantage of the internet as a powerful new technology for sharing knowledge instantly, with a worldwide audience, at zero marginal cost, in a digital form amenable to unlimited processing.

The concept of providing free online access is actually in use long before the formal introduction of the term "open access" – researchers in the field of computer science began to build their own anonymous ftp-archives in the 1970s and in the early 90s

physicists and mathematicians created the arXiv-archives. A key role in this process play and library specialists in the mid-90s who, together with scientists, establish the open access movement.¹ An estimate shows that between 2017 and 2021 open access publication will cover 50% of scientific journals, and by 2025 – about 90% of them will be available in this mode (Lewis, 2012).

2. Definition and typology of OA to scientific publications

There are various definitions and interpretations of open access in the literature, each meeting the relevant historical context (and mainly the change of technology). Moreover, there are various ways to distinguish between different forms and types of OA.

2.1. OA definitions

For the first time, the term “open access” is formulated in three statements from the beginning of the 21 century, when access to the internet gets more widespread. These are the Budapest Open Access Initiative (February 2002), the Bethesda Statement on Open Access Publishing (June 2003) and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (October 2003). The formulated in these documents definitions (between which there are slight differences) contain the main characteristics of OA.

According to the Budapest Open Access Initiative open online access is scientific and scholarly journal literature that authors give to publishers and readers without asking for any kind of royalty or payment. This category includes primarily peer-reviewed journal articles, but it also includes any unreviewed preprints that scholars might wish to put online for comment or to alert colleagues to important research findings. By "open access" to scientific literature, the Initiative means its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. The only constraint on reproduction and distribution, and the only role for copyright in this domain, should be to give authors control over the integrity of their work and the right to be properly acknowledged and cited.

The Bethesda Forum enriches the Budapest definition with the right to display the work publicly and to make and distribute derivative works, as well as the right to make small numbers of printed copies for their personal use. The definition is expanded also regarding the purpose for which OA works can be used - the

¹ See Suber, 2009 for a thorough timeline of OA development.

expression "any other lawful purpose" is replaced by "any reasonable purpose". For a scientific publication to be considered OA, besides the requirement the author to grant to all users a free, irrevocable, worldwide, perpetual right of access, another requirement is introduced - a complete version of the work and all supplemental materials, in a suitable standard electronic format should be deposited immediately upon initial publication in at least one online repository. Copyright is even more limited – to proper attribution of authorship.

The Berlin Declaration confirms the formulated in Budapest and Bethesda definition, adding on an explanation about the contributions that could be regarded OA – original scientific research results, raw data and metadata, source materials, digital representations of pictorial and graphical materials and scholarly multimedia material.

The concept of OA in all three definitions includes the removal not only of price but also of permission restrictions related to copyright. If one has to give a brief definition of OA, it could be a scientific publication is with open access when it is as digital, online, disembodied and free of most of the restrictions related to copyright. Or, put in another way in ever shorter words, OA literature is free-to-use royalty-free literature.

2.2. OA typology

The most commonly used typology of OA is about user rights or freedoms. By the scope of restrictions removed one could distinguish two types of open access - "removal of price barriers" and "removal of permission barriers". To describe these types, OA literature uses the terms gratis OA and libre OA. The first type removes only the price barriers – the work could be used without payment, but is not exempt from the limitations arising from the protection of copyright or publishing contracts, i.e. users are limited to its "fair" use,² or have to request permission to exceed it. In the second type of open access both pricing restrictions and limitations related to copyright are removed, i.e. excess of "fair" use is expressly permitted. Or, to be simpler, both types remove price barriers, but libre OA removes one or more permission barriers, while gratis OA removes no permission barriers.

Another feature that allows the definition of different types of OA is about venues or the vehicles for the delivery of OA. There are two primary vehicles for delivering OA to research articles, OA journals (gold OA) and OA repositories (green OA). The main difference between them is that OA journals conduct peer review and OA repositories do not. This difference explains many of the other differences between them, especially the costs of launching and operating them. However, despite OA repositories do not perform peer review themselves, they generally host articles peer-reviewed elsewhere. OA journals find it easier than non-OA journals to let authors retain copyright – OA journals find it easier than OA repositories to provide libre OA while usually OA repositories cannot generate permission for libre OA on their own. When authors transfer copyright to publishers, they transfer the OA decision to publishers at the same time, thus OA archiving requires the publisher's permission. Even if most publishers allow green OA, many do not. Moreover, many qualify their permission and some add new restrictions over time.³

OA archives or repositories do not perform peer review, but simply make their contents freely available to the world. They may

² Fair use is a legal term used in the US legislation which lays down rules for unlicensed, but legal use of copyright material. To define the scope of fair use protection four criteria are used that are related to the purpose of use, the type of protected material, the used relative share of the material and the effect of the use, as far as it can be measured by its market value.

