Scholarly Journal and Digital Database Pricing: Threat or Opportunity?

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For over 3.5 centuries, scientific scholarly journals have demonstrated remarkable stability. Over the past few decades a large number of studies have shown their continued use, usefulness and value. However, two phenomena have evolved over the past three decades that have the potential of either destroying the system or substantially enhancing its considerable usefulness and value. These two phenomena are the maturation of communication technologies and the economics of the journal system; particularly pricing of traditional journal subscriptions and access to digital full-text databases. Certainly, the new technologies should, if deployed with care, enhance the journal system; but the greatest threat to the system appears to be pricing policies that have resulted in substantially reduced personal subscriptions, increased reliance on library access, library prices raised far higher than inflation or increased journal sizes would warrant, and libraries and scientists having to rely more heavily on obtaining separate copies of articles through interlibrary loan, document delivery, preprints, reprints and photocopies or electronic copies from authors and colleagues. This paper provides some insights gained from analysis of over 13,500 responses from readership surveys of scientists; cost analysis of publishing, library services and scientists' communication patterns; tracking of a sample of scholarly journals from 1960 to 1995; and review of over 600 publications dealing with scientific scholarly journals. This paper will attempt to dispel some myths concerning communication costs, system participants' incentives, and reasons for increased prices. It will also present perspectives on pricing that might help in an electronic age and some suggestions concerning subscription pricing, site licensing, and online access to separate copies of articles.

Are Scientific Scholarly Journals Worth Saving?

Over the years there have been a number of skeptics regarding the use, usefulness and value of scientific scholarly journals. However, since the 1950s, there have been over twenty studies that show that scientists rely more on journals than any other source for their information [1](although this is not true for engineers or "technologists"). Surveys of scientists conducted from 1977 to 1998 by King Research show the following. A 1977 national survey of scientists showed that they averaged 105 readings of scholarly journals and a follow-up survey in 1984 revealed about 115 readings per scientist and several surveys in organizations from 1993 to 1998 yielded combined estimates of 120 readings, thus suggesting that amount of reading might have increased over the years.[2] Extrapolated to the entire population of scientists and articles published, these data indicate that the average readings per article was about 640 readings per article in 1977 and about 900 readings in the late 1990s. Three studies in the 1960s and 1970s estimated the amount of reading per article by asking sampled scientists to indicate which articles listed on recently published Tables of Contents they had read. Average readings per article (extrapolated to the population of scientists sampled) showed that psychology articles averaged 520 readings per article,[3] economic articles averaged 1,240 readings,[4] and Journal of the National Cancer Institute articles averaged 1,800 readings per article[5 6] (or 756,000 readings for the entire journal of 12 issues). Thus, there is ample evidence that scientists read many scholarly articles and that journals are well-read.[7]

Scholarly articles are read for many purposes ranging from supporting specific research and teaching projects to administrative purposes. They are also read to keep current in their disciplines. A number of studies have shown the importance of scholarly articles for these and other purposes and our surveys of university scientists show that readings for teaching purposes are rated highly in importance (4.82 on a scale of 1 to 7) and even higher for readings for research (5.03). One-third of the readings are said to be "absolutely essential" to the teaching or research.

Non-academic scientists were asked to rate the importance of five resources used by them to perform six types of activities. The resources included computing equipment/workstations, instrumentation, consulting advice, support staff and publications (mostly journals). The average ratings of importance (1 to 5) for publications are: professional development (4.04 – highest among the resources), primary research (4.03 – 2nd highest), other R&D activities (3.87 – highest), writing (3.76 – highest), consulting or advising (3.60 – 2nd highest), and presentations (3.31 – 3rd highest).

Machlup[8] mentions that there are two types of value of the information provided by scholarly journals: purchase value and use value. Purchase value is what scientists are willing to pay for the information in monies exchanged and their time expended in obtaining and reading the information. The purchase value expended on scholarly journal information exceeds $6,000 per year per scientist; most of which involves their time spent obtaining and reading the information. In fact, the "price" paid in scientists' time tends to be five to ten times the price paid in purchasing journals, separate copies of articles and other journal-related services. Of twenty studies by various researchers that provide estimates of time spent reading, the median time spent is 9.0 hours per month or about 108 hours per year per scientist. Our surveys show that scientists annually spend about 105 hours reading scholarly articles; up from 80 hours in 1977. Also, scientists are spending more time obtaining articles because they more often use library-provided articles than their own personal subscriptions (more is said about this later).

