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# A Proposed Solution to the Scholarly Communications Crisis

Chad Schatzle

**ABSTRACT.** After reviewing the history and parameters of the scholarly communications crisis, particularly in regard to skyrocketing prices for journals in the natural sciences, the author reviews and rejects previously attempted solutions. He then employs the principles of game theory in proposing a new solution to the crisis. doi:10.1300/J204v03n03\_04 [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <<http://www.HaworthPress.com>> © 2005 by The Haworth Press, Inc. All rights reserved.]

**KEYWORDS.** Scholarly communication, scientific journals, journal pricing, serials pricing, game theory

## INTRODUCTION

The current system of scholarly communication is unsustainable and change is unavoidable (Odlyzko, Transforming Scholarly Communication and Libraries). Various solutions such as alternative publishing models, open access, and library consortia have been tried and have achieved mixed results. Given that the scholarly communication crisis is the result of an imperfection in the serials publishing market, an economic solution may be the answer.

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### ***A Note on the History of Scholarly Periodicals***

The forerunner of the modern scientific journal was the *Philosophical Transactions of the Royal Society of London (Phil Trans)*, circa 1665 (Guédon). *Phil Trans* was created by Henry Oldenburg, and was essentially a correspondence transmitted among a few hundred noted scientists spreading news of assorted observations and discoveries (Gleick 75-76). However, the intent of the publication was not necessarily to spread knowledge or information, rather to register intellectual property (Guédon). Thus, a scientist could attach his name to a natural “law” or discovery through publication in a peer-reviewed journal (Guédon). The journal’s power to publicize authors and their discoveries gave publishers the power to grant the intellectual property to the author (Guédon). In short, the periodical benefited the printer or publisher more than the writer (Guédon).

While the number and quality of periodicals have increased since the days of Henry Oldenburg, it was not until after World War II, in the early 1950s, that the explosive growth in the number of periodical titles created a problem (Ekman and Quandt 34-45). In order to understand the explosive growth of periodicals, and natural science periodicals in particular, we must first examine the scholarly communication process as it exists in academe.

### ***The Process of Scholarly Communication***

Scholars share the results of their research with others through the process of scholarly communication (Odlyzko, *Transforming Scholarly Communication and Libraries*). The process entails two basic dimensions: the actual production of the article (and journal within which the article is published) and the academic environment in which the process thrives. With respect to the actual production of the article, scholars typically seek out a peer-reviewed journal that publishes in their area of expertise. Before being accepted for publication, the journal article is reviewed and revisions are suggested by other scholars with similar expertise. Once the editing process is complete, the article is published in paper or electronic (or both) form and is available to other scholars and members of the public. Generally, a person accessing the article will not pay the publisher directly as the academic institution through which the article is obtained pays an annual subscription fee to the publisher.

Typically, a publisher is responsible for the acquisition, development, design, production, marketing, and distribution of the article (Odlyzko,

Transforming Scholarly Communication and Libraries: Affordable Publishing). Consequently, the author's role is limited to submitting the article and addressing any editing issues; the publisher will be responsible for all other aspects of the article's publication. This is in keeping with the model of scholarly publication as devised by Oldenburg in 1665, and assures the publishers authority to grant intellectual property (Guédon).

There is a tremendous pressure to publish in the most prestigious journals in the scholar's discipline, and to publish often. For scholars, production of an article can have as much (or more) to do with attracting funding to the academic institution, promotion, tenure, and other rewards as it does with sharing the results of research with others (Budd 73-74).

Furthermore, citation-ranking publications such as those produced by the Institute for Scientific Information (ISI) have only exacerbated the problem (Guédon). The citation rankings are based upon frequency of journal citation (Black 411-419). Accordingly, the more a journal is cited, the more the journal is believed to be accepted or at least acknowledged as an important resource (Black 411-419). The greater the ranking of a journal, the more likely it is to be considered for acquisition during collection development (Black 411-419). Thus, in an age of constrained library budgets, scholars prefer to publish in journals with higher citation rankings as their work is more likely to be included in library collections, and consequently, more likely to be cited in other scholarly publications.

Publishers are also quite interested in having as many journals at the top of the citation list as possible because the higher the publication is on a citation list, the more likely it is to be purchased (Guédon). And if publishers can assure that only their journals are acquired through the use of bundling, they can manipulate the citation list as their journals will rate higher because their journals are much more likely be cited by scholars at the institutions receiving only their publications (Guédon).

