

Open Access, library and publisher competition, and the evolution of general commerce

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Abstract. Discussions of the economics of scholarly communication are usually devoted to Open Access, rising journal prices, publisher profits, and boycotts. That ignores what seems a much more important development in this market. Publishers, through the oft-reviled “Big Deal” packages, are providing much greater and more egalitarian access to the journal literature, an approximation to true Open Access. In the process they are also marginalizing libraries, and obtaining a greater share of the resources going into scholarly communication. This is enabling a continuation of publisher profits as well as of what for decades has been called “unsustainable journal price escalation.” It is also inhibiting the spread of Open Access, and potentially leading to an oligopoly of publishers controlling distribution through large-scale licensing.

The “Big Deal” practices are worth studying for several general reasons. The degree to which publishers succeed in diminishing the role of libraries may be an indicator of the degree and speed at which universities transform themselves. More importantly, these “Big Deals” appear to point the way to the future of the whole economy, where progress is characterized by declining privacy, increasing price discrimination, increasing opaqueness in pricing, increasing reliance on low-paid or unpaid work of others for profits, and business models that depend on customer inertia.

Keywords: Open Access, Big Deals, price discrimination

1 Introduction

Concerns about libraries not being able to afford rapidly escalating journal costs go back many decades. Over the last 15 to 20 years, they have intensified. This was partially because the cost pressures have become more burdensome. Perhaps even more important has been the arrival of the Internet, as well as of computerized typesetting and other modern electronic tools. These have offered the possibility of much less expensive methods of scholarly publishing. As one result, there has been an increased push for various forms of Open

Access. (It is also advocated for other reasons, of course, primarily to make information more widely available.) There have also been calls for scholars to stop collaborating with the expensive commercial publishers, by refusing to submit their papers to them, as well as to referee submissions or edit journals. The most recent prominent call of this nature was initiated by Tim Gowers in early 2012, and as of this writing has attracted over 13,000 signers [14].

Protesters, such as those who endorse the boycott [14], tend to cite the high profits of commercial publishers, most commonly of Elsevier, the largest one, as injurious to scholarly communication, and unjust, being based on donated labor of academics. They also often complain about the “Big Deals” that large publishers, again with Elsevier in the forefront, force libraries into, cf. [2,9]. In these contracts, which are universally shrouded in secrecy (although an interesting project is revealing some of the details [10]), libraries are forced to accept multi-year commitments with steady price escalation and little flexibility in selecting what journals they get. This has all the obvious disadvantages for libraries and the academic community. However, such discussions almost universally ignore the positive effects of the “Big Deals,” as well as the degree to which those positive effects are key to the main action in scholarly publishing, namely the competition between libraries and publishers.

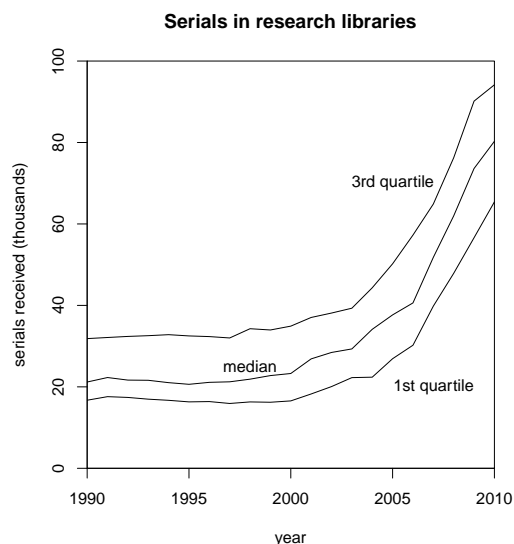


Fig. 1. Number of serials available in research libraries from 1990 to 2010. Shows the median as well as the first and third quartiles of the number of serials received by academic members of ARL.

The main contribution of this paper is an investigation of the effects of the reviled “Big Deals” on access to scholarly journals. In spite of their low reputation, over the last decade they have produced a remarkable increase in availability of serials. This is shown in Fig. 1 and is discussed in more detail in Section 4. The data for the analysis is taken from the

careful and detailed statistics for the 115 academic members of the Association of Research Libraries (ARL) [7]. Those members include almost all large university libraries in the U.S. and Canada. (For more about ARL, its statistics, and the selection of data, see Section 5.) The median of the number of serials received by ARL members almost quadrupled during the period under investigation, going from 21,187 in the 1989-1990 academic year to 80,292 in the 2009-2010 one. Practically the entire increase took place during the last half a dozen years, without any big changes in funding patterns, and appears to be due primarily to “Big Deals.”

Members of ARL are all large libraries, but with substantial variation. In the 2009-2010 academic year their budgets (as defined by ARL) ranged from \$8.3 to \$111.6 million, with a median of \$22.8 million. Thus improved access to journals for just these institutions still leaves out in the cold the general public as well as students and researchers at many hundreds of other higher education institutions in North America, as well as potential readers in other countries. (It should be noted, though, that many of those institutions do appear to be benefiting from “Big Deals” and other arrangements, it’s just that this study is limited to ARL members by the nature of the data that is was available .) It also ignores wider issues of access to other types of information, cf. [28]. Still, these 115 institutions do contain a very substantial fraction of both authors of scholarly journal papers as well as of readers. Thus it is of interest to see what the recent trends have meant for them, especially since there are analogies and implications for the wider economy.

Fig. 1 demonstrates not only that the average number of serials available in ARL libraries has grown, but that gaps between the large and small libraries have decreased. This is shown in more detail in Section 4, especially in Fig. 2. Section 5 proves that this occurred without any dramatic changes in either relative or absolute spending on serials. This socially positive development is the outcome of the growth in price discrimination, the selling of the same product or service at prices varying depending on customer. As an example, in 2007 unlimited access to the entire collection of journals published by Elsevier cost the University of Michigan \$1,961,938.75, while the University of Montana paid \$442,224.78. Such practices are increasingly common, although usually carefully hidden from view. (Uncovering this degree of differential pricing required considerable effort by Ted Bergstrom and his collaborators, including fighting a lawsuit from Elsevier [10].) Hence the spread of “Big Deals” provides interesting perspectives on the development of the modern economy. Before considering that wide subject, let us return to the scholarly journal crisis.

Can commercial publishers continue to prosper? Financial analysts are divided. A team from Exane Paribas in Paris declared (as cited in [40]) that the boycott initiated by Gowers [14] was effectively a tempest in a teacup, and that sales of Elsevier shares by investors foolish enough to be scared offered a “trading opportunity.” On the other hand, Claudio Aspesi and his colleagues at Bernstein Research in London have been bearish on the commercial STM (science, technology, and medicine) publishing sector for several years (cf. [3,4] and other reports) and decided the recent events were foretelling serious trouble [5].