Use value is related to the consequence of using scholarly journal information. Examples of use value include a dollar value on savings achieved by reading (about $25,000 per year) and producing work with greater quality, faster or at a lower cost in time or money. Several studies, dating back to the 1950s, have shown that amount of reading is correlated with productivity. Our surveys established that amount of reading is positively correlated with five indicators of productivity (i.e., outputs and input time measured in five ways). Another indicator of use value is that scientists whose work has been formally recognized through awards, special assignments, or designated by personnel department (for our survey purposes) tend to read more than others. This was observed in the 1960s[9] and was invariably observed on 16 of our surveys. Thus, there is also abundant evidence of the purchase and use value of scholarly journals and one must conclude that any changes in the future should ensure that the use, usefulness, and value of scholarly journals be retained.

Scholarly Journals Examined from a Systems Perspective

In the late 1970s King Research performed a series of studies for the National Science Foundation on scientific and technical information communication, with particular emphasis on scientific scholarly journals.[10] As part of these studies we identified and characterized all the principal functions performed in the journal system, participants who performed the functions and hundreds of detailed activities necessary to perform the many functions. For each activity we established quantities of output and amount of resources required (with dollar amounts placed on the resources). We also traced the flow of "messages" transmitted among participants which, in 1977, numbered in the billions. We also examined all of the activities in terms of the introduction of evolving technologies to assess when comprehensive electronic journals were likely to become common-place.

As a result of our 1978 systems study we indicated that:

> "Recent technological advances, which were developed largely independently of the scientific and technical communication, provide all the components of a comprehensive electronic journal

> system. Such a system would provide enormous flexibility, particularly because individual articles can be distributed in the economically advantageous manner. Much-read articles may still be distributed in paper form, and infrequently read articles can be requested and quickly received by telecommunication when they are needed."

We went on to say that:

> "This comprehensive electronic journal system is highly desirable and currently achievable. It is believed that within the next twenty years, a majority of articles will be handled by at least some electronic processes throughout but not all articles will be incorporated into a comprehensive electronic journal system."

Unfortunately many communications researchers scoffed at this "pessimistic" view and some at NSF were disappointed.

One aspect of the systems analysis done at the time was to sum the resource costs applied to all the activities identified in order to establish an overall journal system cost. In 1977 we estimated the total amount of resources expended that year on scientific journals to be $4.7 billion (or about $16.4 billion in current $s considering increases in resource costs). This systems approach ignores the amount of money exchanged between participants such as the price paid by scientists and libraries for subscriptions purchased, the price paid for online bibliographic searches, fees paid for document delivery services, and so on. Including such "costs" would only duplicate the costs of system resources applied by publishers, online vendors and document delivery services. Thus, the "costs" to the U.S. economy (or scientific community) in 1977 for processing and using scientific journals was $4.7 billion or $16.4 billion in 1998 dollars. This cost comes to about $5,900 per scientist or about $65 per reading of articles.

In 1998 we estimated the comparable system cost to be $45 billion, which comes to about $7,200 per scientist or $60 per reading. The increase in cost per scientist is attributable to increases in scientists' costs due mostly to their time spent in acquiring and reading articles. The number of personal subscriptions of scientists has decreased by over one-half, with nearly all the reading replaced by library-provided journals. Thus, scientists spend more time obtaining articles and they also spend more time reading articles (due perhaps to an increase in size of articles). The decrease in cost per reading is due to relative decreases in library and publishing resources expended. The relative resource expenditures of libraries (and other intermediary services) are down, whether calculated by cost per scientist or cost per reading. The cost per scientist is down about 25 percent because of relative reduction in library budgets, but also because of efficiencies due in part to library automation. Cost per reading is down nearly 50 percent due in large part to a large increase in amount of reading from library-provided journals resulting from the shift of reading from personal subscriptions to library-provided articles.