### ***THE CRISIS IN SCHOLARLY COMMUNICATION***

The vast increase in the number of published scholarly works, in large measure due to the academic reward structure, has resulted in a crisis in scholarly communication (Guédon). Between 1986 and 2003, the cost of scholarly serials grew 215% according to statistics collected by the Association of Research Libraries. In contrast, the rate of inflation for the same time period, as measured by the Consumer Price Index, grew at only 68%; additionally, there was a 138% increase in the number of

serial titles. Consequently, the cost increase combined with the increase in the number of titles (even accounting for large increases in materials purchasing budgets) has resulted in a reduction in the number of serials purchased by academic institutions (Odlyzko, Transforming Scholarly Communication and Libraries: Serials Pricing).

One possible solution to the scholarly communications crisis is to eliminate the role of the commercial publisher, and some institutions have made attempts to do exactly that. One such example of a system of scholarly communication where the commercial publisher has been eliminated is the arXiv archive. "arXiv is an e-print service in the fields of physics, mathematics, non-linear science, computer science, and quantitative biology" (arxiv.org). Paul Ginsparg created arXiv in 1991. Initially, arXiv had only about a thousand users (Ginsparg). However, arXiv use has grown tremendously and now boasts over 35,000 users worldwide (Ginsparg) and over 200,000 electronic transactions per day (arXiv Web server usage for Feb. 26, 2006). Currently, Cornell University (with partial funding from the National Science Foundation) owns and operates arXiv (arxiv.org). arXiv contains a number of highly respected journals that are available for free download by anyone, and is particularly prized for its collection of physics articles.

Collections similar to arXiv, such as *First Monday* and the *Electronic Journal of Combinatorics* are also available. While the journals do apply some pressure to the commercial serials publishers, they are unlikely to correct the fundamental market problem; an inelastic market, that is, a market that is not affected by pricing and vice versa (Guédon).

Libraries and universities have also created alliances that publish journals designed to compete directly with the large, costly journals sold by commercial publishers (Guédon). One such example is the Scholarly Publishing and Academic Resource Coalition (SPARC) (Transforming Scholarly Communication and Libraries: Affordable Publishing). SPARC produces journals that are designed to go head to head with particular journals from commercial publishers. The SPARC journal may be free or substantially cheaper than the commercial publisher's journal (Guédon). For example, SPARC produces *Organic Letters* (subscription price \$2,438), a journal designed to compete directly with Elsevier's *Tetrahedron Letters* (subscription price \$9,036) (Guédon). Interestingly, when competitive journals are introduced, commercial publishers' price increases for that particular journal level off (Guédon). Regrettably, SPARC must fight an uphill battle with each journal it launches (due to the citation index problem as previously described), and given the breadth of journals owned by commercial publishers, it is simply not feasible to

go head to head with every journal (Guédon). In fact, SPARC-like journals may even exacerbate the scholarly communication crisis as libraries will be faced with even more core journals to consider for purchase. Moreover, SPARC attempts to add competition into the marketplace, when an entire market overhaul is what is needed.

Another challenge to the commercial periodical publishers has come from library consortia. Library consortia comprise libraries that have banded together to pool their resources (Guédon). The theory behind the consortium is that their members' combined purchasing power will increase their leverage vis-à-vis the commercial publishers (Guédon). Specifically, the libraries bargain as a group in an effort to force vendors to make a global deal in which one vendor will receive all of the business (Guédon).

One successful example of a consortium that has received positive results is the Canadian National Site Licensing Project (CNSLP). CNSLP is a library consortium that hoped to capitalize on libraries' cooperative abilities in areas such as interlibrary loans. CNSLP pooled their resources, about 50 million Canadian dollars, and set up a negotiation with commercial serials publishers. CNSLP would only bargain for full collections (thus ensuring the global deal) and would keep a confidential list that ranked vendors in an effort to create uncertainty in the market. The consortium would then only negotiate with vendors according to the order of their confidential ranking, and unsuccessful negotiations with vendors meant that the consortium just moved to the next vendor for negotiations (Guédon).

Overall, CNSLP's negotiations resulted in significant savings and a cap on price increases; additionally, the increases in shared knowledge and collaboration, especially in the area of negotiating tactics and legal experience, are seen as a positive outcome (Guédon). Consequently, library consortia have had a direct impact on the cost of periodicals and provide an excellent foundation for changing the commercial serial market.