The bearish views on Elsevier are based largely on the estimate that the “Big Deals” are becoming unaffordably expensive and will soon start breaking down. That might happen. However, the complaints about unaffordable journals go back many decades, yet they

somehow have been afforded. To understand how this was possible, one needs to take a larger view of the economics of scholarly communication. The high profits earned by commercial publishers, as well as by many non-profit professional societies, are one of the lesser inefficiencies in that system. Those profits are just a fraction of the actual, and now unnecessary, real costs of the current scholarly journals. And those real publishing costs are much smaller than the (now) unnecessary real costs of the library system. Publishers have managed to continue with their “unaffordable” journal price increases by squeezing some of that inefficiency out of the libraries. And there is a lot more to be squeezed.

Discussions of the economics of scholarly publication almost uniformly ignore the dominant economic factor in that area, namely that most of the cost is inside libraries¹, and that technology is making feasible and desirable the dramatic downsizing of traditional functions not just of publishers, but also of libraries [32,37]. (Those costs, in turn, are dwarfed by the costs to authors, editors, and referees, cf. Section 2, but those costs do not involve any money transfers and are not accounted for.) As a prime example, while librarians increasingly take on new roles, handling the huge volumes of books and bound serials is still a large part of the cost of library systems. Yet, at a rough estimate, 90% of the books and 99% of the journals in a typical large academic library can, should, and will be sent to inexpensive off-site warehouses, with usage shifting to electronic copies. That will free up space and eliminate many of the jobs in the system.

The key role of high internal library costs in academic information systems is probably ignored because of a general reluctance to face unpleasant facts². Libraries are central to the image of modern universities, the repositories of knowledge and wisdom. They are unifying institutions, serving everybody on campus and often in the community at large. Their buildings are usually centrally located, and are among the most imposing around, and they are staffed by the helpful librarians, perhaps the best-loved group on campus. The notion of laying off those friendly librarian colleagues and closing down library facilities in order to sustain the profits of Elsevier is repugnant. But that is what we are facing. Furthermore, sending physical collections to inexpensive off-site warehouses, closing down physical library facilities, and limiting hours of operation of remaining ones, all of which has been taking place to only a limited extent so far, is not only inevitable, but desirable. Online access is more effective and is bound to dominate to an increasing extent. Such a transformation has already taken place to an even greater extent in corporations, which have largely eliminated their libraries, but do pay for access to commercial databases, including those that contain scholarly materials.

ARL statistics, summarized in Section 5, show that while library budgets have grown much faster than general inflation, they have shrunk compared to university budgets. At the same time, the fraction of library costs that are devoted to purchases of books, journals, and databases has grown over the last two decades from about a quarter to about a third (if we consider the full costs of library systems). This indicates that libraries are becoming less important to universities, while publishers have roughly maintained their position by wresting more of the resources from the libraries. (There has also been growth in spending on other scholarly communication services outside the library/publisher area that are not captured in the ARL statistics.)

Among recent moves towards mandated open access in Britain, the Finch report and the RCUK Open Access policy have been criticized by many Open Access advocates for tilting towards publishers through an embrace of Gold Open Access (in which publishers are paid to make the articles in their journals publicly available). This is seen as potentially imposing crippling additional costs on researchers. However, although this was not mentioned explicitly in those reports, a very obvious move might be to recover those extra costs not from research funds, but from library budgets, and force cutbacks in traditional library functions. Thus while Aspesi et al. [6] have seen these recommendations as a threat to publishers, it may actually mean another victory in their competition with libraries.

Open Access is not the same as low-cost publishing. The two can be treated as orthogonal aspects of scholarly communication. However, the low costs made possibly by modern technology make a break with traditional high-cost subscription publishing models far more feasible. Andy Grove, the famous former CEO of Intel, argued that a 10-fold change in cost or capability of a technology requires fundamental rethinking of the basic business model. Electronics does offer the possibility of a 10-fold decrease of basic journal publishing costs. As one example, it is argued later in this paper that just the money that the ARL libraries alone spend on acquisition of serials would in principle suffice to fund an adequate Open Access publication support for all the scholarly journals in the world.

Open Access has manifold advantages for society as a whole and for scholars. However, the inertia of librarians and scholars has kept them from taking advantage of the opportunities offered by modern technologies. On the other hand, publishers have moved faster, and it now appears that subscription journals may survive for a long time, together with their associated unnecessarily high costs and unnecessarily high profits.

The evolution of scholarly publishing, including the changing roles of libraries and publishers, is of interest as a bellwether of change in academia in general. Two decades ago, the arrival of the Internet and other electronic technologies led to prophecies that universities were doomed [31]. Instead, as others predicted, e.g. [36], they blossomed. (See Section 6 for some statistics.) Today a new wave of “disruptive innovation” is threatening the traditional academic model, with a proliferation of for-profit educational institutions as well as free massive online courses being cited as just the start of massive changes. Chances are that, as was argued in [36], there will be far less of a collapse than is promised (or threatened), and that the new techniques will be more of an addition than a replacement for traditional approaches. Education, just like medicine, is a growth business in a world that depends increasingly on training and expert knowledge. Hence this sector as a whole is not likely to shrink. However, change is likely. In particular, some of the trends in research that doomed old-style industrial research labs [33] are now showing up in universities. A natural development might lead to the abolition of traditional departments, for example. It will be interesting, therefore, to see the degree to which universities are willing, or are forced, to outsource their library functions to Google and publishers. That might that serve as an indication of how likely more disruptive moves are to occur in academia.

More generally, the evolution of scholarly publishing provides interesting insights into the evolution of commerce in general. The availability of the comprehensive and reliable ARL statistics enables us to obtain quantitative measures of some phenomena that are

usually hidden from view. One of the most important and interesting of these phenomena is the growth in price discrimination, as in the University of Michigan paying \$2 million for something that the University of Montana obtains for \$440 thousand. As was easy to predict a long time ago, differential pricing is the driver behind the systematic destruction of privacy. This is finally beginning to be slowly reflected in press coverage, cf. [13,17]. For the most part, though, it is studiously avoided, both in scholarly venues (such as the call for papers in the conference [20]) and in most newspaper articles, which cite arguments that data sharing rules should not be so tough as to “hinder or undermine the ability of companies to innovate” without explaining what kind of innovation is meant [44]. The reason this topic is so studiously avoided is likely because it is even less pleasant to think about than downsizing libraries in order to preserve Elsevier’s profits. The logic of growing price discrimination leads to visions of a “dystopian future” [26], where many of the basic assumptions about the economy no longer apply. Scholarly publishing provides useful insights into why differential pricing is spreading, why it is spreading so slowly and surreptitiously, and why its spread is hard to resist.

Scholarly publishing also illustrates some other developments in the modern economy. The ability of consumers to find information and hunt for the best deals is justly celebrated [12,16], and has done much to improve the efficiency of the economy. But this development is accompanied by countervailing tendencies, such as greater opaqueness in other areas of the economy, as was evidenced by all the “toxic” financial instruments that facilitated the bubble that led to the crash of 2008. In journal pricing, we also observe greater opacity, with list prices being essentially meaningless, and real prices hidden behind non-disclosure clauses in sales contracts.