The relative cost of publishing has apparently also decreased. For example, the cost per page published is down about 25 percent, due in part to use of technologies, increased efficiencies, and increased sizes of journals. The cost per scientist is down nearly 20 percent, due in part to the factors mentioned above, but also the fact that there is an average of about three fewer subscriptions circulated per scientist. The publishing cost per reading is also down about 35 percent due, in addition to the factors above, to a greater amount of reading. The point of this discussion of the systems perspective is to ponder the question of ***why have average prices have risen by a factor of nearly nine times over a period of time in which the relative cost of publishing has actually decreased?***

To Understand Price One Must Understand Publishing Costs

While there have been literally hundreds of articles written about the price of scholarly journals in recent years, very little has been written about the cost of publishing journals. Yet to understand why prices are what they are, one must know about the cost of publishing journals. One reason that costs are not often discussed is that publishers don't want their competitors to know their costs. Also, costs vary a great deal among journals, depending on the characteristics of journals (i.e., manuscript rejection rates, number of articles, number of pages, number of issues, circulation, etc.) and type of resources used (i.e., location and experience of editors, technologies applied, quality of paper, etc.). With that in mind, we decided to develop a cost model of journal publishing in order to analyze effects of circulation, changes in characteristics of journals over time, and how such factors might affect the price of journals. Using data we collected for the journal systems analysis and more recent pieces of information gleaned from the lierature, we formulated a cost model that has been reviewed by staff from different types of journal publishers and the model was said to be reasonable with the caveats mentioned above.

The cost model consists of five functions or groups of activities as follows:

- Article processing including manuscript receipt processing, initial disposition decision-making, identifying reviewers or referees, review processing, subject editing, special graphic and other preparation, formatting, copy editing, processing author approval, indexing, coding, redaction, and preparation of master images.

- Non-article processing includes many of the same activities involving editorials, letters to the editors, brief communications, and book reviews. It also includes preparation of issue covers (for paper versions), tables of contents and indexes.

- Reproduction involves printing, collating, binding of issues, and printing for reprints (all of which are not necessary for electronic versions).
- Distribution of paper versions involves wrapping, labeling, sorting by zip code, mailing, and electronic versions include storage and access. Subscriptions maintenance is required of both versions.
- Support activities include marketing and promotion, rights management and other legal activities, administration, financing, and other indirect activities.

Based on average journal characteristics or cost parameters (e.g., 8.3 issues, 123 articles per title, 205 manuscripts submitted, 1,439 article pages, 260 special graphics pages, 1,728 total pages, and 5,800 subscriptions) the cost model estimates for these functions are: article processing ($190,045), non-article processing ($19,415), reproduction ($100,995), distribution ($80,540) and support ($168,540) for a total of $559,535.

By holding all other cost parameters constant, we can assess the effects of cost parameters on the total and unit cost. For example, we find that the cost per subscription varies substantially by number of subscribers (in 1995 $s):

Subscribers	Cost per Subscription
500	$775
1,000	$404
2,500	$181
5,000	$107
10,000	$70

The price necessary to recover costs at 500 subscribers is at least $775 per subscriber, but decreases sharply to the 2,500 –5,000 subscription range, at which point the unit costs decrease slowly approaching an asymptote (which is the incremental reproduction and distribution costs). At 500,000 subscribers the cost is $2 above these costs. Of course, in reality the cost parameters and unit costs among journals vary. For example, large circulation journals tend to publish more issues, have expensive photos and graphics, reject more manuscripts, and use more expensive covers and paper. However, by holding non-circulation parameters constant we get a good picture of the effect of size of circulation. Similarly, by varying number of articles published from, say 50 to 200, we find that cost per subscriber increases from $58 to $137 (at 5,800 subscribers), but cost per article decreases from $6,700 to $4,000 per article. Comparing 1975 journals (and their corresponding parameters) with 1995 journals we find that the cost per page actually decreased from $385 per page (in 1995 dollars) to $250 per page.

What do Average Prices Mean?

Prior to discussing reasons why journal prices have increased as much, it is worth noting that there are several ways in which one can measure average price. In the literature, average price is nearly always calculated as the average price per title. That is, the prices of a set of journals are summed and divided by the total number of journal titles in the set. This average has specific meaning. For example, it makes sense for an individual library to estimate the average price for their collection in this way; particularly for comparison over time. However, from a total systems perspective it makes more sense to measure average price by the price per subscription. That is, one takes the total price of all journals circulated and divides by the total circulation. This average price is much lower than the average price per title and has a much different meaning. The point can be made through a simple arithmetic example, taking into account that low circulation journals have higher prices due to higher fixed costs. In 1995 we observed the following equal number of journals in four ranges of circulation (i.e., quartiles) and costs (or price) based on equivalent cost parameters (i.e., equal number of articles, pages, issues, etc.):