³ For a list of OA journals in all fields and languages, see the Directory of Open Access Journals (<http://www.doaj.org/>). For a list of OA repositories around the world, see the Directory of Open Access Repositories (<http://www.openoar.org/>) and the Registry of Open Access Repositories (<http://roar.eprints.org/>).

contain unrefereed preprints, refereed postprints, or both. Archives may belong to institutions, such as universities and laboratories, or disciplines, such as physics and economics. Authors may archive their preprints without anyone else's permission, and a majority of journals already permit authors to archive their postprints. On the other hand, OA journals perform peer review and then make the approved contents freely available to the world. Their expenses consist of peer review, manuscript preparation, and server space. OA journals pay their bills very much the way broadcast television and radio stations do: those with an interest in disseminating the content pay the production costs upfront so that access can be free of charge for everyone with the right equipment. Sometimes this means that journals have a subsidy from the hosting university or professional society. Sometimes it means that journals charge a processing fee on accepted articles, to be paid by the author or the author's sponsor (employer, funding agency).

Besides these two OA vehicles, there are other ways to grant OA which emerge with the development of the internet environment such as personal web sites, e-books, discussion forums, email lists, blogs, wikis, videos, audio files, RSS feeds, and P2P file-sharing networks, etc. However, they will not be discussed in detail.

3. Economic effects of OA

The economic effects of OA are analysed through the concept of its benefits which could generally be divided into two groups – individual and collective. Besides the economic benefits, one must also consider the "price" of OA, as well as its limitations.

3.1. Individual benefits of OA

The main advantage of the publications with open access for users is that OA removes price barriers and limitations associated with permissions and copyright. Publications with open access are not created for free, the point is just that the price is not paid by consumers. Thus, more people have the opportunity to use more products, which is beneficial for them and for the creators of these products, as well as for the development of science, as the main users of such works are namely other researchers.

The most obvious benefit of OA for researchers is that their works immediately gain visibility on a global level. In order to understand the not so visible benefits of open access for researchers one should consider their motivation to publish, which is different from that of most other authors whose works are protected by copyright. On the one hand, the purpose of research publications is somewhat altruistic – scientists publish the results of their work to enable them to be reached by a maximum number of colleagues to be used and upgraded, thus developing knowledge in the specific area of research and of science in general. On the other hand, unlike the works of other authors (music, movies, artwork, etc.), scientific publications most often are not intended to generate immediate cash profits, as most scientific journals, regardless of whether they are OA or paid, do not pay royalties to their authors for the articles published. The motivation of scientists to publish is rather based on the creation of opportunities for indirect gains, mostly related to their career development.

The motivation of researchers who publishing with OA could be compared to that of programmers who developing open source software, which is also associated with the extraction of career benefits. This issue is examined by the Nobel laureate in economics for 2014 Jean Tirole (Lerner and Tirole, 2002). Speaking the language of economics, a researcher will publish with OA when he will gain net profit (in the broad sense) that is equal to the sum of the immediate profits (immediate revenues minus direct immediate costs) and subsequent profit (follow-up revenue minus subsequent follow-up costs). Obviously, when publishing with OA, the immediate revenues are zero or at best – minimal, while there are direct costs – one could consider as such those costs that are associated with research (whether they are borne by the researchers themselves, or the institution in which they operate); time spent on a

particular study (and not on another one or on teaching), especially for its preparation for publication; the cost of the publication (if any), etc.

On the other hand, however, there are no subsequent costs, while the subsequent profit could be big, ranging from increasing the citation,⁴ which leads to the affirmation of the researcher in the scientific community; accelerated academic development; proposals for higher-paid positions, publishing contracts and others. These are the so called "signalling incentives", which could be divided into two groups: those that affect career development and those that are associated with ego satisfaction. According to economic theory signalling incentives are stronger, when: first, the results are more visible for the interested audience; second, the impact of an effort on the results is greater; and third, the results are more informative regarding the abilities of the contractor (Holmstrom, 1999). It is undisputed that in science the satisfaction of these conditions depends on the quality of the researchers and their work themselves. Open access publication, however, due to its very nature allows to increase the signal incentives. This in turn leads to an increase of the economic efficiency of the publication with OA from the point of view of researchers.