Some of the phenomena that scholars object to, such as publishers making profits out of the unpaid labor of authors, editors, and referees, are of ancient standing, and are now being replicated far more widely elsewhere in the economy. Many of the most successful tech companies of the modern era, such as Facebook and Google, derive their value from the unpaid labor of their users. Thus what is claimed to have been a possibly passing anomaly in scholarly publishing is actually becoming a central feature of the modern economy.

The core of this paper is Section 4, which explores the effect of “Big Deals” on access to scholarly information among ARL members. First, though, a general overview of scholarly journal cost structure and of the perils of technological and market prognostication is presented in Section 2. Then there is discussion of the value of quantity and quality in Section 3, since many scholars dismiss concerns about publishing by claiming that all that is needed is a tightening of standards in order to eliminate any crisis. Then comes Section 4, as mentioned above. It is followed by Section 5, which describes the data sources that are used, and their limitations. Section 6 has a deeper look into the budgets and relative roles of universities, publishers, and libraries. Section 7 summarizes the arguments that scholarly journal publishing can be carried on at a far lower cost than it is at present. Section 8 delves into the competition between libraries and publishers, and what their best courses of action for the future are. Finally, Section 9 has the conclusions.

2 Open Access, academic publishing, and academic inertia

Calls for Open Access became prominent about two decades ago, and there were many predictions that it would arrive quickly. Instead, we have seen steady growth, and this has led to some expectations that we are close to a critical point, beyond which some form of Open Access as well as new, lower cost, publishing models would become dominant. However, the evidence of this paper suggests that the future may unfold in a different way. The posting of preprints, while still not universal, is spreading, and the arguments for it are even stronger than before. However, the high cost journals are still surviving, and may continue to do so.

This paper is not about Open Access. Rather, it is about what is actually happening in the rest of scholarly publishing, and why instead of pure Open Access, we might instead end up with something that might have a similar effect. In particular, we might have various institutions paying subscription fees to high-cost publishers to provide access to wide classes of readers (potentially entire nations). Thus practically nothing will be said about the extensive literature on Open Access, on Green versus Gold models, and the like. Just a few references to that area are Peter Suber's blog and [11,21,22,24,25,29,30,45,46]. There is rapid growth in Open Access, as shown by some of these papers, by the Directory of Open Access Journals maintained at Lund University, and by other sources. The question is, is it fast enough to prevent publishers from entrenching their high-cost journal model. Thus, for example, in mathematics, arXiv receives about 25,000 submissions per year, but that is still only about one quarter of all mathematics papers that Mathematical Reviews processes each year. The growth rate in arXiv submissions is around 15% per year, a rate that is far faster than the approximately 3% per year growth in the number of articles, and not dissimilar to other growth rates observed in other aspects of Open Access. However, that growth is not as fast as what can be seen in Fig. 1 over the last few years for increase in access to serials at ARL libraries.

While there is no space in this paper for a complete review of the scholarly literature, it will be handy to build the presentation and analysis around an early paper [32]. It estimated that a typical article cost about \$20,000 in author's time and \$4,000 in time of reviewers, both costs that don't show up in any budgets, but do reflect the effort devoted to scholarly publications by unpaid experts. It also estimated publisher revenues per article of about \$4,000, and internal library costs of about twice that. It also estimated that \$300–1,000 per paper would suffice for very good quality in an online-only environment, and that costs of digitizing old materials would be low (see also [34]). All those estimates still appear reasonable, and even lower costs have actually been demonstrated, as is discussed in Section 7. These estimates were then used to argue for a shift to new low-cost and Open Access journals.

While the conclusions and predictions of [32] did reflect a realization of how much of an obstacle the inertia of the academic system posed, the main failure of that paper was in underestimating that inertia. As has been noted many times recently, “scholarly behavior is profoundly conservative where communication is concerned and that, if anything, younger members of a discipline are even more conservative than their elders who are better established” [27]. The growth in novel forms of peer review has been extremely slow. Even the

high energy theoretical physicists, the first field to embrace the predecessor of arXiv, and to submit virtually all their preprints there, continue to publish most of their papers in conventional journals. A particularly telling observation is that even Stevan Harnad, that indefatigable advocate for Open Access, has scaled back his effort in this area in frustration.

Some studies of rates of diffusion of technologies found that while new forms of communication were often embraced rapidly by scholars [38], that was not the case with the basic journal publications, which were often deeply embedded into the sociology of their fields, and so on their own would likely take generations to evolve substantially. The only way to speed up the process appears to have “forcing agents,” who can compel change [35]. One set of potential forcing agents were university administrators. However, with a few exceptions, they have been slow to act or lead, either from ignorance, or pusillanimity, or perhaps from a deeper understanding of how fast academia can move. As a result Open Access mandates have been coming primarily from funding agencies, and relatively slowly.

The high internal costs of libraries compared to the purchase cost of serials was an obviously important factor [32,37]. Further, consideration of the entire scholarly communication system, in which publishers and librarians were the intermediaries between scholar authors and scholar readers led to the prediction that there would be an intensifying conflict between these two groups, as old roles became obsolete or were shifting, and new roles were emerging. From the beginning it seemed likely that publishers would be more successful at it than librarians [37]. The evidence of this paper supports that prediction. However, the field is in a state of ferment, and it is hard to tell how the competition will turn out in the end, given that Open Access mandates are increasing, and new inexpensive journals are proliferating.

3 Quantity, quality, and value

The basic assumption made in this paper is that more information is better. We do have a rising chorus of complaints about information overload. Furthermore, most researchers depend most of the time on a limited number of information sources. This is the basis for some of the concerns about the viability of the “Big Deals” (see, for example [4]). Research libraries might reduce their subscriptions to just a small core of journals, and rely on purchasing access to individual articles as needed. Just how much are all those extra journals worth? Why can’t the libraries be more selective?

There are several answers to that. There is a continuation of the traditional growth in the volume of scholarly information, at about the traditional 3% per year rate that has prevailed for many decades. There is no sign this is going to stop. Furthermore, with the increased emphasis on interdisciplinary and multidisciplinary research, there is a need for access to all the research that is being produced.

Second, all the evidence we have is that libraries are not very good at selecting the best. And, of course, the scholarly community itself is not very good at deciding what is the best. The defects in the editorial and refereeing processes have been known for long, and are becoming ever more apparent. Scholars cannot rely on just a narrow slice of available information even if it is confined to what has received the highest grade of approval from the current system.

Another answer is that all those extra journals must be worth something. This is demonstrated by the behavior of scholars and libraries in the past. After all, the bottom quarter (in terms of serials received) of ARL members obtained fewer than 17,000 serials in the 1999–2000 academic year, before “Big Deals” became dominant, while the top quarter all procured over 34,000. Why did those richer libraries bother? If the extra 17,000 serials could be dispensed with, why didn’t those institutions save the millions of dollars that each one spent annually on acquiring them?

Further, decisions about usage, acquisition, and retention of scholarly material are made at the margin. And most of the current physical collections are of marginal value. One can imagine that in negotiations, in response to librarians’ pleas that the “Big Deals” are unaffordable, publishers point out that they would be easily affordable if librarians sent off much of their hard copy material to distant and inexpensive storage facilities, shut down some library facilities, curtailed operating hours, and so on. All these steps would lower the level of access to useful information, but so would abandoning the “Big Deals.” The real question is, which hurts more? In either case, resources are devoted to providing access to material that, for the most part, has little value individually, but substantial value in total, not least in the “option value” of being able to access it when desired.