Circulation	No. of Journals	Average Circulation	Cost/Price
< 900	1,693	520	$747
901 – 1,900	1,693	1,310	$316
1,901 – 5,700	1,693	3,290	$145
< 5,700	1,693	18,100	$ 53
All	6,772	5,805	$315

Average price per journal can be roughly estimated by summing the four sets of prices of all journals in each quartile (e.g., $747 x 1,693) and dividing the total of the four quartiles by 6,772 journal titles (recognizing that this estimate is below the real average). As shown the average cost/price per journal title is $315 per title.

The average price per subscription is estimated by summing the four sets of prices of all subscriptions in each quartile (e.g., $747 x 1,693 x 520) and dividing the total of the four quartiles by the total number of subscriptions which is about 39.3 million (i.e., 6,772 journal titles x 5,805 subscriptions per title). The average price per subscription is $96 or far less than the price per journal title ($315). Thus, it is clear that the highly skewed distribution of journal circulation means that large circulation journals dominate average price calculated in this way. Yet this measure of average price is more meaningful when considering the impact of price on the U.S. economy or in terms of examining price trends to the entire scientific community, not just individual libraries. Other measures are also more meaningful when comparing prices among sets of journals since they vary so much in circulation and size and since both parameters have a significant bearing on cost.

Reasons Why Journal Prices Have Spiralled Upward

Some of the high increases in price over the past two decades can be explained by inflation and increase in the size of journals. In fact, our data show that about 56 percent of price increases are explained by these two factors alone. Another more subtle factor is that the estimated number of scientific scholarly journals increased from 4,447 in 1975 to 6,771 in 1995 and most of the new journals have a small circulation and, therefore, higher than average price. Consequently, the continued addition of new journals has had the effect of increasing average price per title (and per subscription). In fact, journal prices have increased at a rate greater than inflation since at least 1960.

This phenomenon can be shown by examining the 1975 number of journals in the quartile ranges shown for 1995 above, and applying the same calculation of average price per journal title and per subscription. In 1975 about 880 of the 4,447 journals had fewer than 900 subscribers; 805 had between 901 and 1,900; 1,579 between 1,901 and 5,700; and 1,183 over 5,700 subscribers. In 1995 each quartile had 25 percent of the journals, but in 1975 the same ranges had 19.8; 18.1; 35.5; and 26.6 percent of the journals so that one can see that there are now more of the smaller circulation journals and fewer larger ones. In order to make unbiased comparisons we again assume that all cost parameters remain the same and average prices in the four ranges do as well. We find that the average price per journal title of 1975 journals with their circulation would be about $270 per title compared with $315 in 1995. Thus, this average price per journal would have increased about 17 percent due to the change in distribution of circulation. A much smaller increase is observed in the average price per subscription (i.e., from $91 per subscription for 1977 circulation to $96).[11] Note that the average circulation per title did not decrease much from 1975 to 1995, (i.e., from 6,100 to 5,800 subscriptions) but the median dropped from about 2,900 to 1,900 subscriptions.

The distortion in distribution of circulation is attributable to more than the influx of new, small circulation journals. Increased prices have had a spiraling effect. As mentioned above, the average number of personal subscriptions per scientist dropped more than 50 percent over a twenty year period. Had the average remained constant, there would be about 19 million more personal subscriptions than there now are. Even at modest personal subscription prices, publishers have undoubtedly lost billions in annual revenue which they have tried to recover through exceptionally high price increases to libraries. They are able to do this because library demand is much less sensitive to price changes than personal subscription demand. Prices jumped particularly high in the late 1970s due to high inflation, fluctuating exchange rates and other factors. When this happens, subscriptions can decrease even though the number of scientists interested in a discipline continues to increase. With small circulation journals, decreases in circulation result in an accelerated increase in cost per subscription. For example, if

circulation decreases by 100 subscribers from a 2,500 level, the cost at 2,400 subscribers would be $6 more per subscriber. However, a 100 subscriber decrease from 500 to 400 subscribers would require an increased cost of $186 per subscriber in order to recover costs. Examples of required costs are as follows:

Circulation Drop	Required Cost Increase
2,500 to 2,400	$6
2,000 to 1,900	$8
1,500 to 1,400	$18
1,000 to 900	$41
500 to 400	$186

Thus, the accelerated cost increases can result in further decreases in circulation, leading to higher costs and, in turn, to spiraling prices. Since personal subscriptions are much more sensitive to price changes than library subscriptions, the spiraling effect was initially observed with personal subscriptions.