The benefits of OA regarding *publishers* are mostly related to the reduction of the costs of their activities, which somewhat compensates the loss of revenue from sales. Some of these savings – for example, eliminating the cost of printing and physical distribution, are inherent not only in publications with OA, but also to all digital editions. But there are costs typical for paid publications that are absent in those with open access. They are associated with the subscription, the technical means for copyright protection, legal services, etc. Moreover, many journals with OA eliminate marketing expenses, relying on advertising and publicity provided by search engines, blogs, discussion forums, social networks, etc.

OA *journals* are sustainable from an economic point of view, because the real costs of peer review, manuscript preparation and distribution are much lower than the current subscription prices of most paid journals. The main idea of the funding of open access journals is that those who have an interest in the dissemination of information, pay the "production" costs in advance, so it can be free of charge for everyone that has the necessary equipment. Some OA journals are financed by subsidies (by scientific institutions, libraries, foundations, government agencies, etc.), while others require payment for the publication of approved articles from the authors themselves. It should be noted that nearly 70% of open access journals do not require any payment by the author, while about 75% of the paid journals have (some) charges. In reality, almost 90% of the fees paid in journals are either waived or paid by sponsors on behalf of authors (Suber, 2006). Moreover, open access journals can generate profit through advertising, publishing of printed versions or additional services (Suber, 2012). And the fact that their popularity is becoming greater increases the potential amount of such revenues.

3.2. Collective benefits of OA

Open access is a useful tool for *research institutions* – on the one hand, they can use it as a means to facilitate the monitoring and evaluation of the implementation of their research programs; on the other hand, providing OA to the research, carried out by them, they promote their activities; and last but not least, OA allows them to identify "white spots" in science – niches that could be filled. Research institutions receive the same benefits as the external donors of research that have an interest to monitor and evaluate how effectively allocated funds are utilised, and to ensure maximum publicity and dissemination of the activities they are funding. All this gives an incentive for more research institutions and donors to pursue policies of open access and to require the researchers they

⁴ Currently, the standard measure of the value of scientific journals and publications are citations. See Swan, 2007 for a quantified analysis of the impact of OA on the number of citations, the time between publication and citation, as well as the impact factor measurement of publications.

fund to provide OA to the results of their scientific activity. These are the reasons for the increasing number of universities and research institutes that allocate special funds for payment of fees for publication in "paid" OA publications on behalf of the researchers.

Another collective beneficiary of OA are *libraries*, as OA solves the pricing crisis for scholarly journals, which, as already mentioned, is in the core of the OA movement. OA also serves library interests in other, indirect ways. Librarians want to help users find the information they need, regardless of the budget-enforced limits on the library's own collection. Academic librarians want to help faculty increase their audience and impact, and help the university raise its research profile.

OA increases the return on *funding agencies* investment in research, making the results of the funded research more widely available, more discoverable, more retrievable, and more useful. When funding agencies disburse public funds, OA helps in a second way as well, by providing fundamental fairness to taxpayers or public access to the results of publicly-funded research. For example OA is included as a mandatory requirement in the rules for the implementation of EU's Horizon 2020 (European Commission, 2013).

There is increasing evidence that even *countries* benefit from OA, because, as in the case of funding agencies, it strengthens the impact of research in which they invest public funds. Open access expands and accelerates the application and commercialisation of research results, thus increasing the return on public and private spending in this area. It enables many entities (e.g. medics, students, small businesses in the field of consultancy, architecture, electronics, ICT, biotechnology and nanotechnology, etc.) to enrich their knowledge, to provide better services and to increase the productivity of both their own work and that of their clients. The impact of OA is stronger in certain sectors (mainly knowledge dependent services), but is also great in areas such as management and economic theory and practice, because it improves the quality of services and products. Furthermore OA can have a positive impact on the development of policies thanks to better-informed participants in policy-making, as well as to the expanded access to the information their decisions depend on.⁵

As already noted, there are benefits for *society* as well, because by using open access, research becomes more effective and more efficient, providing faster and better results. Moreover, OA facilitates the development of knowledge in specific areas, as well of science in general. The positive impact of OA is further associated with increasing the awareness of citizens and consumers, leading to better use of public services, greater consumer choice, etc. This in turn increases the individual and public welfare.