And of course there is much more that can be said in favor of wider availability. The Open Access movement is based on the argument that we need far wider distribution of research results. This paper won’t attempt to survey all the arguments that have been produced. It will suffice to say that they appear overwhelmingly persuasive, and are becoming ever more valid as scholarly literature grows and the need for and opportunities in interdisciplinary work increase.

Bradford’s law from information sciences was formulated to provide a quantitative estimate of diminishing returns from search in journals. This “law” (which is an empirical observation, akin to various other “laws,” such as those of Pareto and Zipf), together with other evidence from a variety of fields, suggests a more general rule [39] that as a very rough guide, information, whether in a library, or on a hard disk, or measured in transmission capacity, should be valued on a logarithmic scale. Thus if a collection of 10,000 serials is valued at 4, one that is 10 times as large, with 100,000 serials, might be worth 5. That is a gain, but not by factor of 10, but just by 1.25. For this paper, though, a precise measure is not necessary. Wider access is taken as positive. What we find, as is shown in the next section, is that “Big Deals” have led to a major step in the right direction.

4 Effects of “Big Deals”

ARL statistics for the academic years 1989-1990 through 2009-2010 (depicted in all the graphs as 1990 to 2010), show that the last decade has produced a remarkable increase in availability of serials. This is shown graphically in Fig. 1, which is based on a ranking of the ARL academic libraries by the number of serials they receive.

The increase in numbers of available journals was also accompanied by a notable leveling in availability among ARL members. This can already be discerned in Fig. 1, but is much clearer in Fig. 2. For each year, the academic members of ARL were ranked by the number

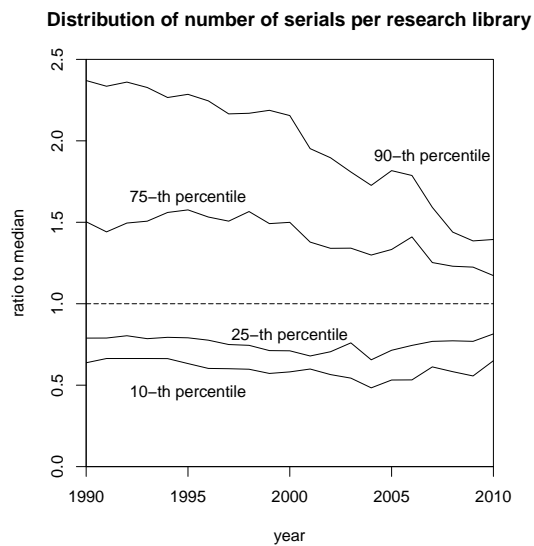


Fig. 2. Ratio of the number of serials received by various research libraries to the median, for 10th, 25-th, 75-th, and 90-th percentiles, ranked by the number received.

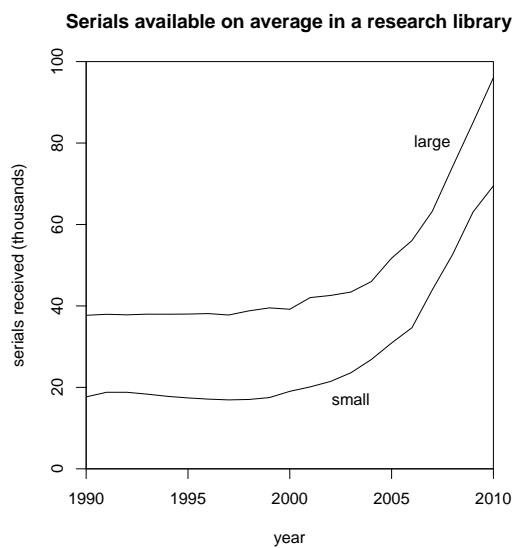


Fig. 3. Average number of serials received in smaller and larger research libraries, 1990-2010.

of serials they received, and the percentiles and displayed ratios were computed. There is a great degree of compression, especially at the top, with the 90-th percentile institutions far closer today to the median than in earlier years. The distribution of library budgets has not changed much over this period³, so what we observe is the result of increased price discrimination. Figures 3 and 4 show statistics for the “small” vs. ”large” ARL libraries, defined in each year as those below and above the media in terms of total library budgets. (Thus “small” is a relative term, as in 2010 this category included a few libraries with budgets of over \$22 million.) They demonstrate that the “small” institutions gained more than the “large” ones⁴. The average price per serial received by ARL academic members has plunged over the last decade, to a level last seen around 1990, even in current dollars, without any adjustment for inflation. (Unless stated otherwise, all dollar figures in this paper are in current dollars.)

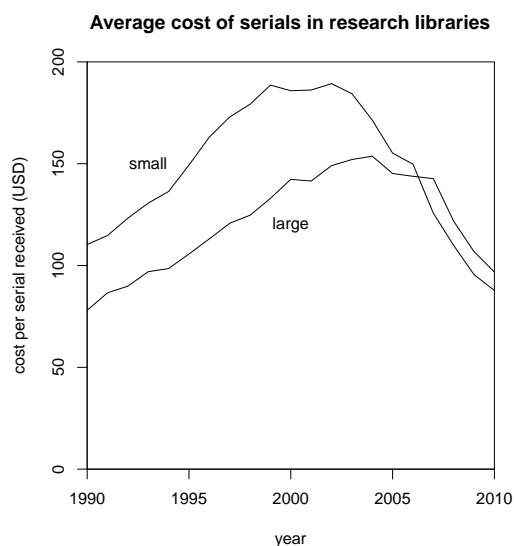


Fig. 4. Average price per serial received that was paid by the smaller and larger halves of research libraries, 1990-2010. (Current dollars, not adjusted for inflation.)

The growth of the last decade was certainly made possible by improvements in technology, so that huge collections of journals can be made available in electronic versions even by libraries that could not possibly hope to house them physically. But much of the credit must be assigned to the reviled “Big Deals,” in which publishers enriched their offerings by tossing in many additional journals. This increase in journal availability was not accompanied by commensurate revenue increases. As is shown in the ARL statistics summarized in Section 5, while the growth in spending on serials did outpace the growth in library budgets, it did so by a smaller margin in the first decade of the 21st century than in the last of the 20th.

A serious deficiency of the results presented here is that they tell us practically nothing about the “Big Deal” practices of the large publishers, such as Elsevier, Springer, and

Wiley. Those are the publishers who attract the most attention, and they also take a lion's share of the journal spending at libraries. However, they publish relatively few journals. As an example, Elsevier, the largest of these publishers, has just under 2,000 serials [19]. They are disproportionately expensive, and also have disproportionately many articles. However, since ARL statistics only provide the total number of serials in member collections, the contribution of Elsevier is essentially in the noise. What we can observe is basically just the effect of various aggregators. Furthermore, many, and perhaps most, scholars, care only about peer-reviewed journals. There are only about 20,000 to 25,000 of them, and the ARL statistics this paper is based on do not distinguish them from others.