Even with these reasons for the price increases the past few decades, other factors must contribute as well. One explanation is that publishers have grown substantially in terms of the number of journals published. Some of this is due to publishers starting new journals and "twigging" journals into two or more when they increase in size; although the trend in recent decades has been to let them grow in size. Another factor has been the growth through merger. McCabe has provided evidence that such growth results in higher prices of journals (see the McCabe paper). Others have speculated that commercial journal publishers are making an exorbitant profit by increasing prices, although this has yet to be proven for all commercial publishers and net revenue may also be positive for some society and other non-profit publishers.

Other Factors That Affect Demand

Clearly, demand for scientific journals is affected by price, but there are other factors that affect demand as well. Scientists are shown to be willing to pay more for better journal attributes such as quality, speed of publishing, comprehensiveness and relevance of articles covered, and reputation of authors. In fact, studies in the 1970s suggest that such attributes were more important at that time than price. Our studies have shown that availability and relative cost of alternative sources of information determine to a large degree whether or not scientists and libraries will purchase journals. For scientists there are three types of alternative sourcee of information. One alternative source, discussed by Odlyzko, involves information from other research that has led to the research reported in an article or from near equivalent research done by others. A second alternative source of information recognizes that research results are often reported in a number of different channels such as discussions, presentations, conference proceedings, technical reports, patents and books, in addition to journal articles. A third kind of alternative source of information involves the many distribution means and media in which journal articles are found. Alternative distribution means from which scientists can choose include personal subscriptions, library subscriptions, and separate copies of articles such as preprints, reprints, interlibrary loans and document delivery, and photocopies provided by colleagues, authors and others. These distribution means can be in paper, electronic (CD-ROM or online), or microform. The point is that numerous combinations of distribution means and media are used by scientists based on their assessment of availability and relative access costs.

Sources of articles that are read have changed dramatically over the years as shown by the proportion of readings from three sources below:

Source of Article	1977	1993-1998
Personal subscriptions	68.4%	27.5%
Library-provided	14.7%	55.0%
Other	16.9%	17.6%
Total	100%	100%

Clearly, scientists are reading less from their personal subscriptions, which undoubtedly is due to their subscribing to fewer journals. Library-provided articles have been the alternative source of choice. The proportion of readings from other sources (e.g., shared department collection, colleagues and authors) has remained constant over the years.

Our cost studies show that there is a breakeven point in amount of reading, over which it is less costly to subscribe to a journal and below which going to the library is less expensive. The breakeven point, of course, is lower with higher prices. By knowing the distribution of reading among journals, we have determined the sensitivity of demand to personal subscription prices. We have also shown that scientists' time is an important component in the cost equations and scientists generally behave in an economically rational manner in deciding whether or not to purchase a journal. For example, distance to the library also affects breakeven point and the purchase of journals and, as corroborating evidence, we have observed that:

- Scientists close to libraries purchase fewer personal subscriptions than those farther away (e.g., 1.8 subscriptions for those less than ten minutes away versus 2.6 for those further away).

- Scientists close to libraries and shared department collection read more from these sources than personal subscriptions (e.g., 91 percent of readings by those less than 5 minutes away; 65 percent for those 5 to 10 minutes away; 43 percent for those more than 10 minutes away).

It is clear that the relative cost of alternative sources is important and scientists' time is an essential component of cost that must be kept in mind. Now that scientists can obtain some copies of articles online, the choice is complicated somewhat. However, as will be discussed later, amount of reading and scientists' time both remain important factors in the decision.

Libraries are faced with similar choices between purchasing (in paper or electronic media) or relying on obtaining separate copies of articles. The amount of reading of specific journals, their price and the cost of obtaining separate copies are all important factors which should play a role in decision-making. Over time, scientists pretty well know how much they will read a journal, but it is more difficult for libraries to establish the extent to which individual journals are used. A common practice is to ask library users to leave journal issues and bound volumes on the table to be counted (or from circulation bar codes) when re-shelved. A weakness in this method of observation is that use of an issue (or bound volume) may involve reading of several articles and **all** readings should be counted when deciding between purchase or obtaining separate copies of articles. However, reasonable adjustments can be made to the use data.