### ***GAME THEORY AND THE SCHOLARLY COMMUNICATIONS CRISIS***

As previously described, consortia have had an impact on commercial publishers, particularly in the area of negotiations between the parties; and as with any negotiation, price is a key issue. In the natural sciences serials market, "Pricing is based on what the market will bear not on the value of the commodity" (Bosch 107). Studies have shown that

the price of a journal per 1,000 typed characters can vary tremendously, indicating a disconnect between production costs and price (Guédon). What's more, the existence of only a handful of dominant suppliers means that price competition is weak or almost non-existent, and is expected only to worsen as consolidation of the industry continues (Bosch 107-115). More still, marketing strategies such as "bundling," used by some of the largest suppliers, such as Elsevier, increase the costs of periodicals over time (Odlyzko, *The Crisis in Scholarly Communication*). Bundling essentially makes it difficult to cancel any particular journal without substantially increasing the costs of the remaining bundled journals (Odlyzko, *The Crisis in Scholarly Communication*). As a result, it becomes nearly impossible to reduce the costs of journals even if the number of journals subscribed to is reduced. Thus, pricing in the natural science serials market is not driven by normal market forces (Bosch 107-115), and in reality an oligopoly exists (an oligopoly exists where control over most of a product is held by a small number of producers or sellers) ("oligopoly, oligopsony" 294).

While consortia are headed in the right direction, much more could be done. Enter game theory. Game theory was largely developed by John von Neumann, perhaps one of the most gifted mathematicians ever to have lived, and economist Oskar Morgenstern (Harford 156-158). Their seminal text, *Theory of Games and Economic Behavior*, was published in 1944 (Harford 158).

In the most general sense, game theory "attempts to explain the behavior of 'players,' where the optimal moves of these players depend critically upon the moves taken by other players" (Graham 67). The "players" in the serials game are the serials producers or sellers (e.g., Elsevier, Gale) and the serials purchasers (e.g., academic libraries). Game theory has many variations, depending on the type of "game" or factual situation involved. For our purposes, we will concentrate on the variation of game theory known as "non-cooperative" game theory. In non-cooperative game theory, "it is assumed that each player will maximize its (*sic*) own interests, as opposed to the collective interests of a group of players. It is not ruled out, however, that these interests might coincide: an individual player might in fact cooperate with other players. If, however, this happens, it is because the player chooses to cooperate out of self-interest, rather than because the player is bound by some sort of obligation that is enforced by an external agent" (Graham 67). In the case of scholarly communication, the serials producers or sellers are the "players" that seek to maximize their own interests. Clearly, the library consortia are engaged in cooperative behavior.

Non-cooperative game theory is useful where the strategic behavior of firms in markets with a limited number of sellers (such as the natural sciences serials market) is sought to be understood (Graham 67-83). Once understood, a different form of negotiation between sellers and buyers can be created that is more beneficial to buyers, in this case, libraries.

### ***THE PROPOSED SOLUTION***

As previously stated, libraries have attempted to cut out the commercial publisher altogether, an interesting idea, but unlikely to work in such a profitable industry (due to market inelasticity). Libraries have also attempted to inject a measure of competition into the natural sciences serials market by banding together and creating academic journals that compete with high-priced commercially published serials, especially in the natural sciences. But ultimately, this tactic will also fail as it does not change the nature of the market, it only adds a small dimension of competition. Coalitions such as SPARC have made some headway in bringing about a reduction in the costs of some journals, but more importantly, such coalitions demonstrate the need for greatly increased market competition (Guédon). Unfortunately, re-creating SPARC-like alliances may be impracticable given the breadth of the serials industry. Finally, librarians have created coalitions to increase their collective spending and bargaining power. The coalitions are a step in the right direction, but could be vastly improved by applying game theory.

In order to introduce much-needed competition into the serials industry, consortia such as the CNSLP should be set up in the United States—the larger the consortium the better. As with CNSLP, the consortium would only bargain for full collections (Guédon). Likewise, the consortium must attempt to create uncertainty in the market, as CNLP did by keeping its rankings confidential (Guédon). However, the new consortium should use an auction system to achieve uncertainty.

Why an auction? According to game theory, if an auction attracts even one additional bidder, the auction will raise more money than any other possible negotiating arrangement (Harford 167). In this case, the consortium would attempt to get access to the largest-possible collection for a set amount of dollars, in essence raising the largest-possible collection size. The auction would be structured in a way similar to the auction of United Kingdom (UK) cell phone spectrum rights, widely hailed as a very successful auction from the government's perspective (Harford 168-175).

In the UK auction, bids were taken remotely over the Internet for five licenses to use available UK cell phone spectrum rights. The beauty of the auction was that competition for any one license would drive up competition for the remaining licenses, because a firm that was not the leading bidder on any particular license had to keep bidding on that license or any other license, or withdraw from the auction. This resulted in firms continuing to bid on the license that offered the best value at that moment. Consequently, spirited competition over any particular license would raise its price relative to the other license, which would then look like a bargain. Ultimately, the bidders would never know which bid would win any particular license and therefore had to make sure they were always satisfied with their position relative to all of the licenses. The best strategy to achieve this is to place a winning (or the highest) bid on the license currently with the most value, relative to the other licenses. If none of the licenses look like a good value, the bidder would withdraw (Harford 169-170).