Publishers' pricing practices are not the result of altruism. These practices make excellent business sense for publishers. With electronic delivery, providing access has practically zero marginal cost. From long interactions with libraries, publishers likely have a good sense of how much they can squeeze out of each institution. Once that point is reached, the incentive is to increase usage by everyone at that institution. That way people get introduced and hopefully addicted to new data sources from that publisher, which will make it that much harder for their libraries to pull out of the "Big Deals." Further, making all journals available to all customer libraries serves to decrease the advantages of Open Access. The faculty, students, and staff have the necessary articles seamlessly available (courtesy of the librarians and the library budget), and so are less likely to complain to their colleagues at other institutions about not being able to find all they need. Therefore those colleagues feel less pressure to get involved in Open Access activities.

In the short (and even intermediate) run, "Big Deals" therefore do promote wider access to scholarly literature, and they do serve to push libraries to be more efficient. Thus what we observe in the ARL libraries is Adam Smith's "invisible hand" producing socially desirable outcomes. In the long run, of course, "Big Deals" do entrench the publishers, their profits, and their inefficiency.

Perhaps the greatest puzzle about the wider availability of journals through "Big Deals" is that it has not occurred much earlier. First, though, let us look at the ARL data, and at some general financial statistics of universities, libraries, and publishers.

5 ARL and other statistics

The Association of Research Libraries (ARL) has, as of this writing in early 2013, 126 members. Of these, 11 are public, government, or other non-profit non-academic institutions (Library of Congress, Library & Archives Canada, New York Public Library, ...). Those 11 are excluded from all statistics presented in this paper, since they usually have much wider missions, and are on average far larger in terms of budgets. (The largest budget among ARL members has for a long time belonged to the Library of Congress, which currently spends about 6 times as much as the largest academic library, that of Harvard.)

ARL prepares annual reports on operations of its members [7]. They cover academic years from July 1 to June 30, and have in recent years been prepared by Martha Kyrillidou and her colleagues. Thus the report entitled *ARL Statistics 2009–2010* covers the 2009–10 academic year, and was issued in the fall of 2011. It will be referred to in this paper as

the ARL 2010 report, and similarly for other years. Almost all statistics in this paper are based on the 1990 through 2010 reports. The 2011 report is now available, but the bulk of the research was done before it was published, so it is not included. However, it does not appear including it would have led to any significant changes in either the statistics or the conclusions.

The membership of ARL is very stable. Over the 1990–2010 stretch, academic members grew from 107 to 115, with just one withdrawal. Although the non-renewing library (Stanford) was large, and the 9 new members considerably smaller, the distribution of library budgets has not changed much. In 1990, the average budget was \$12.99 million, and the standard deviation was 50.0% of that. By 2010, the average budget had grown to \$27.49 million, while the standard deviation only increased to 54.2%, and the distribution curves for budgets (not shown here) were almost identical for those two years. (All figures are in current US dollars, not corrected for inflation. Canadian data is presented in US dollars in ARL statistics.)

ARL statistics are an unparalleled resource of detailed information about research libraries. They go back to 1907 (the famous “Gerould Statistics” of the first few decades). They are very carefully collected, and are a result of the very open and collaborative culture of librarians. Still, in spite of strenuous attempts at uniformity (and use of National Information Standards Organization guidelines), they are not perfect. The voluntary nature of reporting, the presence of legacy systems and procedures, and sudden local changes leads to some obvious anomalies. As an example, the expenditures by Harvard on acquisition of serials reached \$10.5 million in the 2004 report, then came down to \$8.4 million in the 2009 report, and then skyrocketed to \$15.3 million in 2010. Yet another anomaly was the number of serials received by the University of Michigan, which was reported as 67,554 in 2004, 124,809 in 2005, 118,654 in 2006, and 71,788 in 2007. Both cases likely arise from changes in categorizations. Such anomalies were ignored in preparing the statistics in this paper, in the expectation they would not affect overall averages much. (In a few cases, missing values were interpolated.) Anomalies of this nature do not appear to be present in total library budgets, nor in the amounts spent on acquisitions. This is likely the result of stricter accounting standards and controls for monetary expenditures.

The serial counts shown in the figures are those for the total number of serials reported as being received by various libraries. The serials that are purchased are a more relevant figure. However, not all libraries report this figure separately, so in order to have fuller coverage, the total serial count was used. That is not likely to cause a major distortion, as among those institutions that do break out the purchased serials figure, the fraction of serials that were received but not purchased was 24.1% in 1990 and 27.6% in 2009⁵.

For all statistics, calculations were done separately for each year. Thus the “small” category of libraries in Fig. 3 included all libraries whose total budget was at or below the median for all budgets for a given year.

One of the major deficiencies of ARL reports is that they seriously understate the internal costs of libraries. They count only the direct pay of employees, and not any of the health care or retirement benefits those employees receive. ARL reports also do not include most of the maintenance costs of library facilities (heat, electricity, cleaning, ...).

Given the enormous variation in how universities account for such costs, it would indeed be hard to come up with a uniform reporting standard that could be implemented easily, so these omissions are understandable. Still, what they mean is actual total library costs are likely about 25% higher than the budgets given in the ARL reports (as confirmed by some correspondence with librarians).

6 Universities, publishers, and libraries

The ARL has statistics showing library budgets as fractions of total university budgets for a sizable collection of their members [8]. The chart for the 40 members that have reported data all the way back to 1982 shows an inexorable decline in this ratio, from about 3.7% to a bit under 2.0%⁶. As was mentioned above, more accurate accounting would inflate the cost of libraries by about 25%, so the decline was from a level of about 4.5% to about 2.5%. But the trend and size of the decline would not have been affected materially by this adjustment.

Thus libraries have been getting a shrinking part of the entire budget, and there would be no journal crisis had they just maintained their share from the 1970s. However, this has to be put in context.

Universities have an insatiable desire for more funding. They are complicated entities, and need to support many activities. Retirement bonuses for administrators, buyout packages for heads of athletic departments, fancy big football fields, and of course fancy salaries for football coaches, all compete for funding with a variety of other categories, including libraries, faculty salaries, classroom and lab buildings, mental health counseling for students, and many other cost centers. Note that the \$2 million or so that a typical large university paid for access to all Elsevier journals in 2007 would not be enough to pay for a single prominent football coach.

A very remarkable fact is that, in spite of all the wailing and gnashing of teeth, universities have been extremely successful in obtaining more funding. This is surely the result of the observation cited earlier in the Introduction, that education is becoming ever more important as technology and the economy advance. Table 1 shows statistics for ARL members in the last two decades (with CPI denoting the main Consumer Price Index for the U.S.)⁷. Their budgets have grown far faster than the economy as a whole. And so have library budgets, even though they grew more slowly, and not as fast as spending on library acquisitions.