What Are We Really Buying?

We mentioned earlier that scientists consider journal attributes to be important in their decision-making process and that availability and relative costs of alternative sources of information are important as well. Another perspective is that we are buying two "product" components: (1) the information contents and attributes and (2) combination of distribution means and media. With

traditional scientific scholarly journals (and articles) the information contents and attributes remain the same regardless of combination of distribution means and media used.[12] Furthermore, the cost of processing the information contents is essentially the same regardless of distribution means and media. That is, should a scientist obtain articles from personal subscriptions (in paper or electronic medium), library-provided articles (in paper or electronic medium), or in separate copies from a database, colleague or author? Since the cost of processing the information content is about the same for all distribution alternatives, one can disregard it and focus on the costs of the alternative distribution means and media.

First, just a note of clarification concerning information content costs. In the literature one finds widely varying estimates of the cost of processing the information content, say, from $200 per article to $8,000 per article (in mathematics journals). The lower estimates tend to be made by those publishing exclusively electronic journals and who are strong advocates for doing away with the paper medium. Yet in a sense this cost is a moot point because those indicating that the cost might be as low as $200 per article could just as easily distribute these articles in paper issues at the additional cost of reproduction and distribution. Thus, the price would recover two components of cost: (1) information content processing (i.e., anywhere between $200 to $8,000 per article) and (2) the cost of distribution means/media of the version preferred by users. Obviously, distribution cost by electronic media is negligible, whether by subscription or by separate copy of articles. Paper distribution of subscriptions tends to be in the $25 to $35 per subscription range and paper distribution by interlibrary loan or document delivery tends to be in the $15 to $30 per item range.

Thus, it would seem that electronic distribution would always be the alternative of choice. However, when amount of reading and user costs are taken into account the choices are not so clear. For example, most of the readings of current articles are identified through browsing for the purpose of keeping up with the literature. Assuming the $35 paper distribution cost and that a scientist reads 35 articles from a year's subscription, the distribution component of the price would cost the scientist only $1 per reading versus near zero cost for electronic access. Yet, when the cost of scientists' time (for browsing) and equipment are included, it appears that the paper version costs less per reading or is very close to that of the electronic version. Then other aspects of the two versions would prevail in decision-making. Similar arguments can be made for library decisions concerning purchase (in paper or electronic) or access to separate copies of articles. Here the unit cost per paper version distribution can also be negligible because reading is in the hundreds for some journals. Thus, again libraries can choose one or both versions depending on factors other than cost.

Of course, publishers do not distinguish between the information content and distribution components of price. However, Harnad has suggested that authors (or their funders) pay for the information component and then journals would be "free" since articles would be distributed electronically. This suggestion ignores the potential desirability of the paper distribution medium that might be less expensive to some users and/or preferred for some other reason.

The point is that there is some merit in distinguishing between the information content and distribution components of costs/prices. The information content costs have remained relatively stable (or perhaps decreased some) over the years and these costs are now recovered primarily by library budgets versus an earlier combination of lower library payment and payment by scientists (often from discretionary funds provided by their employers). This transfer of cost recovery sources has resulted in publishers getting hammered because of spiraling prices, libraries paying more for less information, and scientists' paying more in the scarce resource of their time. Funders of the scientists and libraries are questioning the whole process, even though in fact they

may be paying less in cost per reading considering all resources expended. One can make a strong argument for funders paying the information content costs since they already pay for authors' time (which appears to exceed the information content processing costs of publishers). However, it is difficult to see how this might come about; particularly, since page charges have met with such resistance.

Some Alternative Pricing Policies

One way in which the two cost/price component approach can be addressed is with site licenses. We have suggested that one possible scheme to achieve this type of site license is detailed below:

- The license would cover all journals provided by the publisher, regardless of whether the library, organization, department, or any employee subscribes to the journal.

- The library and publisher would establish the current subscription cost of all subscriptions to the publisher's journals in the organization.

- The library would estimate the total readership in the organization of the currently purchased journals and estimate the subscription cost per reading (i.e., current revenue divided by total readings).

- The first annual access cost would be this current total subscription amount.