Additionally, the auction ran in short rounds of about half-hour intervals in which bidders had to submit new bids or withdraw from the auction. Finally, the bid results were quickly posted on the Internet, in effect forcing the auction to take place in a public forum (Harford 168).

In order to create a similar situation for the consortia, the body of journals would be segmented. For example, the science journals such as physics, biology, chemistry, geology, mathematics, medicine, and engineering would be segmented into groups. Journals such as education, music, language, literature, history, and sociology would be segmented into another group. Likewise, journals relating to business, economics, and law would be segmented into yet another group. A determination as to the optimal number of group members would be made by various trial runs of the auction.

The consortium would determine the number, type, quality, and amount of access to journals the consortium currently had. It would then determine the group's expenditure for the journals. Once arriving at that figure, the consortium would offer that amount of money, X dollars, as the amount of money the serial publishers would be asking for in exchange for their journals. Additionally, to sweeten the deal, the contract would remain in effect for five years, at the same yearly amount. For example, with a very large consortium, the amount of money in play would be \$200 million (\$1 billion over a five-year period), broken up among the various groups of journals (i.e., \$120 million for the science journals, \$40 million for the humanities journals, and \$40 million for the business and legal journals). Clearly, competition for the science

journals would be fierce, and companies would vie to offer the most attractive journal packages with regard to number, type, quality, and amount of access. However, even if their bid were not the highest, the firm would be forced to bid on another group of journals or face withdrawal from the auction. Withdrawal from the auction means that the company can no longer bid on any of the groups and will essentially be unable to sell to the consortium for the next five years, thereby passing on many millions of dollars that will be paid to the winning bidder. Thus, a company will face pressure to bid continually on one of the journal groupings until it has offered all of its collection and has nothing more to offer. Ultimately, the consortium's goal will be to spend no more than the previous year (and lock in prices for the next five years) and end up with more journals than before.

Additionally, holding the auction only once every five years has the added benefit of increasing stability to the consortia's collection as well as slowing the learning curve of auction bidders (Guédon).

It is possible that bidders could offer very little in the way of journal access, but given the amount of money the successful bidder would earn, it would seem foolish not to try and outbid the competition, especially for companies that are largely selling access to an asset (i.e., journals) that it already possesses. Essentially, failure to bargain in good faith would be akin to throwing money (and five years worth, at that) out of the window. For-profit companies, especially those with shareholders, would be under intense pressure to win the bid given the large amount of money involved and the winner-take-all design of the auction. Additionally, the possibility exists for the smaller companies to score a major coup by winning the auction. This would create a stronger competitor for the larger companies in the future, which would result in greater competition in the market, much to the delight of the consortium.

Another possibility is that the major players in the market refuse to play and simply do not show up at the auction (although this is unlikely for fear of creating stronger competition as outlined earlier). Should this happen, there would be a dramatic increase in the use of SPARC and SPARC-like journals, and a torrent of scholars clamoring to publish in those journals. After all, who would want to publish in a journal that was not accessible to a large section of academe (especially given the impact of ISI as discussed earlier)?

A standoff would be unfortunate for both the bidders and the consortium. However, given that the consortium is largely made up of academic and municipal entities, who are by their nature slow to react, the publishers, whose stock may be under daily scrutiny in the market, would

likely blink first. Moreover, serials publishers do not have a product that can be sold to another market if the academic market goes bust; the academic market is their only market. Even a standoff, as long as it were temporary, would entirely change the serials publishing market for the better, and more rosy scenarios would allow the consortium to lock in prices for five years with access to more journals than before.

### CONCLUSION

The current state of scholarly communication is in need of change. The greatly increased cost of serials combined with the increase in the number of titles has resulted in a reduction in the number of serials an academic institution can reasonably purchase. Libraries have begun to address the crisis in serials pricing by removing the commercial publisher from the process entirely. Libraries have instituted open-access alternatives, which have been only moderately successful. Libraries have also banded together in library consortia, whereby serials purchases are made by a group of libraries. Consortia allow libraries to increase their leverage vis-à-vis the commercial publisher, and negotiate a global deal in which one vendor will receive all of the business. Consortia have had promising results, and with the application of game theory, whereby consortia auction off their purchase budgets to various producers or sellers, libraries can cap spending as well as increase access to serials.

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