Table 1. Annual compound growth rates.

year	US GDP	US CPI	university budgets	library budgets	library purchases	serials purchases
1990–2000	5.55%	2.85%	6.83%	4.65%	6.16%	6.93%
2000–2010	3.85%	2.53%	8.70%	3.74%	4.84%	5.64%

[Note: The growth rates for total budgets for ARL member universities are suspiciously large, and will need to be verified. They are based on data from the ARL for 1990, 2000, and 2009 (since figures for 2010 were not available, so a 9-year annual growth rate was entered in the 2000–2010 line). Only figures for the 89 ARL members for which data were given in the ARL tables for each of those three years were used. Some of the figures in those tables seem anomalous. For example, the budgets of the University of Connecticut, University of Michigan, University of New Mexico, Ohio State, Temple, University of Utah, University of Virginia, and Western Ontario are all shown in those ARL compilations as increasing by more than a factor of 3 from 2000 to 2009. This is rather implausible, unless it corresponds to some major changes in accounting, such as sudden inclusion of revenues from affiliated hospitals, and if it does, this would be misleading. Still, there have been other reported statistics of higher education budgets in the U.S. outpacing not just inflation, but GDP growth and sometimes even medical sector growth, so whatever the right figure in that column, it is likely to be high.]

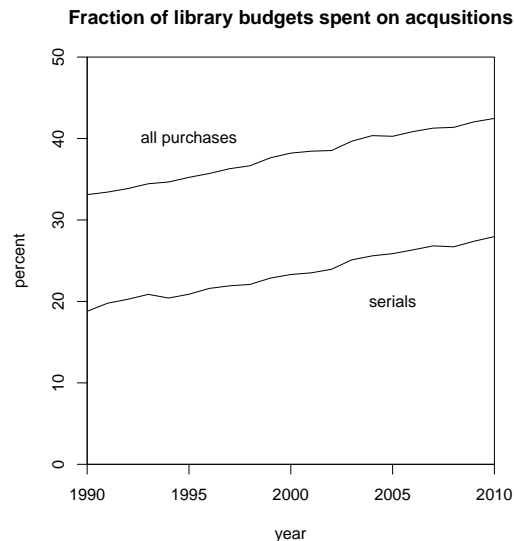


Fig. 5. Fraction of library budgets devoted to all acquisitions and to purchases of serials.

One result of the trends shown in Table 1 is displayed in Fig. 5. The share of library budgets that goes out in purchases of books, journals, and databases has grown substantially, from 33% in 1990 to 42.5% in 2010. (If we correct for the undercounting of library budgets cited before, the growth is from about 25% to about 33%.) Further, all of this growth is accounted for by serials. Books and other materials have just about held their own (with book purchases shrinking at the expense of the rest).

Collectively, academic members of ARL had budgets that added up to \$3.16 billion according to the 2010 report, so that their actual costs were likely close to \$4 billion. Of this, \$1.34 billion was spent on outside acquisitions, and \$884 million of that on serials.

The entire scholarly publishing market, as measured in terms of publisher revenues, is someplace around \$20 billion per year⁸. Of this, journals account for \$8-10 billion.

There are various estimates for the number of scholarly articles published each year, although it does seem to be agreed this number grows by between 3% and 3.5% per year. The report [47] had a figure of about 1.5 million English-language peer-reviewed being published in 2009. There are some estimates that are higher, around 2 or 2.5 million, and they may also be correct, in that they may include non-English publications as well as some serials that are not peer-reviewed. This paper uses the round figure of 2 million for simplicity.

7 Lower cost models

Revenues of \$10 billion and 2 million articles mean an average cost to society of the scholarly publishing system of about \$5,000 per article. This does seem to be typical. Note that this does not differ much from the estimate made almost two decades ago [32] of about \$4,000 per article.

If we consider the Reed Elsevier annual report for 2011 [19], we find that the science and technology segment of the Elsevier business unit had revenues of about \$1.7 billion, and published around 240,000 articles. Since that division also published books and engaged in other activities, if we assume \$1.2 billion as the journal revenues, we obtain a figure of about \$5,000 per article. Many professional societies operate at similar levels. For example, the American Mathematical Society had journal revenues of \$4.7 million in 2010, and published 873 articles, for revenues of \$5,400 per article⁹.

Most of the arguments for Open Access are valid irrespective of the costs of publications, and are based on the public good, efficiency of research, and similar considerations. However, the possibility of moving to dramatically lower cost structures does make a switch to new business models much easier to perform. It has been clear for two decades that much lower costs in scholarly publishing are possible, but with some exceptions, little has been done to the bulk of the literature to move in that direction.

As a point of contrast and information, the costs of running the arXiv preprint server are under \$10 per article that is submitted each year. There is still some cost. Various problems arise with submitters (most handled by unpaid volunteers who do some minimal screening to eliminate inappropriate postings), basic software changes have to be handled, new features need to be put in, compatibility has to be preserved, and so on. However, with minimal human intervention costs can be very low. Once experts get involved, costs can mount up quickly. As an example, the MathSciNet reviewing operation of the American Mathematical Society [1] collects revenues of about \$100 per reviewed paper, and, depending on how various expenses are allocated, costs possibly not much more than half of that, or about \$50 per paper. This time subject experts with PhDs in the appropriate disciplines are involved, as well as myriads of unpaid reviewers, and publishers cooperate in providing metadata and other information. Still, this cost is about two orders of magnitude lower than current average cost of an article. That serves to disprove frequent claims of publishers that metadata provision is expensive.

Can one operate high-quality scholarly journals for less than \$5,000 per article? That this issue is still debated is a good introduction to a major theme of the rest of the paper, the slow rate not just of actual change, but even of information diffusion in our society. Almost two decades ago various investigators estimated that between \$300 and \$1,000 per article should be sufficient for good service [32]. Since that time mountains of evidence have accumulated to support that conclusion. There are now numerous journals operated by their editors, without any explicit monetary flows. Further, we have, among others, the Edgar and Willinsky study [18] of almost 1,000 journals that use their Open Journal System (in use by about 5,000 journals in all) which found the first copy costs (which is essentially all that matters if one considers purely electronic publishing) of \$188 per article. Clearly, many of these low-cost ventures do benefit from implicit subsidies (such as free use of university information technology infrastructure), and would not scale to larger journals without having to pay for various types of administrative assistance. Still, when we have examples of 10x cost savings, even a doubling of the cost to pay for all those extras still leaves us with a 5x cost advantage.

That lower costs were possible was obvious even three decades ago, since the costs per article varied wildly between publishers. This showed that costs were not a matter of unavoidable necessity, but of market power, choice, and inertia. This has become far clearer since then. There are many cost reductions that are feasible and desirable. Let us consider some.

The first step is to abandon print entirely, and publish strictly electronically. That will eliminate the expenses not just of the print operation, but also of the preparation for print. Once that is done, it will be much clearer that there is much more that we can choose to economize on. For example, why devote a lot of effort to ensuring consistency in layout, reference styles, etc. in a purely electronic journal? (Those activities do consume extensive effort even in low-cost serials, see, for example, the data for the Open Journal System journals [18].) In a printed version, it might have made some sense, but in the modern online environment, where readers follow threads from one journal to another, this uniformity contributes little.