3.3. The price of OA

OA literature is not free to produce or publish. One might argue that it is much less expensive to produce than conventionally published literature, even less expensive than priced online-only literature. The question is not whether scholarly literature can be made costless, but whether there are better ways to pay the bills than by charging readers and creating access barriers.

The costs of producing OA literature, the savings over conventionally published literature, and the business models for recovering the costs, depend on whether the literature is delivered through OA journals or OA repositories.

First of all, OA dispenses with print, but so do many non-OA journals nowadays. Secondly, OA eliminates subscription management (soliciting, tracking, renewing subscribers, negotiating prices and site licenses, collecting fees). Thirdly, OA eliminates website administration costs (authenticating users, distinguishing authorised from unauthorised users, blocking access to the

⁵ See Houghton and Sheehan, 2006 for a quantified analysis of OA economic benefits for the state.

unauthorised). On the next place, OA reduces or eliminates legal expenses (drafting and enforcing restrictive licenses). Moreover, many OA journals eliminate marketing and rely solely on spontaneous aid from other players, such as search engines, bloggers, discussion forums, social tagging, and social networking. While reducing these expenses, OA adds back little more than the cost of collecting author-side fees or institutional subsidies.

As long as the full-text is OA, priced add-ons or enhancements are compatible with OA. If the enhancements are expensive to provide, then providers may have to charge for them. If they are valuable, then providers may find people willing to pay for them. At some OA journals, priced add-ons provide part of the revenue needed to pay for OA.

“Free is ambiguous. We mean free for readers, not free for producers. We know that open-access literature is not free (without cost) to produce. But that does not foreclose the possibility of making it free of charge (without price) for readers and users” (BOAI, 2012).

3.4. Limitations of OA

Open access is not synonymous with universal access. Even after OA has been achieved, there are still some access barriers that remain in place. These could be related to filtering and censorship. Many institutions, employers, and governments, as well as the authors themselves might want or have to limit the research results achieved that could be seen and used by the general public. On a second place, there are some connectivity barriers. Although internet access is spreading fast, the „digital divide“ still exists even in the most developed countries and keeps billions of people, including millions of serious scholars, offline. Thirdly, some limitations are related to language. Most online literature is in English, or just one language, and machine translation is still very weak which limits the possibilities for use of OA research results to just those that are common with the language in which the respective study is published. Last but not least, there are handicap access barriers. Most web sites (especially voluntarily maintained OA repositories) are not yet as accessible to handicapped users as they should be which limits the possibilities for these vulnerable social groups to use the advantages offered by OA.

Moreover, there are many differences among the disciplines that affect the funding of OA. One should not expect OA to make progress in all disciplines at the same rate, any more than one could expect it to make progress in all countries at the same rate. Most of the progress and debate is taking place in the fields of science, technology, and medicine studies, but OA is just as feasible and useful in the humanities.

4. Conclusion

Access to the Internet dramatically changes the means for dissemination of scientific knowledge. Open access to scientific publications is an indicator of the new concept of scientific publications that focuses on the development of knowledge and science.

Although there are many definitions of open access, all are united by the main characteristics of OA – the absence of mandatory restrictions on access (incl. pricing) and recognition of authorship as a minimum limitation of use. Open-access (OA) literature is digital, online, free of charge, and free of most copyright and licensing restrictions. OA removes price barriers (subscriptions, licensing fees, pay-per-view fees) and permission barriers (most copyright and licensing restrictions).

Because of its economic efficiency, besides consumers and authors themselves, the potential benefits of open access also affect many other groups – publishers, research institutions, specific economic sectors. Besides its effects that support the development of science, OA is beneficial for the whole society and could even be seen as a factor for the increase of social welfare. However, even after OA has been achieved, there are still some access barriers that remain in place.

OA literature is not free to produce, even if it is less expensive to produce than conventionally published literature. The question is not whether scholarly literature can be made costless, but whether there are better ways to pay the bills than by charging readers and creating access barriers. Because of the many benefits for different stakeholders, OA is emerging as a practice worldwide and could be regarded as the new way of scientific communication and the future of scientific publishing.

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