- Any electronic access to currently purchased journals would be free. Electronic access to any other journals available from the publisher would be at the calculated cost per reading (plus allocated support costs, e.g., 35 percent). Distribution of paper issues from any of the journals would be the reproduction, distribution, and allocated support costs (e.g., $31 times 1.15 or approximately $36 per annum).

- During the first year, each access to the articles would be counted electronically and used as a basis for future charges on a cost per reading basis.

- The publisher must agree to ensure future access to all the journals covered by the term of the agreement, thus permitting the library to discard all relevant paper issues.

This type of site license provides advantages to every participant. While libraries and their constituents pay the same amount to publishers as they do now, they achieve considerable savings in storage (e.g., approximately $70 per subscription) and maintenance. They also save an estimated $1.43 per reading by avoiding current reshelving and photocopying costs (which for a frequently read journal can be as much as the subscription price). Libraries also save on interlibrary borrowing or document delivery costs from journals in the publisher's database that they did not purchase. Finally, the library has the option to retain certain current periodicals or department collections in paper. These savings far exceed any advantages they might have been achieved from reduced electronic journal prices.

Publishers have the advantage of retaining any cost savings they obtain from electronic publishing, plus they receive additional revenue from distribution of electronic separates that were previously obtained outside of their control.

Readers benefit by having the choice of obtaining articles in paper or electronic versions, both at substantial savings in their time and to their parent organizations. In other words, by this kind of negotiation, publishers win, libraries win, readers win, and funding sources win.
This kind of agreement, of course, may have downsides, but it is given to demonstrate the need to arrive at arrangements that can be beneficial to all participants in order to end the adverse effects of current pricing strategies.

Another pricing approach is to extend current price differentiation to reflect potential readership by purchasers. Varian argues that small niche markets, which accurately describe most scholarly publishing, are generally not well served if the producer is required to charge a uniform, single price. As mentioned earlier, purchasers/users always have alternative sources available to them if cost per reading is too high. Thus, amount of reading serves as a useful means for identifying classes of purchasers for differentiation. Electronic journals provide a useful vehicle for charging on a transaction or potential transaction basis.

In another vein, Getz has suggested that readers be given personal debit accounts with their library to access separate copies of articles. This would permit scientists to order separate copies from services depending on attributes of speed, image, quality, and accessibility that are provided at appropriate prices. This interesting notion, of course, can be extended to subscriptions in print or electronic media and other related services as well. Getz feels that such an account would end up serving users more effectively and relieve libraries from some clerical-like activities. The examples given involve academic libraries, but are even more feasible in a special library environment.

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[1] King, D.W. and C. Tenopir. 2000 "Using and reading scholarly literature". In: Annual Review of Information Science and Technology. Ed. M.E. Williams. Vol. 34. Medford, NJ: Information Today, Inc.

[2] Surveys involved national probability samples of scientists (1977, 1984), audiences of Science and the Journal of the National Cancer Institute, and samples of scientists in organizations such as the National Institutes of Health, AT&T Bell Labs, Oak Ridge National Labs., and The Johns Hopkins University. There was a total of 13,591 responses from scientists. There may be some bias in organization surveys because the organizations are self-selected.

[3] Garvey, W. D. and B. Griffith. 1963. The American Psychological Association's Project on Scientific Exchange in Psychology. Report No. 9. Washington, D.C.:APA

[4] Machlup, F. and K.W. Leeson. 1978. Information Through the Printed Word: The Dissemination of Scholarly, Scientific and Intellectual Knowledge. Vol. 2. Journals. New York: Praeger.

[5] King D. W., D. D. McDonald, N. K. Roderer and C. H. Olsen. 1978. A Survey of Readers, Subscribers, and Authors of the JNCI. Avail. dwking@umich.edu

[6] Estimates of readership of articles by this survey method are in fact biased on the low side because they miss readings that take place after the survey responses, they do not include reading of separate copies of articles (over 100 million currently), and they miss other means of communication.

[7] All uncited data come from: Tenopir, C. and D. W. King. 2000. Towards Electronic Journals: Realities for Scientists, Librarians, and Publishers. Washington, D. C.: Special Libraries Association.

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[11] There is a small distortion in 1975 average circulation in that calculation from the data above gives 6,300 subscriptions per title, but the average calculated from the sampled journals was 6,100.

[12] Of course, there are some attributes achievable through technology, such as hyperlinks.