Some of the terrible waste that is involved in scholarly publishing involves no money, but extra work for authors. For example, some journals insist that not only the final accepted versions of papers adhere to their chosen format, but that even initial submissions do. This is not just wasteful, but silly. Yet it persists, and provides yet another illustration of the inertia in academic publishing.

To get to the lowest ranges of costs, one can also eliminate most of copy editing. The quality of author-prepared manuscripts at the arXiv and SSRN preprint repositories appears completely adequate for many scholars. (The same is true of the conference proceedings that ACM and IEEE publish, where the authors are responsible for producing the files using the publisher-supplied style files.) Many readers of scholarly journals find copy editing useless, although admittedly this is an extreme opinion.

Many authors find that today, copy editing subtracts value, by forcing them to do extra work, usually for no good reason, and often to correct what the copy editors have done.

Overall, it appears clear that one can publish scholarly articles at much lower cost than is done today. One can do it even if one does a moderate amount of copy editing, as the Edgar and Willinsky data [18] shows.

The \$800 million that just the ARL members alone spend on journals is about \$400 for each of the 2 million or so articles that appear each year. And \$400 should be plenty, as was forecast two decades ago, and as is demonstrated by many respectable journals. Yet the world is currently paying about \$5,000 per article. The question is whether we can get there from here.

8 Competition between libraries and publishers

The evolution of academic information systems is viewed most fruitfully as dominated by competition between publishers and libraries. However, one should not neglect the role of an increasing variety of other players, as this sector evolves. A century ago, libraries and publishers were basically the only significant players, and there was a strict separation in their functions. Today, the lines are blurry. It used to be that publishers put out books and journals, and libraries preserved them for posterity. Publishers might keep some copies of old issues in their inventory, but were not obliged to, and had little incentive to reprint. But with electronic publications, it is far more efficient and effective to have the publishers maintain the files, migrate material to new formats, etc. (I am ignoring here issues such as censorship, which is far easier to carry out on a publisher's few mirrors than it is on a thousand libraries.) It does not have to be a publisher that does this, as the Internet Archive and Google Books demonstrate. And there are many other players in this expanding arena, from high performance computing centers that increasingly handle large data sets, to commercial organizations curating genomic databases. That is not a surprise. Information and education are becoming more important to society, so it is to be expected that more will be spent on it. This is the same phenomenon that is driving up spending on medical care. Although various reforms have been carried out and others are planned, the move towards more of the economy being devoted to health is worldwide, associated with rising standards of living. Any increases in efficiency there are likely to be swallowed up in new treatments, or just in more treatments for an aging population. Similar trends appear likely to operate in education. While the traditional functions of librarians and publishers are obsolete, new opportunities are arising for intermediaries between researchers and other researchers, or between researchers and the wider public.

There are many interesting statistics at [7] demonstrating decline of the traditional functions of libraries. Thus between 1995 and 2010, the number of students at ARL institutions grew by 33% (with the ranks of teaching faculty and graduate students climbing 15% and 43%, respectively). The only category of library services involving physical material that showed growth was interlibrary loans, which climbed 92%. This reflects libraries concentrating their budgets on serials, and giving up on trying to keep up with the growth in the number of new books being published. In other categories, initial circulation (i.e., excluding renewals) of physical volumes dropped by 42%. Thus it is a gross exaggeration that "nobody uses the library anymore," as one sometimes hears from faculty or students. But the decline in borrowings per student by more than half is telling. What is perhaps

most surprising is that the number of requests for reference assistance dropped by 66% in absolute terms, as is shown in Fig. 6, and thus by about 75% on a per-student basis. This is certainly a core competency of librarians, and they are great at navigating the torrents of electronic information, as well as providing guidance to the use of traditional printed sources. However, it appears that Google, Wikipedia, publisher databases, and the like are “good enough” for most scholars, and that the convenience of around the clock access from anyplace outweighs the higher quality that librarians provide.

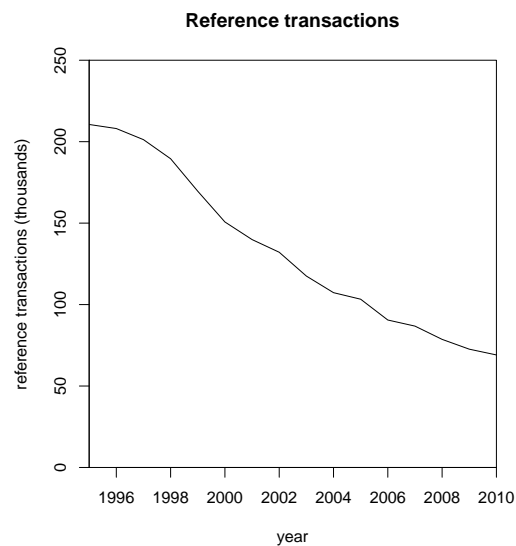


Fig. 6. Average number of reference transaction in reporting research libraries, 1995–2010.

The declining reliance on reference librarians is intriguing. In many, perhaps most, of the areas of the economy we see great willingness to pay more for what is perceived as the very best, even when the margin over second best is extremely slight or illusory. So the very top athletes, artists, and lawyers (and sometimes even academics) see their pay skyrocket, while the crowds of competitors who are almost as good languish in obscurity and often penury. Ranks of applicants to top-ranked universities grow tremendously, even though there is little evidence this leads to more successful careers. But librarian skills are apparently not perceived in this same light.

What librarians could have done, and might yet do, is discussed later. First, though, let’s consider publishers. They have moved faster than librarians to adjust to the new world, as was to be expected [37]. They have many options for maintaining their leaderships (as well as their profits) in the future. A transition to Gold Open Access (in which authors, or their funding agencies, pay the publishers and the articles are made freely available) might not be a threat by itself, but rather a possible opportunity to increase revenues if one can sustain subscriptions, say in a hybrid model. Even if publishers are forced to lower their revenues, they could maintain their profits by making some of the moves discussed in Section 7, such as giving up entirely on print, decreasing the amount of copy editing, and

abandoning the requirements for uniform style in each journal. They might also increase their profits while keeping revenues steady, by implementing some of these moves.

The basic and very promising approach open to publishers is to continue marginalizing libraries by extending the reach and scope of “Big Deals.” The consortium model, in which groups of libraries cooperate to get access to a “Big Deal” is already common, and can be pushed further. The ultimate situation might be national “Big Deals,” where some top-level bodies pay for access for everyone from a nation. Enlarging the “Big Deal,” especially through further mergers, but also by including additional information sources, can serve to create packages that simply could not be dispensed with. The most obvious move in that direction (which is already taking place to a small extent) is to make books, both current and old ones, a part of the “Big Deal.” (Recall that the process of digitizing old printed materials is extremely inexpensive.)

While it is a little puzzling that journal “Big Deals” have been so slow to spread, the slow rate for inclusion of books is much more understandable. For several decades now, the principal method of using scholarly journals has been to scan a multitude of articles, photocopy the ones that appeared to deserve more careful study, and work with those photocopies. Hence the transition to all-electronic journals is relatively seamless, with the photocopying being replaced by printing. It is also far more efficient, as one does not have to go to the library, and handle awkward bound volumes, and instead prints in one’s own office or study. Even so, there are die-hard traditionalists who continue to insist that nothing will replace the traditional methods. However, their ranks are decreasing. Printed books, on the other hand, have many more adherents. They are traditionally used in ways substantially different from that of articles. It would have been difficult a decade ago, for example, to persuade scholars to give them up. However, improvements in technology have led to very nice ebook readers and more general tablet computers, and there is a rapid move in the population as a whole towards ebooks. Scholarly publishers therefore have a chance to jump on the bandwagon and also to speed it up. By digitizing their current offerings as well as their old out-of-print volumes, they can provide better service to readers, and reduce the need for libraries. Furthermore, with the improving quality of print-on-demand services, it is still possible to cater to those who insist on paper copies.

Making books as well as back issues of journals widely available in electronic forms could also help in indirect ways. In the traditional print world, it would have been a major disaster for a small institution, say Reed College, to be given a duplicate of all of the Harvard libraries’ physical collections. There simply would not have been the space or personnel to handle such riches. But, based on experience, we can be sure that Reed College faculty and students would use all that is at Harvard if that were available online. And once Harvard faculty see their colleagues at Reed relying on ebooks instead of hard copy volumes, their resistance to doing the same will diminish.

It would also be wise for publishers to overcome their reluctance to tamper with copyrights, and to forcefully push for legislative solutions to the orphan works problem. Orphan works, which are those that are under copyright, but whose copyright owners cannot be located, provide a major justification for the existence of large physical collections in libraries, as that is the only legal way to make such works accessible to the public. To the

extent orphan works are digitized and made freely available, the need for library facilities (both physical and personnel) declines. That would make it easier for publishers to appropriate even more of the resources now going to libraries.

What about libraries? They are handicapped in the competition with publishers by several factors, see [37]. One of them, that they have the bulk of the resources, and are thus a fat target, is a strength as well. At least in principle it makes possible revolutionary changes. In particular, as was shown earlier, just the external journal purchases of the ARL libraries alone could provide Open Access publishing for the world's entire scholarly literature. Had libraries thrown their resources enthusiastically behind new, low-cost Open Access journals, perhaps the current scene and the unfolding future sketched here would have been different. But that would have required many research partners willing to put their energy into the enterprise (certainly a very doubtful proposition, given the inertia in the academic system), and the willingness of librarians to cannibalize their bread-and-butter operations. Certainly librarians present a classic case of Christensen's "innovator's dilemma," pressed to maintain traditional services, and therefore slow to embrace new ones. As an example, digital libraries have been discussed in the library literature for decades. Further, the amount that ARL libraries spend in a single year on acquisition of serials would have sufficed, with plenty left over, to digitize all their standard books and journals that are out of copyright¹⁰. Yet it was outside efforts, in particular the Gutenberg Project (the early pioneer, almost forgotten), Google Books, and the Internet Archive, that led the way¹¹. And thus today we do see libraries moving towards support of Open Access, beginning to pay some author submission fees, and providing financial and management support for inexpensive new journals. But the moves are slow (reflecting, perhaps, the hesitant embrace of Open Access one detects in [23]), and may not be enough to prevent further publisher encroachments.

We also see libraries moving into other services, such as providing long-term storage for publications, data sets, and so on. However, there they are competing not just with publishers, who also see the opportunities, but also other organizations, such as campus information technology units, high performance computer centers, and a variety of new commercial startups. The opportunities are many, but so are the competitors.

9 Conclusions

The most important developments in scholarly publishing are taking place quietly, with essentially no public discussion. The traditional roles of the two key intermediaries, libraries and publishers, are shrinking. New opportunities are opening up, however, which forces those two groups into new roles, and brings in new agents (such as Google). Who will perform what functions is open to competition, and at this point the publishers are doing better than libraries. Whether this will continue, and what the role of new agents that are competing for these functions will be is hard to predict. However, publishers have provided much better access to scholarly information through the often criticized "Big Deal" packages.

Notes

¹As in all of this paper, only the large North American institutions that are represented in the ARL are considered. The cost structure is often different in other places, in particular in the less-developed world, where labor costs are lower.

²One of the few recent items that even touched on the subject was a post by Phil Davis [15] that cited the decreasing fraction of university budgets available for internal expenses as a sign of greater efficiency inside libraries. As is argued here, it is more a case of publishers performing more of the work that was traditionally in the domain of librarians than of librarians being more efficient.

³See Section 5.

⁴However, this observation should be treated with caution. Library budgets and purchasing patterns depend heavily on the nature of the institution, for example whether it has a medical school, or a law school, and so on. Therefore it would not necessarily be justified to conclude that the higher prices that “small” institutions paid per serial in 1990 compared to “large” ones represented price discrimination. However, the relative gains visible in Fig. 2 do appear to clearly favor “small” schools.

⁵There were various other factors that were disregarded, as they did not appear to lead to large changes in the relevant statistics. For example, starting with the 2007 report, ARL members were asked to report serial titles that were received, and not subscriptions.

⁶It is worth pointing out, though, that the chart for the 17 members that reported since 1966 shows an initial jump from a level of about 2.9%, and then essentially a constant fraction until about 1980, when the decline starts.

⁷The GDP growth rates are derived from http://www.usgovernmentspending.com/us_gdp_history#usgs101, the CPI ones from <ftp://ftp.bls.gov/pub/special.requests/cpi/cpi.txt>. The other figures are from ARL compilations. Although ARL has many Canadian members, this presentation is U.S.-centric and ignores the fact that Canadian data is part of the ARL reports.

⁸See [47] or the Jan. 6, 2012, announcement of the Simba Information report, <http://www.simbainformation.com/about/release.asp?id=2503>. Many sources look only at STM publications, but one needs to consider also the humanities, etc., which, while not large in terms of revenues, are not negligible.

⁹Figures derived from the 2010–2011 Annual Report [1]. (A more accurate accounting would almost surely produce a somewhat lower figure, though, as the revenue figure includes services provided to other scholarly organizations.) That report shows total publications program revenues of \$19.5 million and expenses of \$14.7 million, for a profit margin of 25%. This appears to be not atypical of nonprofit professional societies, which often use profits from publications to subsidize their other activities.

¹⁰As was clear two decades ago [32], and as has now been confirmed by various large-scale projects, such as that of the Internet Archive, one can digitize a book for about \$20 per copy on average. Hence the \$884 million spent on serials around 2010, would have paid for conversion of over 40 million volumes, far more than the number of unique sets that are out of copyright. (Harvard reports about 17 million volumes total, the Library of Congress, 35 million, and this is for everything, including recent publications.)

¹¹As another example of the cautious and incremental librarian approaches, consider the study [43] of costs of print and electronic journal subscriptions. It was far too conservative in the estimates of moving to “Big Deals,” in which per-journal costs outside the purchase price are negligible.

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